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CONTENTS

EDITORIAL

We have received a number of letters commenting our first issue (1984) and wishing the Journal continued success. We are now happy to present before you this second issue (1985), which includes articles offering different perspectives on various aspects of technical and vocational education.

The General Articles Section in this issue contains four articles on different themes. The one on Programmable Automation and its impact on technical education has a lot of significance for technical educators in every country in this age of rapidly changing technology. The need for a new attitude to technology research is emphasised in the article on 'High Technology in Australia — Rhetoric or Reality'. The suggested approach of fostering Total Technology Ph.D. programmes to overcome the economic consequences of over-dependence on borrowed technology in Australia will be of interest to all countries which are similarly placed. The article on technical education in the Arab States provides a perspective view of the problems being faced by the Arab Countries in technical education and these would be seen to be similar for all developing countries. In this age in which women are fighting for a wider access to education and training, the article describing New Zealand's experience on Women's Access to and Participation in Lifelong Education and Training is likely to be of interest to all our readers.

This issue also includes two research reports — one on 'Attitudes of Technical Students towards Teaching Profession' based on a study conducted in Iraq and the other on a 'Common Entrance Examination for Admission to Polytechnics' dealing with an Indian experience. The findings of these two studies are likely to be of considerable topical interest.

The 'Innovative Programmes & Projects' Section has an article on 'Simulation and Games in Technician Education', exploring the possible applications of this innovative approach in technician education in developing countries.

We hope that this issue lives up to the expectations of our discerning readers. We look forward to the continued support and guidance of scholars and practitioners concerned with technical and vocational education system in different countries by way of contributing articles, critical reviews of its content and valuable suggestions for fostering the growth of the Journal.

JOURNAL OF TECHNICAL AND VOCATIONAL EDUCATION: AIMS AND STRUCTURE

In recent years, many countries have concentrated upon improvement and expansion of their systems of Technical and Vocational Education to keep pace with their programmes of development. This has been achieved through several innovations, projects and programmes and there is a need for sharing such experiences among countries of the world. In this context, an important and challenging task is to provide an effective means of communication between all those involved in this system of education. The 'Journal of Technical and Vocational Education' is intended to serve this purpose. This journal will be published from Technical Teachers' Training Institute, Madras, India, and will have two issues in a year.

Objectives:

The objectives of the Journal will be

1. To share experiences in respect of national policies, norms and standards, course patterns and structures, resources and expertise, trends and issues relating to technical and vocational education in different countries.

2. To publish major advances and innovative ideas and report on current trends in the theory and practice of technical and vocational education.

3. To exchange experiences in the design, development, implementation and evaluation of all types of technical/vocational teacher education programmes.

4. To report case studies and research findings on various aspects of the system in different countries.

5. To promote the recognition and understanding of the interaction of technical and vocational education with other collaborating agencies such as industry, Government and society.

6. To project and report on the emerging trends and futurological studies in the technical and vocational education system.

Main Areas

The Journal will cover all aspects of technical and vocational education through articles, research reports, survey reports, experimental findings, case studies, reviews and write-ups on various programmes and projects. The following main areas will be covered in the Journal.

* Curriculum design and development

* Instructional systems

* Technical & vocational education (Formal)

* Technical & vocational education (Non-formal)

* Technical & vocational teacher education

All aspects of technical and vocational education including its social implications and relation with allied educational systems will be covered in the Journal. However, in its coverage of research in the system, the Journal will emphasise application-oriented research.

Scope

The Journal views technical and vocational education in the broadest possible sense. However, the following scope is tentatively drawn up to serve as guidance to the range of themes and topics in the main areas to be featured in the Journal:

1. *Curriculum Design and Development*
   - Theory
   - Practices
   - Evaluation
   - Innovative projects
   - Curriculum research and future trends

2. *Instructional systems*
   - Teaching strategies
   - Laboratory and workshop practices
   - Dynamics of learning and student growth
   - Examination and assessment procedures
   - Media design and development
   - Researches in media, methods and evaluation

3. *Technical and Vocational Education* (*Formal and Non-formal*)
   - Policies and structures
   - Norms and standards
   - Management and administration
   - Current issues and emerging trends

4. *Technical and Vocational Teacher Education*
   - Comparative studies and future trends
   - Professional development
   - Courses and programmes such as in-service, pre-service, distance learning and other forms of continuing education.
   - Innovative practices
   - Researches

Main Sections

Each issue of the Journal will have the following four main sections:

1. *General Articles Section:*

Dealing with articles of evaluative and/or synthetic nature in all areas of technical and vocational education.

2. *Research Reports Section:*

Dealing with research findings relating to researches in technical and vocational education system. The emphasis in this section will be on publication of applied and application-oriented research of national/international interest.

3. *Innovative Programmes and Projects Section:*

Dealing with reports on developmental work and innovative practices in technical and vocational education system.

4. *Notes, News and Review Section:*

Dealing with information about on-going projects and programmes, news about conferences, meetings, seminars, symposia/workshops and reviews of books and other resources in the area of technical and vocational education.

Concluding Comment

The guidelines provided above are not rigid. Every attempt would be made to maintain flexibility in the policy to allow for the growth and development of the Journal in accordance with the interest and needs of technical and vocational education practitioners in different countries.

EDITORS

Programmable Automation: The Impact on Engineering and Technical Education

SAM STERN AND EUGENE F. FICHTER

ABSTRACT

This paper addresses the impact of our rapidly changing technology on educational systems. A model of technological processes is used to analyze the continuing evolution of technology. A second model identifies an emerging pattern of change in educational delivery strategies, curriculum and the time frame of instruction. On the basis of their analysis, the authors conclude that the increased use of technology, specifically programmable automation, will add to — rather than diminish — the value of human involvement in the technological process. This increasing value of human involvement will place greater demands on educational systems and act as a catalyst for significant change in the ways we view, use, and deliver engineering and technical education.

Introduction

Human beings have been looking for easier ways to do their work for a very long time. This universal human pursuit has lead to major changes in the ways we live and earn our living. The technology which is making the current series of changes possible is programmable automation. This technology is one of the drivers of change in our world today. Other drivers of change are our global communications network and expanding economic demands. Together these drivers of change are affecting every aspect of our lives: in our homes, our schools, and especially in our work. Through our improved global communications network we can instantly see how our neighbours around the block or around the world are doing. If we think they have it easier or better than we do — we want what they have. When some one else finds a way of producing a product or delivering a service at a lower cost, its impact is felt around the world. These drivers of change: technology, communications and economics, are interrelated and their influence is felt by all people in all countries.

The expanding and changing uses of technology are creating a new set of challenges for education, training, and retraining. This increasing use of automation and corresponding set of challenges for education raises two significant questions of particular interest to engineering and technical educators. The first question relates to how technology is changing. What is the technology that is driving the present series of changes in the ways we live and work? The second question relates to the challenges for educational systems, specifically engineering and technical education, created by changing technology. How will our educational systems respond to these challenges?

How is technology changing?

All manufacturing and service can be subdivided into processes. Figure 1 is a model of a technological process. This model divides the technological process

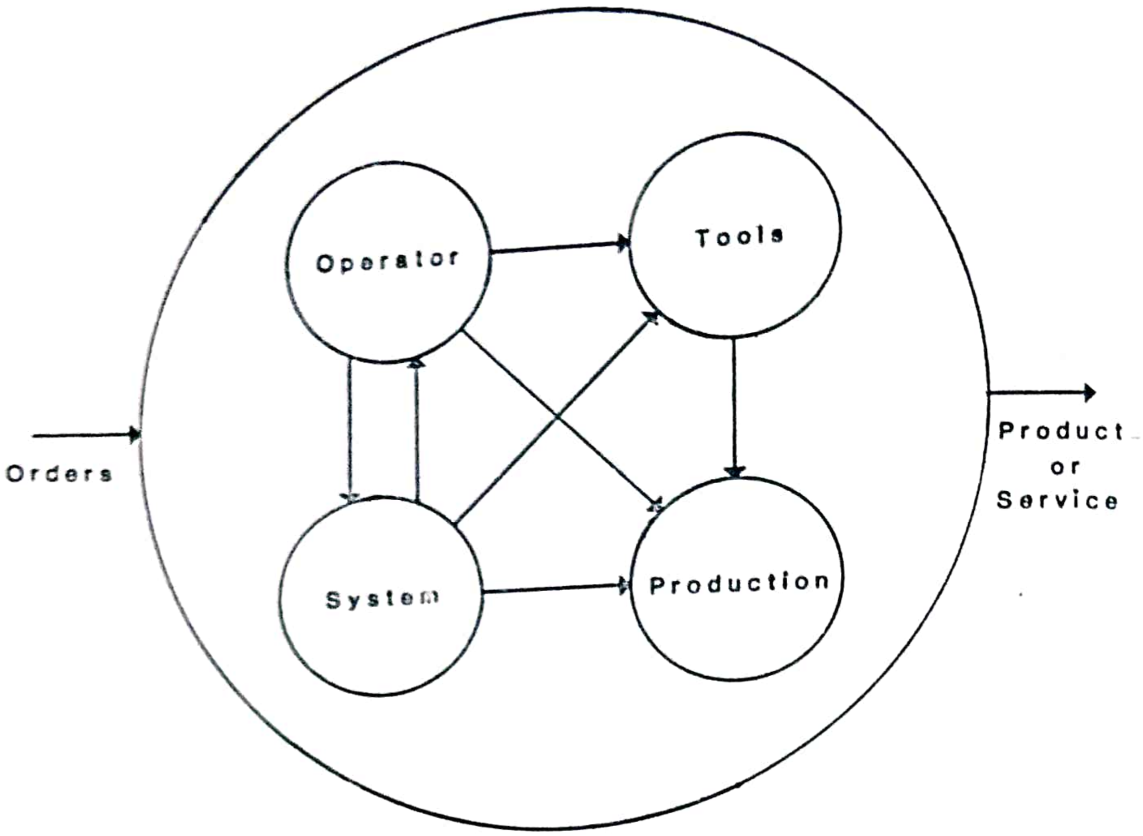

Figure 1: Model of a technological process

into four parts: human operator, system, tools, and production.

The operator and the system are the active parts of the process; they apply tools to the material to accomplish production. The material input to the production phase of the process is part of the input from the system or the operator. The operator and the system accomplish production or deliver a service by performing a number of tasks either on the tools or directly as part of production. The tasks that are performed on the tools are: making tools, providing energy, controlling tools, monitoring tools, and maintaining tools. The tasks performed directly on production are: designing/planning, providing material, and monitoring production. Tool making and providing energy are self explanatory. Examples of control are the control of position, velocity, and force of the tool with respect to the material. Tool monitoring is keeping track of whether the tool is in a condition to perform its production task. Maintenance is the process of preparing the tool to perform its production task. Designing/planning is the process of designing the product or service, planning the required operations, and sequencing these operations. Material provision incorporates all of the tasks necessary to get the raw material to the point where the tools can be applied to it. These tasks include material procurement, transport, warehousing, preparation and machine loading. Production monitoring includes fault checking of the production process and quality control of the finished product.

Using this model to analyze the technological process allows us to investigate several questions related to changing technology. First, how are these tasks divided between the human operator and the system? Figure 2 shows the evolution of the technological process, detailing how the division of labour has changed over time.

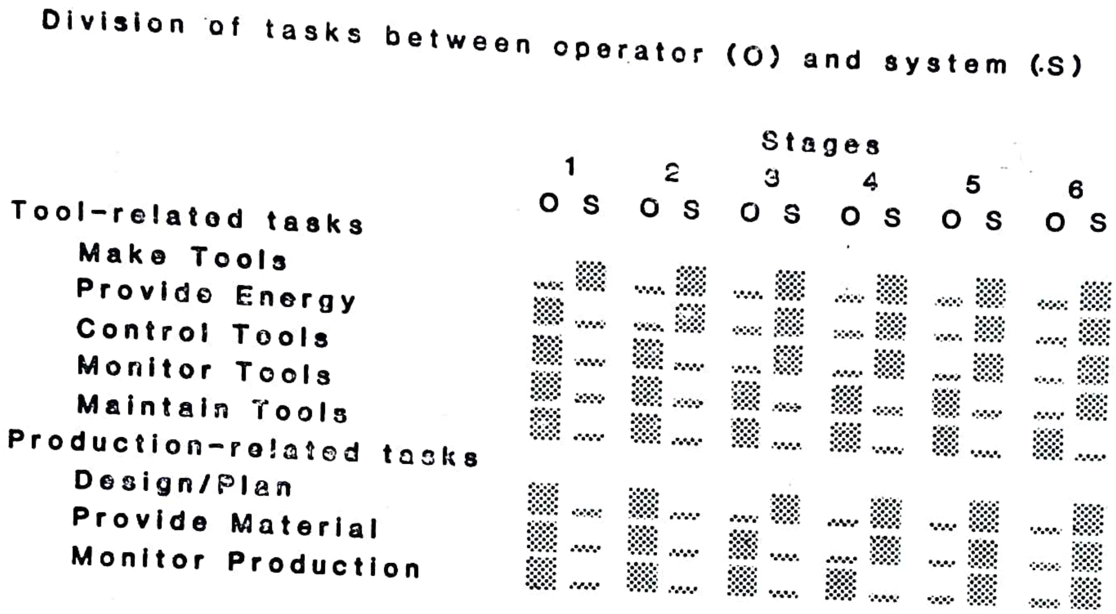

Figure 2: Evolution of technological processes

This portrayal of the evolution of technology is composed of a series of snapshots taken at irregular intervals along a continuum of change. The second question that our model allows us to analyze is, what is the "system" in our model of a technological process and how does the human operator communicate with it? When a human operator works directly with tools in producing a product or delivering a service the interactions are relatively straightforward. For example, when a smith heats steel in a forge, pulls it out with tongs, beats it with a hammer on an anvil, and examines the work—the interactions between operator, tools, and production are relatively easy to understand and analyse. The interactions between human operators and systems are more complex. We will use our model of a technological process and evolution of the division of work between operator and system in our discussion of changing technology.

Evolution of Technological Processes

An example of technology in the first stage of development is the production of a chair with hand powered tools. In this example the only one of the eight tasks which is not directly handled by the human operator is tool making. It is conceivable that even tool making could be done by the operator but this is extremely rare. In this example, the operator is responsible for at least part of the design and planning; even if a design from a book is used, the design must be selected and production must be planned. The operator provides the energy to drive the tools and the control of position, velocity, and force. The operator also monitors the condition of the cutting edge of each tool and sharpens (maintains) it when necessary. Finally the operator determines the quality of the final product. In this example the operator has very close connections with both the tools and the production.

The first significant change in the division of work between the human operator and systems is in energy provision. In stage two, an operator might use hand held power tools or mounted power tools such as a drill press or table saw. A very large part of manufacturing is at this stage of technological development.

Quite a substantial change is now occurring as we move into the third stage. In the third stage a programmable machine is used to produce parts. This machine might be a cam-controlled lathe, often called an automatic screw machine, or it might be a numerical control (NC) machine. The cam-controlled machines were first used about a hundred years ago and the first NC machines were used in the 1950s. A programmable machine transfers most of the designing/planning process to the programmer and the machines he or she uses to produce the program. In the case of the cam-controlled machine, the programmer is the cam designer and the physical embodiment of the program is produced by a skilled machinist in the form of a cam. In the case of the NC machine, the program is produced by a part programmer and the physical embodiment of the program is a tape with holes punched in it or a series of magnetic domains on a magnetic storage medium. The control process is also taken away from the human operator and given to a control mechanism. In the cam-controlled machine, control is built into the cams; in the NC machine control is handled by a general purpose computer or a special design electronic controller. At this stage of evolution a very large portion of the operator's task has been taken over by the designers of the controller and by the programmers. It is important to recognize that these are people, perhaps assisted by tools or machines, who are part of a system.

Programmable automation is not new; the 100 year-old cam-controlled lathe is programmable. What is new and is behind the current series of changes in technological processes is inexpensive and powerful computers. During the last ten years the availability of microprocessors has resulted in dramatic changes in the way machine controllers are designed and produced and in the capabilities of these controllers.

In stage four of the evolution of technological processes the system takes over most of the task of providing material. An industrial robot may load materials or parts into a machine. The worker in the warehouse may no longer walk down the aisles to pick out parts and materials; instead he or she may enter a part number into a keyboard ordering a machine to bring the part to the end of an aisle.

In the fifth stage an automatic inspection device is added. A robot may unload a machine and place the finished part in an automated inspection station. If it passes the test it is sent on; if not, it may be returned to an operator for correction.

Finally at the sixth stage, tool monitoring will also be automated. This may be as simple as a timer which controls the replacement of the tool after a set time interval or it may be a more sophisticated device which checks for tool wear.

What is the "system" and how does the operator communicate with it?

Our model of a technological process helps us look at technological systems. Throughout the evolution of technological processes, we have been transferring tasks from the human operator to the system. The system must perform the tasks the operator previously handled. For example, part of the system is another autonomous technological process which makes tools. This tool making process has an operator, a system, tools (to make tools), and production; it can be automated just as the original process was. This tool making process is a microcosm of the original process. Every one of the constituent tasks of the original process is subject to the same evolutionary development as the original process itself.

How do these changes affect people who work with technology? In the beginning, an operator produced a product or delivered a service almost entirely through his or her own work. The only significant demand on the system was for tools. Now an operator produces a much greater amount of product or service. This means that fewer operators are required to produce the same amount of output. But along with this increased output comes an increasing set of demands on the system. Now there is not only a tool making process but also processes for energy provision, tool control, tool monitoring, designing and planning, material provision, and production monitoring. There are even processes for maintenance and service. Each process requires an operator. Transferring a task from the operator to the system does not eliminate human involvement with that task. This transfer actually increases human involvement. The original operator has input and the new operator within the sub-process is involved. These operators must communicate with each other and each must be able to communicate with the tools and machines involved in the process.

How are educational systems changing to meet the challenges of changing technology?

Just as the three drivers of change: technology, communications, and economics, are changing the world of work, they are also changing our educational systems. Educational systems tend to change slowly, responding to outside stimuli with gradual incremental shifts of direction. But now, largely as a result of programmable automation, significant change is taking place. Our new technology is having its greatest impact on the segments of the educational system that are in closest contact with technology. The areas of formal education that are most closely involved with technology are engineering education and vocational/technical education. Less formal educational programs, including on-the-job training and manufacturer training, are also responding to changing technology. Regardless of the educational area, there is an emerging pattern of change that is impacting educational delivery systems, curricular content and goals, and the time frame allocated to the educational process (Figure 3).

The educational delivery system

Educational delivery systems can be classified according to their position on a continuum of formal to informal educational programs. Some of the characteristics of formal education include:

* certificate or degree based programs;
* a specified program length;
* specified locations for educational programs;
* accreditation;
* a teaching staff with licenses or degrees: and
* formalized or planned program.

Those formal educational programs, including vocational and engineering education, that are most closely related to technology are finding it increasingly difficult to accomplish their missions within their formal structure. As a result they are adopting many of the characteristics of less formal systems. Some indicators of this trend are: increased off campus programs, more use of adjunct staff, co-operative industry education efforts, and a call for significant revisions to degree and certification based programs.

Delivery Systems	More Formal	→→→→→→→→	Less Formal
Curricular Goals & Content	Static Specific	→→→→→→→→	Dynamic General
Time Frame	Young Narrow-band	→→→→→→→→	Older Broad-band

Figure 3: Emerging patterns of change in engineering & technical education

One of the indicators has been the emergence of new partnerships and co-operative efforts between industry and education. As the rate of technological change accelerates, both industry and education are faced with increasing and changing demands for technical instruction. These cooperative efforts have helped both educational systems and industry operate more effective instructional programs.

Faced with growing shortages of qualified teachers, engineering and vocational/technical education programs are using more adjunct staff from industry on a part-time basis. While this helps meet the immediate need, it jeopardizes long term activities such as curriculum development, basic and applied research efforts, student advising, and institutional service. This shortage of qualified and certified staff is forcing a re-evaluation of both secondary and post-secondary certification and accreditation requirements. In vocational and technical education there is a renewed interest in offering credit toward teacher certification for recent and appropriate work experience. Through increased certification requirements current vocational and technical teachers are being required to update their technical skills through coursework or work experience. There is more encouragement for engineering educators to work with industry to gain current design experience that can be passed on to their students.

At the same time that the traditional formal delivery systems are adopting many of the characteristics of less formal educational systems — less formal systems are adopting many of the characteristics of formal systems. Businesses and industries are becoming increasingly involved in education and training and rapidly becoming one of the strongest forces for continuing adult education. Training programs in industry are acquiring many of the formal characteristics associated with colleges and universities. Formal courses, training personnel and extensive training facilities are all part of the increased investment businesses and industries are making in technical education and training.

The Curriculum

Increased technological change and programmable automation is forcing curricular change in all areas of education, but especially in those areas that are most closely related to technology. We are less able to reliably predict what knowledge and skills will be needed for future employment in an increasingly dynamic work environment. As the use of programmable automation increases, the value of human processing will also increase — requiring new skills in working with both people and machines. If our focal point is both changing and broadening at a rapid pace, we cannot design and implement curricular programs that are static and specific. If we do, our curricular beam of light will illuminate only a small part of a moving and expanding picture. More and more educators are recognizing that future curricular development must be broadbased and transportable.

As opposed to a static and specialized focus the new curricular focus in technical education must emphasize the following three sets of general skills:

* communications and teamwork
* problem solving and systems analysis
* information acquisition and processing

As we illustrated with our model of the technological process and evolution of the technological process, the increased use of automated systems reduces the need for human operator input as part of the production process but creates subprocesses that will require additional human input. The highly developed psychomotor skills required of the operator as an integral part of the production process are now being replaced by automated processes. For example, the highly developed skills of manual drafting and welding are being replaced by new tools, machines and automated systems; but these new tools, machines and the subprocesses associated with them are creating new and important positions for human input. The sets of general skills identified above will be important to the workers participating in each of the subprocesses identified in figure 2.

Communication skills will be increasingly important as each individual will need to effectively communicate with more people than before. The complexity of automated systems is such that more not fewer people will be involved in their design, material provision, tool making, energy production and transmission, control, monitoring, maintenance, and production. This increase in numbers and types of people will increase the value of teamwork and interdependence. The skills that facilitate effective teamwork will be increasingly important as the use of automated systems increase.

The skills of problem solving and systems analysis are also becoming more important for human operators involved in automated production systems. These skills must have a high priority in engineering and technical education programs. Problem solving is common to all areas of design and maintenance. While these skills are difficult to teach, they can be developed in students through open-ended problem solving exercises that require the students to take an increasingly active role in shaping their own learning activities.

The skills of systems analysis are also essential for everyone who will work in complex production systems. Each process and system must work in close harmony with other processes and systems. Each person must be able to communicate with operators in related processes. All of these operators must know enough of the language of each of the other processes to communicate effectively. In our educational programs we can no longer package technical instruction in discrete and isolated disciplines labeled electronics and metals or electrical engineering and mechanical engineering. In the working world of automated systems, the designer of electronic control systems for an industrial robot must have a good understanding of the kinematics and dynamics of the mechanical system he or she is trying to control. Design engineers must not be limited by inadequate knowledge of maintenance practices and procedures. Indeed, all engineers, technicians and trainers must have a basic understanding of the concepts of electronic, mechanical, fluid, and chemical systems if they are to communicate effectively with their fellow workers in an automated production system.

A third set of important general skills relates to information acquisition and processing. With the increasing rate of technological change has come a corresponding increase of docummentation and information. The success of future workers in automated systems will in part be determined by their ability to get the information and documentation they need, when they need it, and then be able to process it effectively. This has profound implications for education and training. It is unreasonable to expect that all or even most of the worker's information needs can be met through formal engineering or technical education programs. The development of information acquisition and processing skills will take on a greater importance.

The time frame

Historically, educational systems have delivered instruction during a well-defined time frame to a narrow band of the population. The majority of formal engineering and technical education programs have been delivered to young adults just before they enter the world of work. But now, the idea that four years of high school, or 2 years of technical school, or even four years and more of engineering school can prepare a person for a working lifetime in a technical career is absurd. Educators, students, employers, and employees are all recognizing the need for a long-range perspective toward education, particularly technically related education.

As a result there is a significant increase in on-the-job training, labour negotiated training and retraining programs, and continuing education programs. While the concept of lifelong learning has been talked about for a long time, technological change is making it a neccessity for workers of all skill levels.

Summary

Our evolving technology is placing increasing demands and expectations on our educational systems, especially engineering and technical education. At the same time, our new technology and use of programmable automation is increasing the value of human input — not decreasing or diminishing it. Our model of an expanding technological process details each of the individual sub processes that lead to the production of a product or delivery of a service. Within each of the sub processes are human operators. The input of each of these operators into the technological process is greatly amplified, increasing the leverage and impact of each individual operator. Education and training must change to help prepare people for the new jobs created by expanding technology. Changes must take place in educational delivery systems, in the curricular goals and content, and in the time frame in which educational programs are delivered. New and added emphasis must be placed on communications and teamwork, problem solving and systems analysis, and information acquisition.

REFERENCES

ALBUS, J. S. (1981). *Brains, Behavior, and Robotics*. New Hampshire: Byte Books.

ASPY, D. N., ASPY, C. B. AND ROEBUCK, F.N. (Eds.). (1984). *The Third Century in American Education*. Amherst, Mass: Human Resource Development Press.

BRONOWSKI, J. AND MAZLISH B. (1975). *The Western Intellectual Tradition*. New York: Harper & Row Inc.

CARKHUFF, R.R. (1984, FEBRUARY). The ascendance of human resource development in the information age. *Training and Development Journal*, **38**(2), 50-58.

GARTMANN, H. (1960). *Science as History*. London: Readers Union.

LEWIS, A. O. (Ed.). (1963). *Of Men and Machines*. New York: E. P. Dutton & Co.

SHERMAN, S. W. (Ed.). (1983). *Education for Tomorrow's Jobs*. Washington D.C.: National Academy Press.

U.S. OFFICE OF TECHNOLOGY ASSESSMENT. (1984). *Computerized Manufacturing Automation: Employment, Education, and the Workplace*. (OTA-CIT-235). Washington D.C.: U.S. Congress, Office of Technology Assessment.

High Technology in Australia: Rhetoric or Reality?

J. G. Sekhon and A. G. Shannon

ABSTRACT

This paper outlines the imbalance in Australia's intellectual trade with particular reference to patents. It is argued that if Australia is not to remain a high technology colony, then a new attitude to research and development needs to be engendered, particularly in the private sector of industry. One solution, which would involve closer collaboration between higher education and industry, is a scheme along the lines of the Total Technology Ph. D. Programme in the United Kingdom.

Introduction

There is much talk about high technology in Australia. We hear about it from business leaders, editorial writers, academics and a few politicians. There is even a little action evident, with efforts to establish some industrial parks and with isolated initiatives from a few, very few, companies.

What we do not hear much about is where the human resources are going to come from to fulfil these great expectations. We comment here on some aspects of the human infrastructure needed to sustain the dreams.

We are not saying that this sudden surge of interest in high technology is not to be applauded; rather we are claiming that a radical reappraisal of ends and a redirection of means are needed. We illustrate this by reference to Australia's record in intellectual trade.

The draft report prepared by the Committee of the Australian Scientific Industry Association[1], whose membership includes representatives from universities, government and industry, articulates its concern in these words:

Australia's overall research and development expenditure is too small, her priorities are askew, and the innovative capabilities of small high-technology companies are not being nurtured. ..Australians still have a 'cargo cult' mentality about technology, regarding it as something that is imported and grafted to their needs.. Unless there are significant changes in attitudes and activities in Australia, our standard of living will fall inexorably as the years go by.

The data presented in this paper are a manifestation of the low level of indigenous industrial R and D activity. When to this is added the fact that Australia's gross expenditure on R and D as a proportion of her GDP is dismayingly low, the dimensions of her dependence on foreign technology become patently plain.

It bears mentioning that on the basis of two indices — technology-intensive exports per capita and the ratio of exports over imports in high technology products — only Greece was lower than Australia among the 24 OECD countries (Jones[2]). The question is whether we can reorder our industrial priorities and change our R and D habits quickly enough.

Patents

Australia has a distinguished record of basic research, but most of the fruits of research have been sold cheaply to foreign organisations and the products brought back later at high cost. Moyal[3] maintains that Australia now generates 2 per cent of the world's scientific research, but only 0.7 per cent of patents.

There are two principal reasons as to why Australia supplies less than 1 per cent of the world's technology in terms of patent property:

- the low proportion of national R and D performed by, and in, the private sector; and
- the pure science bias and inadequate patent orientation of much of the public sector R and D.

The Interscan (Australian Microwave Landing System) is Australia's most ambitious and daring bid yet to win high technology export markets worth hundreds of millions of dollars. The Interscan *is* a major triumph and breakthrough for innovative research. However, Interscan *as a concept*, albeit a brilliant concept, cannot be patented. It is the supply of hardware — the antennae and associated instrumentation with which airports must be equipped — that is the money spinner.

The primary need is to translate our ideas more vigorously into successful commercial ventures. Thornton[4] *et al* ruefully reflect:

> In the CSIRO, University and CAE laboratories, the computers are more likely to be Control Data or IBM or ICL. Yet, CSIRO and the University of Sydney played a pioneering role in computer design. The Government departments and instrumentalities as well as institutions of higher education place orders for computers outside Australia.

Patents have been widely canvassed and used as a measure of innovative activity. The extent of dependence on overseas sources for new manufacturing technology can be measured by patent statistics.

Though inter-industry or inter-country differences in patent activities must needs be interpreted with caution, international differences in the proportion of patents issued to residents and foreigners provide a useful indicator of inventive output and national success in generating domestic technology. Table 1 shows the number of patents granted in selected countries. The table confirms that a higher proportion of patents granted by the Australian Patent Office in 1980 were to foreign applicants. Among the countries shown in the table, only Canada recorded a higher proportion of patents issued to foreigners. However, the Canadian figure evidently reflects the geographical proximity to the United States. Further, the data shown in Table 1 are even more remarkable: they are independent of country size. It is evident that Sweden and Switzerland, with smaller populations than Australia, appear to depend less heavily on foreign technology. To put more affirmatively, it can be asserted that Sweden and Switzerland have been more successful than Australia in generating new manufacturing innovations.

The clear finding which emerges from Table 1 is the exceptionally low level of Australian patenting activity by international standards. Of the countries in the minor proportion of local patenting category, only Canada is lesser than Australia.

TABLE 1: Number of patents granted in selected countries, 1980.

Country	*Patents granted to*		*Percentage granted to non-residents*
	Residents	*Non-residents*	
Australia	620	7,805	93
Belgium	837	5,081	86
Canada	1,503	22,392	94
France	8,438	19,622	70
F. R. of Germany ..	9,826	10,362	51
Japan	38,032	8,074	18
Netherlands	417	2,907	87
Sweden	1,394	3,604	72
Switzerland	1,475	4,486	75
United Kingdom ..	5,158	18,646	78
United States	37,152	24,675	40

Source: Gannicott(5)

Technological balance of payments

Though Australia is regarded as an industrialised nation, it has long been a cliche that she has been content to import technology and technological skills. Her dependence is most marked in the manufacturing sector and her trade is characterised by a considerable imbalance in high research-intensive imports and exports.

The adequacy and scale of domestic research and development may be inferred from available data on the inflow of foreign technology. Table 2 shows that Australia is a heavy net importer of technology, having one of the worst export/import ratios. Anyone would expect Australia to be a net importer of know-how, which she is; but the data show that in comparison with other major OECD countries, she is an *unusually* heavy importer. It is noteworthy to observe that of the countries listed in Table 2, only the US and the UK indicate a *surplus* on their balance of trade, countries which allocate a relatively high proportion of their gross domestic product (GDP) to research and development expenditure.

Further evidence of Australia's imbalance in high technology trade is provided by the ABS (Australian Bureau of Statistics) surveys of research and experimental development undertaken by the private sector. These data, summarised in Table 3, are generally superior, as their coverage is broader and therefore more comprehensive.

TABLE 2: Balance of trade in technology: comparison for various countries 1981

Country	(1) *Exports* ($ m)	(2) *Imports* ($ m)	(3) (1) ÷ (2)
United States	6,170	600	10.3
United Kingdom ..	968	750	1.3
Italy	724	1,043	0.7
F. R. of Germany ..	460	1,000	0.5
France	419	802	0.5
Japan	410	1,450	0.3
Australia	22	126	0.2

Source: Morris(6)

TABLE 3: Payments and receipts by private enterprises for technical know-how, Australia: 1976-77 and 1978-79 ($ m current prices)

Industry	(1) *Receipts for technical know-how from overseas*		(2) *Payments for technical know-how made overseas*		(3) (1) ÷ (2) %	
	1976-77	1978-79	1976-77	1978-79	1976-77	1978-79
Manufacturing	6.0	7.8	51.9	78.0	11.6	10.0
Mining and other industries	1.1	3.8	13.2	50.1	8.3	7.6
Total all industries (excluding agriculture, forestry, fishing and hunting).	7.1	11.6	65.1	128.2	10.9	9.1

Source: Morris(6)

As can be seen from Table 3, Australia has a large and increasing deficit on its overseas balance of payments due to royalties and copyrights. In 1978-79, payments exceeded receipts by $ 116.6 m, compared with $58 m in 1976-77. To quote Morris[6],

> At constant 1976-77 prices, the 1978-79 balance (the difference between receipts and payments) was – $ 98.4 m, which represents a deterioration over 1976-77 of about 70 per cent.

Indeed, as the Federal Minister for Science and Technology (Jones[7]) affirms, Australia ran in 1980 a trade deficit of some A$6 million in goods with a high research content.

Foreign-owned Companies

Aside from a concern with the repatriation of profits, the performance of the host country may be seriously impaired as a result of entry of multinational enterprises. The availability of imported technology acts as a brake on domestic innovation. This is all the more serious as foreign firms are generally concentrated at the innovative, high-technology end of the market.

The extent of foreign ownership, research intensity and technology purchase intensity within the manufacturing industry is given in Table 4.

TABLE 4: Foreign ownership, research intensity and technology purchase in manufacturing industry.

Manufacturing Industry	*Foreign Ownership (percentage)*	*R & D Intensity*	*Technology Purchase Intensity*
High Technology			
Pharmaceuticals	63	High	High
Chemicals	63	H	H
Electrical Machinery ..	39	H	H
Other Machinery ..	39	H	H
Medium Technology			
Glass, Clay	18	Medium	H
Fabricated Metal Products ..	16	M	M
Transport Equipment ..	66	M	M
Low Technology			
Textiles, Footware ..	20	Low	M
Wood Products	8	L	L
Basic Metal Products ..	37	L	L
Food, Beverages and Tobacco	26	L	L

Source: Manderville, Lamberton and Bishop(7).

The table shows that foreign ownership is most pronounced in such capital-intensive, high technology industries as pharmaceuticals, chemicals and petroleum, and electrical machinery. The foreign ownership percentages doubtless understate the present position, as foreign control as a whole has increased in Australian manufacturing industry in the recent past. Hence, there is heightened concern that Australia may become a technological colony. Furthermore, R and D intensity is high in the high technology industries which are to a large extent under foreign control.

There is growing support for the view that increasing foreign ownership and control of Australian industries run counter to the national interest. Foreign technology is rarely suited to Australian conditions, raw materials and scale of production. The domestic activity is largely confined to adaptation. However, the disadvantages do not end there. As Johnston[8] has observed:

> It can be concluded that not only has the reliance of Australia on foreign technology increased, but the growing control of technology by TNCs (transnational corporations) and the restricted basis on which these companies are able to make it available for transfer, suggests that Australian manufacturing industry is effectively being excluded from the new and important technologies except on a 'captive consumer' basis.

Thus there is very good evidence that Australian industry is becoming increasingly reliant on foreign technology and that this technology is introduced into Australia under terms of strict control by the foreign manufacturers. Indeed there is evidence that in key technologies, Australia is systematically denied access. The level of technological expertise has fallen so low in manufacturing industry that firms no longer have the capability to evaluate and select foreign technology.

The evidence mustered by Jones[9] highlights characteristics of R and D in Australia, namely the low level of overall spending by international standards; and the predominance of the government sector as both source of funds and performer of research.

From these two features flow two further facets of R and D in Australia, namely the high proportion of basic research rather than applied research and experimental development; and, the low level of spending on industrial R and D. In fact, the total investment by the private sector in R and D is extremely small; when measured as a percentage of GDP, we have one of the lowest rates of private sector R and D funding among OECD countries. This meagre commitment to R and D by private industry is an aspect of our dependence and an index of our vulnerability which bears careful consideration when we are planning where and by whom the national research and development effort will be carried out.

Solutions: Three British Initiatives

Having outlined some problems, can we offer some solutions? There is no universal panacea, of course, and we feel that our most important contribution to the debate is to highlight the problem. We delineate three British initiatives which, in our view, deserve serious consideration by universities and other institutions of higher education.

The Percy[10] Committee was emphatic that deficiencies in British industry were rooted in education. It said:

> The evidence submitted to us concurs in the general view: first, that the position of Great Britain as a leading industrial nation is being endangered by a failure to secure the fullest possible application of science to industry; and second, that this failure is partly due to deficiencies in education.

The Jones[11] Committee, no less certain of the value of education and training, advised that universities should reverse the current tendency to train scientists towards academic achievement as an end in itself, and should direct the emphasis of their education more towards the needs of manufacturing industry. It went on to say:

> ..students are encouraged to believe that academic achievement is an end in itself and that continuing academic research is the only respectable outcome of their training ..whenever (this attitude) exists it reflects a total unawareness of the realities of the present national situation .. we must look for the solution here in a change of emphasis .. towards the needs of industry. In particular, research work in industrial laboratories should be far more readily recognised for higher degrees. We consider that if scientists were brought up to believe, and trained in curricula which recognised that manufacturing industry is an honourable occupation on which depend the economic strength and prosperity of the community, more would choose to enter it as a career.

There have been a number of valuable attempts in British universities and in polytechnics under the Council for National Academic Awards (CNAA), to move the balance and relevance of Ph.D. education. The tremendous changes brought in the Ph.D. programmes in the universities in Britain relate to shortage of scientists who can apply the results of research to development. The feeling is growing that the traditional straight doctorate, based solely upon full-time research activity in residence leading to the doctoral dissertation, constitutes undue specialisation. There are growing doubts about the value of many theses and about the training that this exercise provides. The Science Research Council is withdrawing support for pure research and giving, more and more, for research that has potential applications or is otherwise related to industry. Part-time doctoral research is being permitted and scientists employed in government or industrial research establishments are being increasingly permitted to submit their experimental results to a supervising university to be considered for acceptance in satisfaction of Ph.D. requirements. As Bragg[12] puts it:

> ..the Ph.D degree, with its emphasis on individual work, often in a narrow specialist field, was seen by many employers as a 'training in unemployability'. The first real attempt to change this situation was the introduction of the scheme now known as CASE — Cooperative Awards in Science and Engineering. Under this scheme the project for a Ph. D. is chosen by an industrial company, in collaboration with an academic department .. after a slow start this scheme has proved very popular. About one third of the 2000 new awards to students for Ph.Ds arc now CASE. They are ideal for investigating problems which a company can deal with empirically for the time being, and which it cannot spare a man to work on immediately, but which it feels could become important in the long term. Some large companies keep a 'portfolio' of CASE projects, using them as their method of recruiting Ph.Ds. They are spin-off benefits in promoting regular contacts between an academic department and the company.

(a) *Aston University Approach*

At Aston University, Birmingham, and at two other technological universities, the "sandwich" principle is being applied at the Ph.D. level with post-graduate students alternating study on campus with research in an industrial laboratory. The Interdisciplinary Higher Degree (IHD) Scheme at Aston was set up with the object of broadening post-graduate education and orientating it towards the needs of industry. The research projects are supervised by a team consisting of two members of the University staff from different departments and — most important — a member of the sponsoring organisation.

A major development has been the introduction of the 'Total Technology' to Ph.D. degrees which is sponsored by the Science Research Council. The total technology programme was designed as an alternate route to the doctoral award, a programme that would enable engineers to practise their professional specialism within the constraints imposed by the realities of industrial life. According to Husband[13]:

> There is no doubt that employers have found difficulty in making the best use of men trained to Ph.D. level in the conventional fashion... industry needs a certain quantity of very highly-trained engineers at the postgraduate level. But engineering skills are applied in industry within a framework of many fnuctions including research, development, design, production, marketing and overall technological management. Thus, while there will always be a need for the orthodox approach to Ph.D. training in engineering there is likely to be a greater need for Ph.D. graduates with a good understanding of the wide range of functions involved in engineering and, more importantly, the knowledge and ability to integrate these functions in an effective fashion.

The problem of developing Ph.D. courses which would train graduate engineers in this much broader fashion was faced by a working party of the Science Research Council. The working party included representatives from higher education and industry. The term 'Total Technology' was put forward as an apt description of the new approach.

To quote from a Science Research Council leaflet on Total Technology

> Total Technology is a fresh approach to the Engineering Ph.D. It embraces the many functions of engineering — research, development, design, planning, production, operations, maintenance and marketing — and also the management skills needed to weld them into a successful whole. Total Technology aims to give young engineers a thorough training in all these functions to enable them to become effective, practical engineers quickly.

About ten universities and polytechnics offer Total Technology Ph.D. programmes as preparation for a successful career in industry.

A typical Total Technology student carries out a research project on an industrial problem in a firm under joint academic and industrial supervision; a group activity such as a design project: and attends lecture courses in related technical subjects and also in finance, economics, marketing and industrial relations and sociology.

The approach to the production of total technology Ph.D. graduates takes the form of a three-year programme of lectures, coursework and research.

(*b*) *Loughborough Programme*

The Loughborough Total Technology Ph. D. programme has been running since 1974. Collaborating companies include Plessey, Pye, RHP, Metal Box and Wilkinson Sword.

The normal procedure is for the student to enrol on the one year M.Sc. course in Manufacturing Systems Management and Development in the first instance. On successful completion of the M.Sc. examinations the student then moves to a sponsoring company to spend two years on field research.

The research topic involves the analysis and solution of a genuine manufacturing problem and the student is supervised by both University and company staff. It is also possible, however, for the student to complete the two year research segment within the University laboratories.

(c) *Oxford Study Groups Experiment*

The Oxford Study Groups with Industry is an eminently successful experiment in mathematical cooperation between the University of Oxford and industry. According to Ockendon[14], Tayler conceived the idea of applied mathematical Study Groups as a forum for bringing together Oxford applied mathematicians and industrial researchers whose problems were in some way connected with differential equations. The basic aim was to prevent physical applied mathematics in Oxford from becoming too unrelated to the real world and the idea was, and still is, to set aside five days for continuous intensive voluntary collaboration between the industrial visitors and faculty members and graduate students.

The spin-off from involvement with Oxford Study Groups with Industry in terms of graduate education in applied mathematics has been considerable. Students reading for higher degrees began to work on problems which have been shelved for lack of time or manpower at previous meetings and wrote M.Sc. or Ph.D. theses that were closely connected with one of the industrial problems. Let Tayler[15] indicate the benefits which accrued from the Study Groups.

> Companies that had spent some time discussing a research problem with a graduate student were anxious to employ him, and the students gained insight into what it might be like to work in an industrial environment. Indeed, many discovered that some of their preconceived ideas about the lack of challenge in industrial research were false, and the stimulation of a real, as opposed to an academic, problem had a marked effect on graduates who had followed mostly pure mathematics courses as undergraduates.
>
> Thus an unforeseen and valuable educational benefit was conferred, and the department graduate strength in applied mathematics increased. Also in this phase some companies were keen to send observers, possibly because of the opportunities for recruitment of graduates with some experience of and taste for industrial research, and the total number of industrial visitors increased substantially.

Conclusion

To conclude, we make the simple observation that sustained economic growth cannot be created by governmental edicts, by monetary policy or by tax cuts alone. Technological literacy of a high order is crucial to our future industrial competitiveness. The need to ensure that the moving frontier of facts is fed into professional practice has never been more urgent in our nation's history: the advancement of industrialisation requires the application of the most recent advances in science to technology. The costs to the nation, for ignoring or failing to meet the need to supply the market with men and women trained to exploit to the full the possibilities opened up by the technological revolution, will be high indeed. Unless there is an appropriate and immediate response from our higher education institutions, Australia's technological sovereignty and excellence would be gravely imperilled.

REFERENCES

1 AUSTRALIAN SCIENTIFIC INDUSTRY ASSOCIATION, *Draft Report* of the Committee, Melbourne, 1983.

2 B. O. JONES, *Science and Technology Statement* 1982-83, Australian Government Publishing Service, Canberra, 1983.

3 A. MOYAL, The Company of Scientists. Editorial, *Search*. 14, 7-8, 1983, pp.170.

4 B. S. THORNTON, F. X. LINTON-SIMPKINS, P. M. STANLEY, and G. LOCKSLEY, *Computers in Australia: From Computer Usage to Commercial Success:*

Foundation for Australian Resources, Sydney, 1983.

[5] K. G. Gannicott, *Australia's Dependence on Foreign Technology*, The Parliament of the Commonwealth of Australia, Legislative Research Service, Discussion Papers. Number 1. Canberra, 1982.

[6] P. J. Morris, Australia's Dependence on Imported Technology — Some Issues for Discussion, *Prometheus*, 1, 1, 1983, pp. 144-159.

[7] T. D. Manderville, D. M. Lamberton, and E. J. Bishop, *Supporting Papers for Economic Effects of the Australian Patent System*, Australian Government Publishing Service, Canberra, 1982.

[8] R. Johnston, *Australian Technology: An Endangered Species*, address presented to the National Science Forum, National Press Club, Canberra, 23rd June, 1981.

[9] Jones. *op.cit.*

[10] Lord Eustace Percy, Chairman, *Higher Technological Education*, Report of a Special Committee, His Majesty's Stationary Office, London, 1945.

[11] F. E. Jones, *The Brain Drain*, Report of a Committee on Manpower Resources for Science and Technology under the chairmanship of Dr. F. E. Jones, Her Majesty's Stationary Office, London, 1967.

[12] S. L. Bragg, *Development of University-Industry Partnerships in Britain*, Paper presented at the Thirteenth Quinquennial Commonwealth Universities Congress. University of Birmingham, 14-20 August, 1983.

[13] T. M. Husband, Total Technology in Engineering, *Engineering + Training*, 17, 1975, pp. 153-154.

[14] J. R. Ockendon, Differential Equations and Industry. *Mathematical Scientist*, 5, 1, 1980, pp. 1-12.

[15] A. B. Tayler, Mathematical Modelling and Numerical Analysis; Oxford Study Groups with Industry 1968-79, *Bulletin of the Institute of Mathematics and its Applications*, 16, 1, 1980, pp. 7-10.

Technical and Technological Education in the Arab States—Problems and Prospects

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ABSTRACT

In this paper, the main problems facing the technical and technological education system in the Arab States are reviewed in the light of the socio-economic background of the region. Future trends in the system have been indicated, considering the developments that are taking place in the region.

Introduction

In the last few decades, the Arab region has witnessed several radical changes and transformations after a long period of colonization and backwardness stretching to several centuries. The region which was the cradle of the first and some of the most remarkable and outstanding human civilizations suffered from the total destruction of all educational establishments and agricultural and irrigation systems that existed up to the twelfth century. After the First World War and the collapse of the Ottoman Empire, the Arab region was divided into several small states and some of them became independent. Most of the remaining parts were also given political independence after the Second World War with the exception of Palestine which was subjected to a new colonization. The initial waves of the industrial revolution started to reach the region at the turn of the century and modern systems of education were gradually introduced. The main concern of such systems was to train personnel to run the administration of the new states with little or no regard to economic development.

However, the impact of the great technological revolution that swept the world immediately after the Second World War created new and greater demands for skilled manpower, if the Arab States were to develop economically and to exploit their abundant natural resources. The educational systems which were limited in most cases to a small proportion of the population, the large majority remaining illiterate, and geared to the teaching of humanities rather than science and engineering, faced a new challenge and further strains. Vocational, Technical and Engineering education in the Arab States represents even today a small proportion of the total educational system despite its rapid growth in the last two decades.

The problems of teaching technology in the Arab States, which may be similar to all other developing countries, can be considered against such background as given briefly above. It may be an accepted fact that economically, the gap between the rich and poor countries is getting wider because of the rapid technological development. It is also true that the difficulties encountered in technological education in developing countries are becoming greater and more complicated. In this paper, the main problems facing technical and technological education in the Arab States are reviewed.

Socio-economic Background

The Arab region which is made up of 22 States (including occupied Palestine) covers about 14 million square kilometres and has a population of about 160 million. It is endowed with a good deal of natural and human resources and, in some countries, with a capability to mobilize adequate financial resources. This latter aspect may occasionally be overstressed, for, in spite of the oil revenue in some Arab countries, the region, taken as a whole, is not in fact as wealthy as many people may imagine. The GNP of the entire Arab World for example is ca. $ 170 billion which is less that 8% of the GNP of USA and only about 50% of the GNP of France.

The average per capita GNP for the Arab States is ca. $1000 which is obviously far below the corresponding figure for USA ($ 8000) and France ($ 6000). There are great differences too within the region, the per capita GNP being $ 12000 for some countries and below ca. $ 200 for some others. Table (1) give details of these general indications for all the Arab States.

Like many other regions in the developing world, the Arab homeland faces a multiplicity of developmental problems, prominent among which are those relating to manpower development. Great strides have been achieved in the various sectors of the economy during the last 10 years, evidenced, for example, by the doubling of the number of engineering colleges in the region during the period 1970–1980 and the great expansion in technical education.

Although development plans have generally been drawn up on the basis of country priorities, the trend for regional cooperation is considerable. The movement within the region of production factors (labour & capital) and the formation of specialized regional organs and development finance institutions are obvious manifestations of complementarity and the desire for closer cooperation.

The problems facing the Arab States in their drive to develop are numerous and vary from one country to the other, but the following problems have been identified by several regional meetings as the most urgent and common to almost all the Arab states:

1. A low level of productivity in various sectors of the economy, with deficiencies or high cost of essentials such as food, water and housing and of basic services such as health, education, transport and communication.

2. A high degree of dependence on foreign suppliers, to the extent of over $ 60 billion per year for engineering consultancy services — often with a great deal of low quality, high cost and inappropriateness.

3. Shortage of certain categories of skilled manpower partly due to the mismatching of the educational system with the real needs and partly by the emigration and/or lack of motivation of high-level manpower.

4. Inadequate infrastructure and measures for the promoting of an indigenous technological capability in the selection, depackaging, adaptation and efficient running of imported plant.

Educational Development and Manpower Needs

There has been a greater awareness in recent years of the importance of expanding and adapting the educational systems in the Arab States to meet the needs of national development plans. The measures taken may vary from one country to the other but serious efforts have been and are being made to combat illiteracy (e.g. the national campaign to eradicate illiteracy in Iraq was completed during 1978-1980). Compulsory education upto the primary level has been introduced in

TABLE 1: Some general data on Arab States.

a	b	c	d	e	f	g	h	i
	Country	*Surface Area Km²* (×1000)	*Popula-tion* (×1000)	*GDP Total* $ (*million*)	*GDP per Capita* $	*Number of students, ca. 1977 thousands* 1st Level	2nd Level	3rd Level
1.	Algeria	2382	17900	17000	954	2785	615	53
2.	Bahrain	1	267	980	3669	46	19	1
3.	Egypt	1001	38741	16400	424	4151	2283	493
4.	Iraq	435	11907	15400	1300	1950	600	91
5.	Jordan	97	2800	1500	540	402	186	17
6.	Kuwait	20	1129	12800	11400	125	132	10
7.	Lebanon	10	3056	1800	603	500	180	45
8.	Libya	1760	2700	18200	6758	572	198	14
9.	Mauritania	1100	1500	450	300	65	9	0.5
10.	Morocco	446	18250	8200	453	1668	529	60
11.	Oman	212	817	2300	2800	63	3	NA
12.	Qatar	11	160	2400	15000	26	11	1
13.	Saudi Arabia	2150	9500	58000	6155	726	258	33
14.	Somalia	638	3354	540	160	230	12	2
15.	Sudan	2506	16953	5000	300	1218	307	22
16.	Syria	185	7845	6200	792	1320	512	74
17.	Tunisia	164	6065	4600	773	969	211	23
18.	U.A.E.	84	670	7500	12000	61	16	0.5
19.	Yemen, A.R.	195	7078	1700	241	260	25	3
20.	Yemen, P.D.R.	332	1800	270	150	207	57	1
21.	Djibouti	22	120	210	1800	10	2	NA
	TOTAL	13751	15255	181450	1190	17354	6165	944

Sources::—UN Statistical Year Book (1978)
—Encyclopedia of the Third World, G. T. Kurian, Man. sell, London 1979
—UNESCO Statistical Year Book 1978–1979.

several states and to the secondary level in some of them. Table (1) gives details of the number of students in each state for the three levels of education which show the great variation that exists in the rate of educational development in the Arab States. Nevertheless, the problem of illiteracy still presents a major obstacle to development in the region. In some states as much as 88% of the population is illiterate (Mouritania and Morocco).

While the expansion in general education at the primary and secondary levels with the ultimate aim of achieving compulsory education at those levels serves important social purposes and generates a better social environment for the release of latent technological capabilities in the region, the availability of all levels and types of skilled manpower remains the main criterion for a rapid technologically-based economic development. It is precisely in this area that concerted efforts are being made to improve and develop the educational system to become more responsive to the new needs of society. Greater emphasis is being placed on the training of technicians and engineers and some notable progress has been made in recent years in some of the Arab States. However, the total number of engineers and scientists in the region is rather low compared to those in other regions as shown in Table (2). The total number of technicians in the Arab States is even less than the number of engineers available and compares very unfavourably with other countries or regions. Table (3) shows the present enrolment in technical education in the Arab region in proportion to population and the GDP compared with Singapore and the United Kingdom, by way of example.

The manpower needs of the Arab region can be obtained by the summing-up of country estimates, which have been made in a number of Arab States in recent years. There are numerous factors and uncertainties that adversely affect the degree of confidence one can place in such estimates. In particular, the precise definition of knowledge and skills actually required may be difficult to ascertain in addition to the great internal migration of labour between the Arab States as well as the external one. An important factor that confuses the true manpower needs was found in a case study on the "Efficiency of Engineers' Employment in Iraq" to be the substitution of grades of engineers to fill the great technician shortage. In turn, this resulted in a further demand for engineers while as much as 58% of them well fulfilling technicians' functions. Despite these doubts, all indications point to the fact that the main problem facing development in the region is the shortage of skilled and technical manpower.

Technical and Technological Education

As was mentioned above, the expansion in vocational, technical and engineering education in the Arab region was considerable in recent years, but the proportion of such education remained significantly small in comparison with the general and other types of education. The multiplicity of the problems facing technical and technological education are related to the rapid social and economic changes, the sophisticated requirements of such education and the staggering speed of the technological revolution, as well as many other inter-related factors.

In most Arab countries, vocational education starts at the age of 15 after 9 years of general education, and forms a separate stream in the educational system which is of 3 years' duration. Post-secondary technical education is usually for 2-3 years and engineering education is for 4-5 years after secondary education. The structures of technical and engineering education are basically similar to those elsewhere in the world, with some local variations included in the curriculum. In most engineering colleges, teaching is in English or French (depending on the former colonial power of occupation) but

TABLE 2: Some data on technical & engineering education in the Arab States.

a	b	c	d	e	f		g
	Country	*No. of Tech. Insts.*	*No. of students in tech. Insts. & Arch.*	*Total No. of students in 3rd Level ed. in Eng. & Arch.*	*Univ. Ed. in Eng. & Arch. ca.* 1977		*Total stock of Scientists & Engineers*
					Staff	*Students*	
1.	Algeria	8	NA	3800	466	2413	NA
2.	Bahrain	1	1583	260	NA	NA	NA
3.	Egypt	NA	NA	58300	2165	47789	593254
4.	Iraq	37	20500	17800	618	13169	43645
5.	Jordan	16	3227	1260	65	986	11575
6.	Kuwait	6	3144	1093	48	825	27246
7.	Lebanon	NA	NA	NA	151	2773	28500
8.	Libya	4	250	1700	210	1505	8310
9.	Mauritania	NA	NA	NA	NA	NA	NA
10.	Morocco	1	583	950	135	586	2475
11.	Oman	NA	NA	NA	NA	NA	NA
12.	Qatar	1	434	NA	NA	NA	1352
13.	Saudi Arabia	NA	NA	5698	631	5415	33376
14.	Somalia	NA	NA	95	NA	NA	NA
15.	Sudan	7	2126	1800	50	1410	13792
16.	Syria	40	5835	13001	574	16171	27369
17.	Tunisia	8	4859	1680	105	1154	3421
18.	U.A.E.	NA	NA	NA	NA	NA	NA
19.	Yemen, A.R.	2	450	NA	NA	NA	1394
20.	Yemen, P.D.R.	1	216	295	NA	NA	NA
21.	Djibouti	NA	NA	NA	NA	NA	NA
		132	43212	107732	5218	94196	795718

Sources:—Directory of Arab Technical Institutes, June 1980 (Prepared for UNESCO by FTI, Baghdad)

—Directory of Institutions of Training in the Arab States, UNEDBAS, Beirut, 1978.

—UNESCO Directory of Engineering Education Institutions 1976.

TABLE 3: Enrolment in technical education

a	b	c	d	e	f
			Approximate total enrolment in technical education ca. 1977		
Country or region	*Population, thousands* (ca. 1977)	*GDP total $ billion* (ca. 1977)	*No. of students*	*Per 100,000 of population*	*Per $ b of GDP*
Singapore	2,300	6	11,863	515	1977
United Kingdom ..	55,500	300	100,000	180	333
Total of Arab States ..	152,000	182	43,212	28	273

in some colleges teaching is in Arabic as in Iraq and Syria and Egypt.

In technical education, teaching is partly in Arabic and partly in English and French but the use of Arabic is gaining wider acceptance.

The problems facing technical and technological education in the Arab States are the subject of regular review and consideration at local and Arab level and regional organizations like the Arab Federation for Technical Education, the Association of Arab Universities and the Arab Education Ministers' Council, have emerged to coordinate and strengthen Arab cooperation in this respect. The main problems encountered in the teaching of technology can be grouped as follows: —

General

1. An almost complete separation exists between vocational and technical education from the general stream of education. There is little or no horizontal mobility allowed between the two streams.

2. There are very limited opportunities for capable students from vocational and technical education to continue higher studies. There is usually no vertical linkage between the two streams at university or other forms of higher education.

3. There is a general lack of orientation at the primary and secondary levels for practical work and skill appreciation, the main emphasis being placed on theoretical and academic subjects and rote learning.

4. There is common lack of cooperation and coordination between industry and technical and technological institutions. The involvement of industry in the planning and policy making of such institutions is very rare and limited.

Social

1. There exists an unfavourable social attitude towards manual skills and manual work as compared with that for "White-Collar" work in all Arab States as a result of several

decades of colonial educational systems that prevailed. The fact that technical education is considered to be the stream for the less able students and the "drop-outs" does not give it a good image.

2. A low status is accorded to technicians and technologists in most Arab States as evidenced in the lack of material incentives and legal status to these personnel.

Physical and Technical

1. The high cost of technological education as compared to other types of education is an important factor. The area required per student in engineering is several times more than that for humanities. The workshops, laboratories and pilot plants require heavy investments and call for special design of the buildings with adequate flexibility for future changes and development. The initial capital cost per student is very high and financial resources that can be mobilized are not always available for such schemes.

   The running cost is also much higher in technological education because of the low staff/student ratio required and the higher salaries and incentives that must be paid in addition to the higher running cost of equipment and the need to keep up with new technologies by the continuous acquisition of new equipment.

2. There is a need for high level and specialized technical manpower to run and maintain the sophisticated equipment and machinery installed at colleges of engineering and technical institutes. Such skilled manpower is usually very scarce in a developing country and it is readily attracted to industry where the incentives are greater. For technical and technological education, it is essential that teachers must have good practical experience to be able to pass on the technological skills to their students. But such staffs are not only difficult to find, but highly unlikely to be released from industry on a permanent or temporary basis.

3. Curriculum development is a continuous process in the teaching of technology and must be carried out systematically and in harmony with the technological changes in a country. But the rapid technological revolution in the region is generally much more swift than the achievements made in curriculum development. The widening gap in the "relevance of knowledge" between what the engineer acquires at the college and that required by society is becoming a serious problem. The external efficiency of technological institutions is suffering more and more in recent years.

4. Teaching material in the form of textbooks and reference books in Arabic are in short supply. General books that may help the public to deal with technology more efficiently are commonly unavailable.

Continuing Education

1. There are insufficient opportunities for technologists in the Arab States to keep up with technological progress in the world. The attitude to continuing education among engineers and technicians is improving, but there are few established systems for re-training and upgrading. Continuing education is not yet incorporated in the technical education system, but, in most cases, left to the initiative of Engineering Unions or Societies.

2. Considering the volume of imported equipment in the Arab region, the training programmes available for

the Arab technologists at places of manufacture are insignificant and in most cases not efficient.

3. Exporters of equipment to the region tend to consider their responsibility ending with the installation of the equipment. Almost no effort is made by them to organize refresher training courses in the Arab States to ensure the efficient use of their equipment.

Future Trends and Conclusions

The main problems that have been outlined above may be common for all developing countries, but some problems may be more peculiar to one group of countries than others. For some of the Arab States, the mobilization of financial resources may not be a major problem but the lack of teaching and technical staff is a more serious problem. There are some instances where modern technical institutes with adequate staff have not attracted sufficient number of students because of the social attitude.

However, there are clear indications that efforts are being made to develop the educational systems to meet the new technological challenge. The following future trends can be detected.

1. The need to combat and eradicate illiteracy is gaining more acceptance throughout the Arab region.

2. Basic education at the primary level for all children is the general aim of all Arab States and compulsory education at the secondary level is the target for some of them.

3. There is evident awareness of the need to develop and expand vocational and technical education and to diversify the general education to become more work-oriented.

4. It is becoming more acceptable now to consider investment in technological education as part of manpower development to be of the same category as investment in industry rather than to be a part of the services sector of the economy.

5. There is greater readiness to provide appropriate funds to develop and expand technological institutions in all Arab States.

6. There is gradual improvement in the social status of the technologist and greater awareness of their importance in the present and future technological progress.

7. More attention is being paid in recent years to introduce skill orientation in primary and secondary education and in some Arab States comprehensive form of education has been started.

8. Better and more efficient employment of engineers and technologists is taken into consideration in manpower planning and in the attempts made for wider reliance on job description.

9. The need to develop continuing education for engineers and technologists as a permanent feature in all systems of higher education is becoming more acceptable. The involvement of industry, the universities, and professional associations will be an essential requirement for its success. This may require also some legislation to make it part of the educational pattern for all technologists.

REFERENCES

REPORT OF THE SEMINAR ON TECHNICAL EDUCATION IN THE ARAB WORLD, organized by the Iraqi Foundation of Technical Institutes, Baghdad, 18-22 Feb. 1979.

"DIRECTORY OF ARAB TECHNICAL INSTITUTES", published by the Arab Federation for Technical Education, Dec. 1980, Baghdad.

ABAYAZID, O., "A Note on the Formation of Instrument Maintenance Technicians in the Arab Region", paper presented to the Arab Regional Seminar on the Training of Instrument Maintenance Technicians, held in Baghdad, 22-26 March 1981.

FINAL REPORT OF THE "ARAB REGIONAL SEMINAR ON THE TRAINING OF INSTRUMENT MAINTENANCE TECHNICIANS" organized by the AFTE/FTI (Iraq)/ UNESCO, 22-26 March 1981, Baghdad.

"SOME ASPECTS OF PROBLEMS OF TECHNICAL EDUCATION IN THE ARAB STATES",

Final Report of the meeting of Technical Education in the Arab States, organized by the Arab League Educational, Cultural and Scientific Organization, Kuwait, 10-15 Nov. 1979.

ABDUL-WAHAB, H. M. S., "The Efficiency of Engineers' Employment in Iraq", Al-Muhandis (The Engineer) No. 61, 1976, Baghdad.

ABDUL-WAHAB, H. M. S., "Educational & Training System Reforms Contributing to Industrial and Technological Development in Iraq". Paper presented to the "International Institute for Educational Planning Workshop" 27-29 Oct. 1980 Paris.

FRENCH, H. W., "Engineering Technicians, Some Problems of Nomenclature & Classification" Report to UNESCO, 1980.

"THE REVISED RECOMMENDATION CONCERNING TECHNICAL AND VOCATIONAL EDUCATION" adopted by the General Conference of UNESCO at its eighteenth session, Paris 19 Nov. 1974.

DIRECTORY OF TRAINING INSTITUTIONS IN THE ARAB STATES, UNESCO/UNEDBAS, Beirut, 1978.

Women's access to, and participation in, Lifelong Education and Training

Dorothy Stafford

ABSTRACT

The paper identifies some of the factors which have historically inhibited and are still inhibiting New Zealand Women's access to participation in lifelong education and training. Sex-role stereotyping of jobs, limited opportunities for apprenticeship training in both public and private sectors, requirement of concurrent work experience in Certificate courses, inadequate impact of equal opportunity policies on employment in industries and in emerging occupations, financial hardships in training and lack of good quality child-care support are some factors that are highlighted. Giving women a chance of non-traditional work, thus encouraging them to consider a wider range of choices than those usually thought appropriate for them and giving them the necessary financial and other support are some of the approaches suggested to deal with these factors.

Introduction

The Women's Training Advisory Committee (WAC) of the New Zealand Vocational Training Council (VTC) has in the course of its work over the past decade, identified many of the factors which have historically inhibited, and are still inhibiting, women's access to and participation in "lifelong education and training". Some of these factors identified by WAC are highlighted here with approaches adopted/needed to deal with them.

Socialisation process

Research has shown that sex-role stereotyping by family and society starts at birth and serves to constrict the activities and behaviour of girls while encouraging the development of "macho" behaviour in boys. Society later has to cope with problems arising from both these effects. The Women's Training Advisory Committee believes *a government-funded long-term public education programme* perhaps best promoted by the Human Rights Commission (HRC)would be *cost-effective* as well as beneficial in human terms.

Formal education

Formal education is, of course, part of the socialisation process and often serves to reinforce prevailing social attitudes although it can also perform the role of change agent. Research has demonstrated the existence of sex stereotyping at all levels of our education system. This affects school girls by:

(*i*) Circumscribing their activities (e.g. in physical education),

(*ii*) Disadvantaging them socially in the school environment (e.g. relative importance of First XV and 'A' Basketball team: relative status of "Head Boy" and "Head Girl"),

(*iii*) Depriving them of their fair share of teacher-time and attention,

(*iv*) Inhibiting their choice of subjects to the extent that they fail to take valuable pre-requisites to further training and/or further employment, or they allow their vocational future to be predetermined from the third form (e.g. by their being channelled into vocational typing classes),

(*v*) Influencing the advice they receive from career advisors,

(*vi*) Depriving them of inspirational female role models (e.g. female principals and heads of departments),

and ultimately affecting the attitudes of prospective employers.

WAC created great interest among school girls last year through media presentations (television, press, radio) on the theme 'Girls Can Do Anything' aimed at encouraging girls leaving school to seek non-traditional employment and employers to give them opportunities. It is essential, though, the Committee believes, that teacher education reflects the provisions of the Human Rights Act through recruitment of teacher trainees who are eager to promote sexual and racial equality and by the inclusion in the core curriculum at Teachers' Colleges, training to correct the bias outlined in (*i*) to (*vi*) above.

Transition Policies

WAC is interested in the evolution of the government's transition policies and the likely benefits for female school-leavers (who are currently over-represented in unemployment statistics) of a national commitment to post-school training. Equitable transition policies will need to include positive interventions to ensure that young women have full equality in all aspects of training and employment.

Vocational Training and Employment

It is important to remember, in contemplating women's access to vocational training and employment, that 85 per cent of vocational training takes place on the job. Since our current sex-segregated labour market confines 50 percent of working women within only six main job categories, and since the whole apprenticeship field has only a very thin representation of women in twenty or so trades, other than Ladies Hairdressing, and no women at all in 55 trades, access to non-traditional employment (occupations where fewer than 25 per cent of the workforce is female) is of vital importance, not only in the interests of equity but because of shrinking opportunities in the traditional female occupations.

WAC believes that action and especially affirmative/positive action, is required in the following areas:

(*i*) *Department of Labour Programmes for the Unemployed*

A successful pilot positive action programme to train women in non-traditional occupations and secure employment for them has been completed in Taranaki Province where several large industrial projects are under way and labour shortages are consequently evident. Similar programmes will, it is hoped, be repeated in other Department of Labour districts throughout the country. Senior employment officers (Positive Action for Women) have been appointed to four Department of Labour districts. Their role will be to promote affirmative/positive action. *Additional appointments will be needed to give national coverage.* Attitude change through *inservice training of Department of Labour staff* is still required. *Statistics on ethnicity* would assist in assessing the position of Maori women, especially school leavers.

(*ii*) *Apprenticeship Training*

WAC is disappointed that considerable time has elapsed since the comprehensive review of apprenticeship but they hoped for inception of schemes of *apprenticeship to industry* has not taken place. Women would benefit by *pre-apprentice full-time* training akin to Maori Affairs Department sponsored trade training, and it is felt that *Maori women should be equitably represented in all Maori trade training courses.* It is heartening to note that the Minister of Employment has introduced a special incentive (Female Apprentices Incentive for Recruitment) of $ 20 a week to those employers entering into contracts with women in non-traditional trades and he hopes that this will lead to the employment of at least 100 women next year in new fields. This will be an important step forward. Action on *recruitment of women into public sector apprenticeships* is now awaited.

(*iii*) *Technician-level Training:*

There is still, and has for some time been, a presumption that appropriate concurrent work experience enhances the quality of the student's performance. No research has been carried out on NZ Certificate students to substantiate or disapprove this theory (to determine whether it is equally true of *all* certificates, or true of some but not all, or true of none).

WAC maintains that the student assessment carried out for the award of NZ Certificates should assess *all* the qualities, skills and knowledge which holders of a New Zealand Certificate are expected to demonstrate, and that the award of a certificate should depend upon success or failure in these assessments.

If concurrent work experience *does* so greatly enhance student performance, then those who *are* in employment could be expected to have a higher pass rate in assessments. From the point of view of women, it is unfair and unnecessary, to exclude students who are:

- not in employment and unable to obtain a job,
- made redundant or otherwise dismissed part-way through their course,
- obliged to leave their job because their, spouse is transferred to another city
- out of the paid work-force for child-rearing.

(*iv*) *On-Job Training*

If the 29 Industry Training Boards (ITBs) set up by the Vocational Training Council could be convinced of the economic and social benefits of equal opportunity policies in their industries they could be an influential network in promoting the co-operation which the HRC has called for between industry and the Commission in the development of equal opportunity policies and affirmative action initiatives. A better balance of male/female representation on ITBs would ensure more understanding of the training needs of women, as might a greater insistence on the part of VTC that heed should be paid to council policy. Employer and Trade Union Training Boards have a particularly important educational role to play.

It is time for more educational work to be undertaken by the Vocational Training Council to encourage more Boards actively to support the Council's positive action policy.

Emerging Occupations

WAC is concerned that sex-segregation of employment in emerging occupations should not be allowed to occur. There are already signs in computer-related jobs that those defined as primary sector (good pay and working conditions, stability of employment, career structure and opportunities for promotion) may become 'traditional' for men and secondary sector jobs (low pay, relatively poor working conditions, lack of career structure, lack of promotion prospects) will go to women.

WAC has already made representations on the proposed establishment of an Information Technology Training Advisory Committee (of the VTC) with these fears in mind.

Financial Assistance while Training

The whole area of grants, bursaries, benefits and allowances is in need of rationalisation. Women as well as men would be greatly assisted by financial encouragement to train rather than remaining on domestic purposes or unemployment benefits.

The Social Welfare Department's Training Incentive Allowance ($ 15 NZ per week) for domestic purposes and widow beneficiaries is a small step in the right direction.

Bursaries for short courses would help. Recognition needs to be given to the greater difficulty experienced by women in earning adequate amounts of money during vacation employment.

Child care support

Finally, WAC emphasises with the utmost urgency that 'improved economic performance' for New Zealand in the future will inevitably be jeopardised unless women are encouraged, with good reason, to believe that the world of paid work is not inimical to their desire for family life. This will mean a recognition of the need for good quality child-care support (which will also benefit the work-force of the future by ensuring that no child lacks the necessary stimulation of intellectual, physical and emotional powers to enable them to contribute fully) during training and employment. Our falling birth-rate perhaps reflects the dilemma of women who now fully understand the effects on career and bank-balance of leaving the paid work-force for unpaid work in the home. Unless women are supported in their desire for choice in their lives and all choices are made rewarding, New Zealand's economic future will once more involve skilled labour shortages and crash immigration programmes and an increasing burden on the young for care of the aged majority.

REFERENCES

ABIGAIL, "Secondary School Influences on Training and Career Aspirations of Girls," Vocational Training Council, 1983.

"NEWS SHEET 24 PILOT POSITIVE ACTION PROGRAMME", Department of Labour Report, Advisory Committee on Women's Affairs, June 1984.

"ISSUES RELATING TO THE TRAINING AND EMPLOYMENT OF WOMEN", Women's Advisory Committee of Vocational Training Council, 1983.

"SUMMARY OF APPRENTICESHIP TRENDS TO 31 MARCH 1983", Department of Labour, 1983.

G. W. FORD, "Technology, Women and Employment: The Need for New Concepts and Criteria for Policy Formulation", University of N.S.W. 1982 (Revised).

SHIPLEY SUSAN M., "Women's Employment and Unemployment: A Research Report", Massey University and Society for Research on Women, 1982.

ZOE DURING, M. D., "Poverty—A Health Promoter's Perspective", Paper to annual conference NZ Association of Citizens Advice Bureau, Rotorua, NZ October 1984.

Attitudes of Technical Students towards Teaching Profession

BASIM N. AL SAMARRAI AND TARIK AL-BALDAWI

ABSTRACT

The purposes of the present study are to measure the attitudes of technical students towards the teaching profession and study their relationship with the variables of sex, family residence and type of high school. The data base is the responses of 185 Iraqi students of the School of Technical Education at the University of Technology, Baghdad on a 30 item attitude scale. The study has showed that students in the School of Technical Education have low positive attitudes towards the teaching profession. Sex, family residence and type of high school do not appear to be relevant variables in determining the attitudes of technical students.

Introduction

It is obvious that teaching is the basic element in the technical education system. An effective technical teacher is in a better position to provide the learners with an appropriate instructional environment which helps them develop experiences and technical skills necessary for the purpose of adaptation for life in an age of fast technological changes. Therefore, training such a teacher has received great attention on the part of specialists in planning technical education. It is obvious that a technical teacher should be in possession of particular personal traits and professional skills which include high positive attitudes towards the teaching profession to be effective. A technical teacher with positive attitudes can increase learners' achievements at school and develop in them the desired level of aspirations and scholarship. Therefore, the discovery of students' attitudes and their modification are certainly important in the teacher preparation programmes. Although family, peer groups, social organization, and media have strong effects in determining the learners' attitudes, such programmes still play a central role in the shaping of desirable attitudes towards the teaching profession. It is hoped that these programmes incorporate objectives which aim at instilling in the students positive attitudes towards the teaching profession. In order to accomplish such objectives, the programme planners need to get some preliminary estimate of the attitudes that the students have to determine, after a period of instruction, whether or not the students' learning experiences have brought about a change in their attitudes. In addition, when the attitudes are measured, many interesting relationships can be investigated. Some light can be cast on the relation of attitude to sex, parents' occupation, family residence, previous school experience as well as a number of other variables.

Earlier Arab Studies

Several Arab researchers have tried to investigate students' attitudes towards teaching in different teacher preparation programmes. In Iraq, it was found that freshman students in primary teacher training schools and Colleges of Education at the Baghdad University had moderate positive attitudes towards teaching as a career (Said, 1982 and Ibrahim, 1978). But Riyad (Muhammad Ali, 1980) found that a large number of Egyptian students at the College of Education, University of Ain Shams had negative attitudes towards the profession. Similar findings were obtained in respect of selected freshman students with high school achievement at the College of Education, Asiot University (Muhammad Ali, 1980). Other studies were concerned with the impact of teacher preparation programmes on attitude change. For example, Ibrahim (1978) found significant differences in attitudes between freshman and senior students in favour of the latter at 0.05 level of significance. In addition, some Iraqi investigators studied the relation of attitude with sex. Female students were found to have more positive attitudes towards the profession than male students (Ibrahim, 1978). Such a result was not evident with regard to students of the College of Education at the Baghdad University (Said, 1982).

Problem

It is noted from the previous literature that the studies in the Arab world have not dealt with students' attitudes in the technical teacher training institutions. Similar to teachers in other areas, the development of positive attitudes towards the teaching profession is a necessary condition for the success of technical teachers in their jobs and their preparation programmes should give high attention towards this end. The present study is concerned with this issue. Its objectives are to estimate technical college students' attitudes towards teaching at the School of Technical Education at the University of Technology in Baghdad, Iraq, and study the relationship of attitude with the variables of sex, family residence and type of high school.

Methodology

Tool

The tool used in the study is a Likert Type Attitude Scale developed by Al-Samarrai and Baldawi (1984) to measure the attitudes towards the teaching profession of students in the teacher training institutions. The Scale contains 30 items, half of which reflect negative attitudes and the other half positive ones. The items cover the following aspects: teaching problems, social and future perspectives, vide Table-2. The scale is easily administered and directions for respondents are obvious. Subjects are asked to either agree or disagree with the statements by expressing their response in only one of five categories: strongly agree, agree, undecided, disagree, strongly disagree. Each of these categories is weighted by values 5, 4, 3, 2, and 1 respectively; and the category that reflects the most favourable attitude gets the greatest weight. A score is obtained by adding together the weights of the categories a respondent has checked. Since the scale includes 30 items, the maximum score, which indicates the most positive or favourable attitude towards the teaching profession, would be 150. A score implying indifference would be in the neighbourhood of 90, or three points on the average for each statement. Very low scores would indicate antagonistic attitudes, with the minimum score being 30. The researchers have reported high internal consistency with reliability coefficient of 0.82 and high construct validity and concurrent validity for this tool.

Sample:

The data for this study is based upon the responses on the Attitude Scale administered to a sample of 185 Iraqi students. The subjects of the sample are junior and senior students of the School of Technical Education at the University of Technology in 1983/1984. The sample subjects are distributed according to the following variables: sex, family residence and type of high school. It includes 28 female and 157 male students; 78 students whose families live in the capital city of Baghdad and 107 students whose families reside in other towns; 127 students of the sample are graduates of high academic schools while 58 are graduates of the high industrial schools.

Statistical analysis

Three statistical indicators are used for data analysis: mean, standard deviation and the Z value. Four comparisions on attitudes are performed. First, the overall means of subject responses on scale and on each scale item are compared with the standard scale mean and the standard item mean. The other comparisons are conducted between male and female subjects, between subjects whose families are residents of Baghdad and subjects whose families live outside Baghdad, and between subjects graduated from high academic schools and subjects graduated from high industrial schools. The means and standard deviations on only scale level for these groups are obtained and used to compare their attitudes. The differences between the various groups are statistically tested by using Z test between means for large samples ($n > 30$), (Johnson, 1976). Z tests on the scale level and 30 Z tests on the item level are made and 0.05 level of significance is used.

Results and Discussion

Four types of comparisons on attitudes towards teaching as a career are made on scale level and the results are presented in Table-1. The first type is a comparison between the overall mean and the standard scale mean. The Z-value of 11.0144 shows significant difference between the overall mean of subject responses on scale and the standard scale mean ($P = 0.05$), indicating that the subjects of the study sample have a positive attitude but on a low level.

TABLE 1: Comparisons of the total and group score means.

Group Scores	*Sample size*	*Mean*	*Standard deviation*	*Z-value*
Sex:				
Male	157	93.694	12.967	0.048
Female	28	93.525	16.343	
Family Residence:				
Baghdad	78	93.769	14.873	0.1865
Outside Baghdad	107	93.38		
Type of School:				
Academic	127	92.3543	13.689	1.7903
Industrial	58	96.1552	13.259	
Total Scores:				
Scale	185	95.476	5.1429	11.0144*
Standard Scale	—	90	0.00	

*Significant difference at 0.05 level.

TABLE 2: Comparison of the Means of Scale Items and Standard Item Mean.

Items	Mean	*Z*-value
1. The Social responsibility of the teacher is no less important than that of a doctor or an engineer.	3.89	7.736
2. Teaching is a boring job which requires writing questions and correcting students' answers many times during the year.	2.89 N.S.	—0.909
3. The teacher is an important element for progress and the country counts on him in fulfilling its goals and objectives.	4.28	12.879
4. The teacher plays an important role in the formation of the students' personality.	3.78	6.84
5. Teaching gives the teacher an opportunity to develop social relations with a great number of people.	3.69	6.127
6. The teacher is a cunning person who tries hard to persuade students that all subjects he teaches are essential and interesting, although he believes otherwise.	3.48	3.922
7. In the teaching profession, drawbacks exceed positive aspects.	2.73	—2.349
8. Teaching is an interesting career as it facilitates monitoring and understanding of human behaviour.	3.48	4.097
9. Teaching is a profession through which power is exercised over people.	3.61	5.159
10. The teacher deals with educational subjects which are of a personal interest for him.	3.27	2.487
11. Most teachers consider their career as a source of happiness.	2.79 N.S.	—1.71
12. The teacher has the opportunity of encouraging the students to share his own interests and ambitions.	3.43	4.236
13. Teaching is a source of psychological upsets, as the teacher might be forced to teach students who are known for their disturbance and annoyance.	2.89 N.S.	—0.99
14. The teacher might be frustrated as students might not share his own interest in a particular educational subject.	2.73	—2.287

Items	Mean	Z-value
15. Teaching is a job which is more secure than many other government or private jobs.	2.9 N.S.	–0.796
16. Teaching provides an opportunity for practising leadership over people.	3.89	9.91
17. The teachers' salary and increments are discouraging.	2.44	–5.29
18. The teacher is an actor whose stage is the class and whose audience are the students.	3.54	4.469
19. The teacher cannot convince or satisfy the intellectual student.	2.95 N.S.	–0.463
20. Teaching is a career which helps to develop the teachers' initiatives and innovation.	3.25	2.011
21. The majority of teachers are proud of their profession.	3.21 N.S.	1.775
22. The teacher's educational excellence in his field of speciality renders him the approval and respect of many people.	3.94	8.62
23. Teaching is a tiresome career.	2.44	–4.913
24. Teaching helps to improve the teacher's personality.	3.55	5.035
25. Society does not respect the teaching profession.	2.9 N.S.	–0.806
26. The teacher's initiatives are halted due to the non-availability of aids and equipment.	2.24	–7.089
27. The teacher enjoys a reasonable amount of freedom and independence in his work.	3.32	2.876
28. Teaching is an unwanted profession because the teacher is always under supervision and is subjected to criticism from many people.	2.68	–2.942
29. No other job is better than teaching with regard to long holidays.	2.33	–6.393
30. Many people like to take teaching as career.	2.97 N.S.	0.289

For this Scale, Standard item mean is equal to 3. N.S.—Not Significant.

The mean on scale for the male subjects is 93.694 and for the female subjects 93.535. The Z value of 0.048 is not statistically significant (P=0.05), indicating that the differences in attitudes between male and female subjects is not evident. The scale mean for subjects whose families live in Baghdad is 93.769 compared with 93.38 for those whose families live outside Baghdad. The Z value of 0.1865 is not statistically significant (P=0.05). Thus the two groups can be considered as equivalent in their attitudes.

Similar to the last two comparisions, significant differences are not found between subjects who graduated from high academic schools and subjects who graduated from high industrial schools as indicated by the Z value of 1.7903.

Table-2 presents the means of subject responses on different items in the scale for the total sample considered in the study and the Z values for comparison between these means, with standard item mean, namely 3.

In addition, the Z tests for the 30 scale items presented in Table-2, show that the means for items 2, 11, 13, 15, 19, 21, 25 and 30 are not significantly different from the item standard mean. (This shows that subjects have undecided attitudes towards the issues indicated in these items). However, there are items that show significant negative and positive attitudes. There is disagreement with regard to issues indicated in item 7, 14, 17, 23, 26, 28 and 29 and agreement with regard to those indicated in the remaining items in various degrees.

Several conclusions can be drawn from the above results. First, students in the School of Technical Education at the University of Technology have low positive attitudes towards teaching as a career. Second, students show undecided and negative attitudes towards certain issues concerning teaching problems, and social and future perspectives of the teaching career. Third, sex, family residence and type of high school do not appear to be relevant variables in determining attitudes of technical students.

The above findings can be attributed to the following reasons:

1. Students are basically admitted based on their averages in the Iraqi Secondary Achievement Examination, regardless of their interest in teaching profession as a future career.

2. The current teacher preparation programmes place insufficient emphasis on working with youth, how to teach and orientation to people.

3. Engineering preparation is overemphasized as compared to professional preparation.

4. There is a lack of orientation towards developing student abilities in problem solving in practical and industry related situations, which can lead to changes in students' attitudes towards the teaching profession.

5. It seems that there is inefficient integration between various components of qualifying programmes which consist of two kinds of subjects, namely engineering science and methodology subjects. The activities in both these subjects are not organised as one feeding resource to make the students qualify themselves as efficient technical teachers. Thus the students do not get enough chances to develop healthy attitudes towards their career.

REFERENCES

AL-SAMARRAI, BASIM AND T. BALDAWI. Developing a Scale of Attitudes Towards Teaching Profession. Baghdad, Iraq: University of Technology, 1984.

IBRAHIM, T. SALIH. 'Attitudes of Primary Teacher School Students Towards Teaching'. Unpublished Dissertation, Baghdad University, Iraq, 1978.

JOHNSON, ROBERT. Elementary Statistics (2nd Ed.) California: Wadsworth Publishing Company, Inc., 1976.

MUHAMMAD ALI, S. Psychological Studies. Egypt: Asiot University, 1980.

SAID, H. SAID, MUHSIN ALc Mansuri and Huda K.M., Attitudes Towards Teaching Profession for Students in Teacher Training Colleges and Departments at Baghdad University. Iraq: Baghdad University, 1982.

Common Entrance Examination for Admission into Polytechnics: An Andhra Pradesh Experience

A. KAMALA

ABSTRACT

The paper presents the findings of a study made on the selection of candidates to the polytechnics in the State of Andhra Pradesh in India based on the performance of candidates in a Common Entrance Examination (CEEP). The findings appear to indicate that the CEEP is quite a useful exercise and selection of candidates through this examination is in the right direction. However, there is a need to follow up the performance of the selected candidates in the next three years to establish the predictive validity of the CEEP.

Introduction

For the first time in India, a common entrance examination for admission into polytechnics (CEEP) was held in Andhra Pradesh. The necessity to conduct CEEP was felt due to the following:

1. Candidates seeking admission passed the qualifying examinations conducted by different bodies like State Boards of Secondary Education of Andhra Pradesh and other States, Government of India, Universities etc., who followed widely differing curricula, standards of examination and methods of evaluation and it was very difficult to obtain a realistic and reliable method of ranking the applicants.

2. Candidates used to apply to many institutions and the top candidates got admission letters from two or more institutions. Vacancies arose in each institution due to movement of selected candidates and these could be filled up only after going through a very long, cumbersome and time-consuming procedure.

The Government of Andhra Pradesh, therefore, decided to conduct a common entrance test and entrusted the conduct of the CEEP to the State Board of Technical Education and Training.

CEEP procedure

Candidates who passed S.S.C. (Secondary School Certificate) or an equivalent qualifying examination securing atleast 50% of the total marks either in one or more attempts were eligible to appear for the CEEP. In the case of Scheduled Castes/Scheduled Tribes (SC/ST) candidates, the minimum total marks was 45%. The conduct of the CEEP in August, 1984 was a gigantic task for which 48,000 candidates appeared. The examination was conducted through 23 co-ordinating centres with many examination centres under each co-ordinating centre. The examination consisted of a 2 hour objective type paper of 50 items in Mathematics (separate for Engineering and Non-Engineering courses) and 50 items in Science of S.S.C. standard. Candidates scoring 30 and above of the total 100 marks were declared qualified at the

CEEP. For S. C. candidates 25 was the prescribed minimum and for S. T. candidates no minimum was stipulated. Qualified candidates were ranked in accordance with their CEEP scores. Where scores were equal, the scores secured in Mathematics, Science and Social Studies taken together in the qualifying examination were considered. In exceptional cases where all these criteria failed to distinguish a candidate's relative merit, seniority in age was used to break the deadlock.

The scripts were coded and valued at a central valuation camp by about 150 teachers from polytechnics. The valuation of scripts was done twice independently and they were tallied by a Chief Examiner. The ranking of the candidates was done by computer and the first 10,000 ranks were cross-checked by manual decoding and ranking. 39,023 candidates i.e., nearly 80% of the candidates passed the examination, details of which are given in Table-1.

TABLE 1: No. of candidates appeared and qualified at CEEP.

S. No.	*University Area*	*No. of candidates*		*Total No. of seats*
		Appeared	*Qualified*	
1.	Andhra	18,370	17,571	3,331
2.	Sri Venkateswara (S.V.)	7,525	6,803	2,386
3.	Osmania	17,579	14,649	1,704
	Total	43,474	39,023	7,421

50% of the seats were available in open competition, the rest being reserved for S.C., S.T., Backward classes (B.C.), Physically handicapped (PH), Sportsmen etc.

Scope of the study

Investigation was carried out to test the effectiveness of the conduct of the CEEP and to examine if it was after all, a painful exercise or an effective tool in selecting candidates for admission into the Polytechnics. The study was limited to the candidates of open competition.

A correlation was worked out between CEEP scores and the scores secured at the qualifying examination by all the candidates of the three University areas: Andhra, S. V. & Osmania Universities. As the previous criteria for selection of candidates was limited to the score secured in the three qualifying subjects: Mathematics, Science and Social Studies, a correlation was worked out between CEEP scores and the scores in the above qualifying subjects.

Generally, the minimum marks secured by the last candidate in open competition was about 70% in the previous years and hence the performance of the students who secured 70% and above in the qualifying examination was examined with respect to the CEEP scores obtained.

A study was also made to find the correlation between the scores in the different ranges in the qualifying examination and CEEP of all the Universities to know the rejection pattern.

Findings

(i) Correlation

The product moment correlation coefficients (r) between CEEP scores and scores in the qualifying examinations for different cases are shown in Table-2.

TABLE 2: Correlation between CEEP and qualifying examination scores

	Sample	*Correlation between CEEP scores and*	*r Value*
1.	All candidates selected.	Qualifying examination marks (total marks)	0.3966
2.	–do–	Qualifying examination marks (Group marks in Maths, Science and Social Studies).	0.4161
3.	Selected candidates who scored above 70% in qualifying exam.	Qualifying examination marks (Total marks in Maths, Science and Social Studies).	0.2660
4.	–do–	Qualifying examination marks (Total marks in Maths, Science and Social Studies).	0.2730

(*ii*) *Frequency distribution*: Table-3 shows the bivariate frequency distribution of candidates who would have secured seats by virtue of their marks in the qualifying examination and CEEP and those rejected by both the criteria.

TABLE-3 Frequency distribution of candidates appeared (Entire State)

Qualifying examination marks → / CEEP Scores ↓	Greater than 90	80–89	70–79	60–69	50–59	40–49	30–39	Total
Greater than – 90	1	2	1	0	0	0	0	4
80–89	9	60	69	33	6	1	0	178
70–79	7	206	471	336	100	11	0	1131
60–69	8	215	1251	1440	594	51	0	3559
50–59	2	112	1440	3244	2078	267	0	7143
40–49	4	71	1252	4630	5185	935	4	12081
30–39	1	40	792	4067	7077	1686	15	13698
Total	32	709	5311	14094	15637	3218	22	39023

NOTE: Total number of seates in open competition is 3710

- (right-hatched) Candidates who would have secured seats by virtue of their scores in C.E.
- (left-hatched) Candidates who secured seats by virtue of CEEP scores
- (blank) Candidates rejected by both CEEP & C.E.,
- (cross-hatched) Candidates selected by both criteria

(*iii*) *Rejection Pattern*

Tables-4 and 5 show the rejection pattern over the whole State and in each University area.

TABLE 4: Rejection pattern—whole State.

Category	*Marks range*			*Total No. of seats*
	Greater than 90	80–89	70–79	
No. who would have secured seats based on Qualifying Examination marks	32	709	2969	3710
No. who have secured seats through CEEP.	25	483	1792	3710
Number rejected	7	226	1177	1410
% rejected	22	32	40	38

TABLE 5: Rejection pattern for individual university areas.

University Area	*Total Number of seats*	*Range of marks* — *Greater than* 90%				80–89%				70–79%				*Total Number rejected*
		1	2	3	4	1	2	3	4	1	2	3	4	
Andhra University	1665	24	19	5	21%	433	319	114	26%	1208	1073	135	11%	254
Osmania Univeristy	1193	7	5	2	29%	159	93	66	42%	1027	381	646	63%	714
S.V. University	852	1	1	—	—	117	98	19	16%	734	366	368	50%	387

KEY: 1–No. of candidates who would have secured admission if admissions were based only on Qualifying Examination marks.

2–No. of candidates who actually secured admission through CEEP out of candiates in (1).

3–No. of rejected candidates.

4–Percentage of rejection.

(*iv*) *Distribution of candidates selected by CEEP.*

Table-6 shows the distribution of candidates selected by virtue of CEEP scores alone, according to University area:

TABLE 6: Distribution of candidates selected by CEEP scores alone.

University Area	*Total Number rejected by CEEP*	*Range of marks* 60-69%		50-59%		40-49%	
		Number selected	%	*Number selected*	%	*Number selected*	%
Andhra University	254	189	74%	64	24%	5	2%
Osmania University	714	537	75%	173	24%	4	1%
S. V University	387	269	70%	103	27%	15	3%
Total	1355	995	73%	340	25%	24	2%

(*v*) *Merit Listing* (*Community-wise*):

Table-7 shows the merit listing of candidates community-wise based on CEEP Scores.

TABLE 7: Merit listing (Community-wise)

Community	*Highest mark* (%)	*Highest rank*	*No. of candidates within first* 100 *ranks*
SC	85	42	2
ST	72	873	—
BC–A	85	35	2
BC–B	87	10	21
BC–C	81	134	—
BC–D	87	17	8
OC	94	1	67

SC—Scheduled Castes S.T.—Scheduled Tribes

BC—Backward classes (A, B, C & D are sub-categories based on degree of backwardness)

OC—Open Competition.

(vi) Frequency distribution (University-wise):

Table-8 shows the frequency distribution of candidates according to merit in the three university areas, based on CEEP Scores.

TABLE 8: Frequency distribution university-wise.

S. No.	Range of CEEP marks	No. of candidates in Andhra University area	S.V. University area	Osmania University area	Total
1.	Above 90%	3	—	1	4
2.	80—89%	108	25	45	178
3.	70—79%	706	163	262	1131
4.	60—69%	2060	558	941	3559
5.	50—59%	3801	1203	2139	7143
6.	40—49%	5666	2084	4331	12081
7.	30—39%	4847	2464	6387	13698
8.	25—29%	380	306	543	1229
	No. appeared	17571	6803	14649	39023

(vii) Distribution of candidates selected community-wise by CEEP.

Table-9 shows the percentage distribution of candidates selected according to community by CEEP.

TABLE 9: Distribution of candidates selected community-wise by CEEP.

Range of marks	S.C.	S.T.	B.C. A	B	C	D	O.C.
Above 90%	—	—	—	—	—	—	0.01
80—89%	0.07	—	0.29	0.49	—	0.45	0.54
70—79%	0.18	0.36	1.84	2.13	1.15	2.46	3.6
60—69%	1.27	1.8	6.82	9.20	4.61	8.0	11.0
50—59%	7.1	5.8	17.87	18.6	12.1	17.8	16.1
40—49%	24.2	20.7	32.57	32.3	33.6	32.3	32.0
30—39%	48.1	53.5	40.59	36.3	48.5	39.0	32.1
25—29%	19.2	17.8	—	—	—	—	—
	27.1	0.7	5.6	17.0	1.3	10.0	58.3

(viii) General

The first rank in CEEP is secured by a boy from the Andhra University area who secured 94%. (This candidate secured 88% in the Qualifying Examination including languages.) Out of the first 10 rank holders, the fourth rank holder is from Osmania University area while all the other nine are from Andhra University area. The highest rank scored by any candidate from S. V. University area is 16. Of the first 100 ranks, 63 are secured by candidates of Andhra University area, 23 from Osmania University area and 14 from S. V. University area. The highest rank secured by any girl is 40 who scored 85%. The number of girls who secured ranks within the first 100 is only 2. The highest rank scored by a candidate who is eligible only for non-engineering courses is 5 and he hails from Andhra University area. Out of the first 100 ranks, only 5 ranks have been secured by candidates with eligibility for non-engineering courses, the highest rank being 6 from Andhra University area.

Conclusion

From the above findings, it has been shown that about 38% of the candidates who would have secured admission into Polytechnics by virtue of their marks at the qualifying examination have been rejected in CEEP and an equal number from the lower ranges of marks have managed to get into Polytechnics by showing better performance in CEEP, probably by virtue of their higher qualifications or by taking special coaching. Hence, it is felt that the conduct of the CEEP appears to be quite a useful exercise and selecting candidates through this examination for admission into Polytechnics is in the right direction. It is hoped that a better set of students will join the Polytechnics through CEEP. However, a study of the performance of these candidates admitted to the Polytechnics will have to be made for the next three years to confirm the presumption stated above and establish the predictive validity of the CEEP.

Simulations and Games in Technician Education

C. Ramakrishna Sastri

ABSTRACT

Games and play have always interested people of all ages. In recent years, their utility as effective strategies for teaching/learning has been recognized and there is a sudden explosion of games of several varieties for educational purposes, particularly in primary and secondary education. Instances of their utilization in Higher Education especially in Technician Education have, however, been few and far between except in Social Sciences and Management Training.

This article reviews the important findings regarding the use of simulations and games in Education and explores possible applications in the Technician Education sector, with special reference to developing countries, where the need for their use appears to have a distinct priority.

Introduction

Games and play are cultural phenomena that have been with us throughout human history.' Play was seen by the social psychologist George Herbert Mead[2] as even essential to the development of the self. Further, Jean Piaget's[3] work indicates that childhood games play an important role in the evolution of intelligence. Thus, play is viewed by social psychologists and cognitive theorists as an essential element in the social and intellectual development of children. Noting the link between play and social life, John Dewey[4] advocated the use of games as an integral part of the curriculum in schools. As a result of these new perspectives, we now witness a tremendous growth of interest in educational games in the last two decades with literally thousands of such games of different varieties produced, evaluated, patented and made available for use particularly in primary and secondary education. According to Duke and Seidner[5] this increased utilization of educational games may be attributable to many factors including the coincidence of three trends: (a) the questioning of the traditional socialization of our educational institutions (b) the current emphasis on the active learner and discovery learning and (c) the appearance of a new medium, the simulation game.

Games, simulations and contests

Games are seen by Greenblat[6] essentially as communication devices and can hence be of great value to the teaching-learning process which is mainly a process of communication. Yet, the importance of games and simulation in education according to Coleman[7] arises in part from the fact that they facilitate the arbitrary setting aside of complex and deadly serious rules which govern every day life and substitution of a set of explicit and simple rules whose consequences vanish once the game is over. Nearly all games are in one sense a caricature of social life; to the players, they are also an introduction to life itself—an introduction to the idea of rules and to the idea of working towards a collective goal.

As in other areas in education, the

phenomenal growth of interest in games and simulations has led to a proliferation of terminology whose scope and meaning has not always been clearly defined. To bring in conceptual clarity and better understanding, R. Garry Shirts[8] produced a simple classification system which involves three mutually overlapping activities (a) Simulations (b) Games and (c) Contests. These intersecting activities yield seven different groups of learning strategies represented diagrammatically in Figure 1.

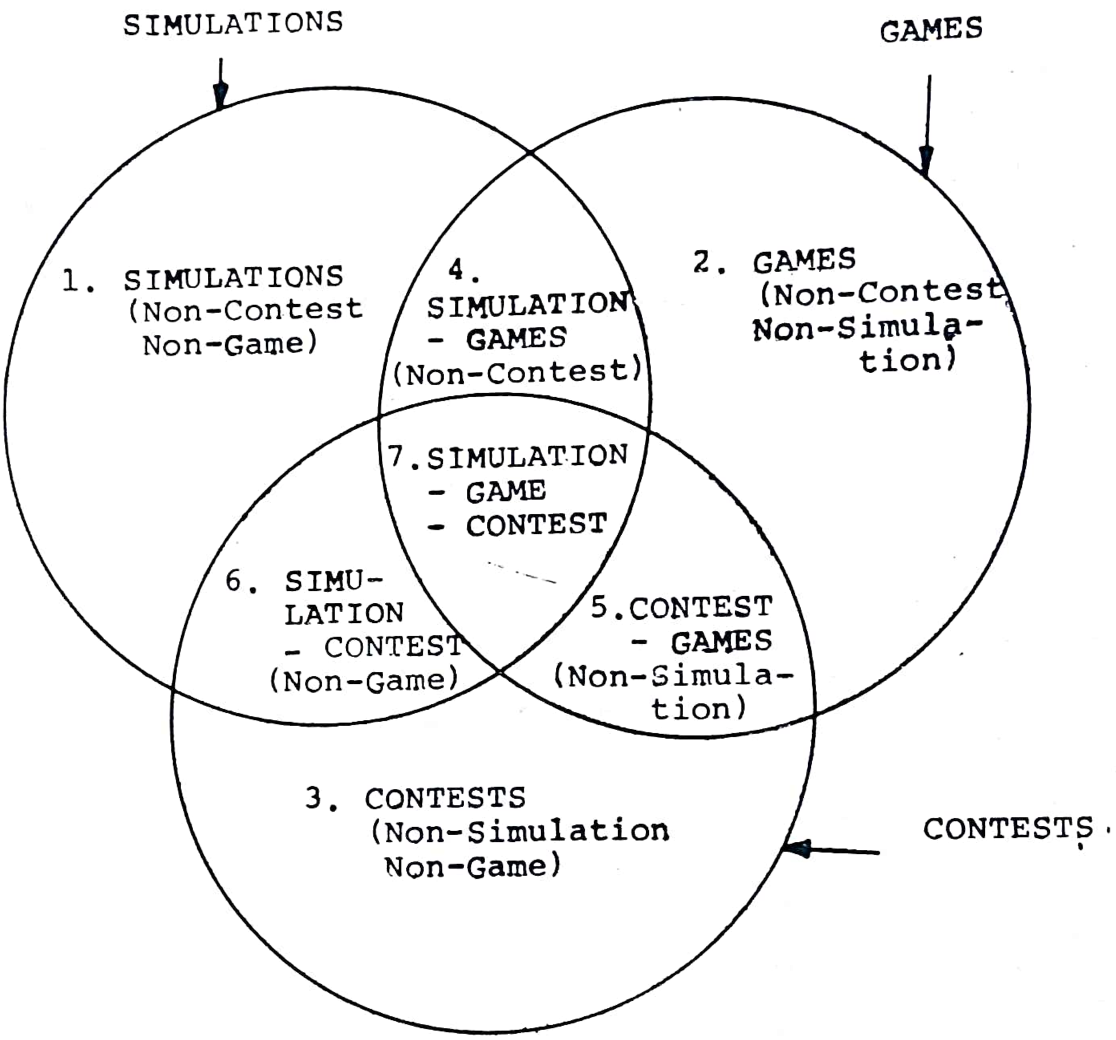

Figure 1

Examples of activities in each category have also been listed by Shirts but what is more significant is that this conceptual framework places Simulations-Games in their proper context vis-a-vis contests.

For those who view Simulations and Games as teaching strategies to achieve learning goals, this framework has another important implication. David W. Johnson and Roger T. Johnson in their book "Learning Together and Alone",[8] strongly emphasize and recommend the increased use of COOPERATION (including peer tutoring and without conflict or contest) as the goal structure which is highly effective in achieving both cognitive and affective outcomes. Several reasons are put forward in support of this conclusion, chief of which are:

1. These goal structures are easier to set up, monitor and evaluate in terms of teaching time and effort.

2. Peer tutors are often effective in teaching children who do not respond well to adults.

3. Peer tutoring can develop a deep bond of friendship between the tutor and the person being helped, a result important for integrating slow learners into the group.

4. Peer tutoring takes pressure off the teacher by allowing him/her to teach a large group of students while providing the slow learners the attention they need.

5. The tutors benefit by learning to teach, a general skill that can be very useful in an adult society.

6. Peer tutoring happens spontaneously under cooperative conditions; so the teacher does not have to organize and manage it in a formal manner.

7. Cooperation promotes the type of learning climate that makes teaching more effective and more fun.

If this recommendation is taken into account, the use of Simulations and Games in Education should largely be designed incorporating cooperative goal structures and avoiding contest and conflict which are tension producing, involve little interaction and coordination of effort, lack communication and could even lead to development of unhealthy attitudes such as dislike, hatred for winners etc.

Educational effectiveness of simulations and games

With rapidly increasing interest in simulations and games in the last two decades, questions regarding their educational effectiveness naturally engaged the attention of researchers but have only been partially answered. More wide-ranging claims about the effectiveness of games and simulations have often been made by game designers and teachers in a speculative fashion than by educational researchers as a result of systematic evaluation of specified outcomes in comparison with other modes of teaching. In an exhaustive study recently reported by Mary E. Bredemeir and Cathy Stein Greenblat,[9] the authors also emphasize the fact that in considering what we know about the effectiveness of simulations and games one should also ask "Under what conditions?" and "How can we be sure"? Clarity is still lacking in terms of "What is being looked for", "the shape of learning experience" etc., and not much realization of the fact that several factors such as "Administrative Variables", "nature of the person", "opportunities to practise", "pleasantness/unpleasantness of the experience" also significantly affect evaluation of 'a' simulation game, not to speak of simulation games in general.

The various claims made about the effectiveness of simulations and games (mostly through anecdotes offered frequently as evidence) according to Greenblat[10] could be classified into the following six categories:

1. motivation and interest

2. cognitive learning

3. changes in the character of later course-work

4. affective learning re: subject matter

5. general affective learning and

6. changes in classroom structure and relations

Evidence as available so far supports the following significant findings:

1. There is an increasing amount of positive data on the effects of teaching with games.

2. Where the evidence does not reveal benefits of gaming techniques over other modes of teaching, neither does it show the reverse.

3. Results from studies with particular games cannot be generalized to "learning with games in general".

4. The quality of evaluative research seems to be improving as researchers become more sensitive to the methodological conditions that yield valid and reliable results. Yet one of the problems that persists is that many users of simulations do not wish to evaluate its learning possibilities separately from the other strategies which make up the "teaching unit" in which it is included. They would argue that simulation acts as a stimulus to subsequent learning and that this spin-off interest can properly be considered as part of the benefit of the technique.

5. There is a substantial body of impressionistic evidence in support of the claim that simulation-gaming teaches facts, concepts and procedures more effectively than conventional techniques. However, the 'hard' evidence favours this technique over conventional methods only with respect to "retention" of what is learnt.

6. Although simulation games are widely believed to have great potential in the area of affective learning, assessment of the effects of simulating-gaming on attitude show a checkered pattern. It suggests that under certain circumstances and for some students, simulation-gaming can be more effective than traditional methods of instruction in facilitating positive attitude change towards the subject and its purposes.

7. It is often found that participants in a simulation/game develop a variety of self integrating outcomes including self-awareness, greater sense of personal power or self confidence, tension-release, more confidence in decision-making abilities etc.

8. In course evaluations using simulations and games, students frequently mentioned the experience as outstanding, reported high satisfaction with the course and perceived the experience as having stimulated their motivation and interest. Several studies support this impressionistic and testimonial evidence although little is reported about the "whys" of motivation and interest stimulation.

9. With regard to changes in learning atmosphere and character of course work resulting from the use of simulation games, three types of claims are made: (1) the course work becomes more meaningful (2) students participate more openly and vigorously and (3) the quality of inquiry is more incisive. Evidence available supports these claims and particularly shows that (a) the experiential learning enables participants to generate ideas, see, feel and interact with meaningful problems (b) changes in classroom structure and relations include more relaxed atmosphere, reduced social distance and more open and vigorous communications and (c) more relaxed social relationships among students and between students and instructor.

Unsolved problems and issues

Although the amount of work done in this emerging field is quite impressive, many unanswered questions still remain. According to Bredemier & Greenblat[9], we still do not have (1) a theoretically based taxonomy of games and (2) clear theories about (a) What aspects they are expected to have (b) What sort of distinct effects (c) On what sort of students and (d) For what reasons. Greenblat,[10] also lists the following unanswered questions which must engage the attention of future researchers:

- What harm is done by bad games/simulations?
- How do variations in teacher behaviour and attitude affect game operation and learning from the experience?
- What kind of game is useful for what kind of learning?
- How can we understand the asymmetrical learning experiences of students who participate in the same game?
- Who dosen't like games and who don't learn from them?
- How many games can be used effectively within a given group?

Scope for accelerating the use of Simulation/Games in education in developing countries

The lack of clear theories and taxonomies notwithstanding, even the little evidence of the educational effectiveness of simulations and games clearly justifies their greater use and application in developing countries, which are seeking to modernize their educational systems on a priority basis. The general situation in most developing countries in the Asia-Pacific region is largely characterized by:

- increasing student enrolment especially in Technician courses
- institutions inadequately equipped and under-staffed
- teaching staff insufficiently paid and lacking in competencies to provide appropriate learning experiences to students
- heterogeneous groups of students in classrooms largely from middle and lower middle class socio-economic groups and lacking in proper levels of motivation

Studies available from India (11 & 12) report these problems which are typical of many of the developing countries. The advantages of using simulations and games particularly in improving retention, enhancing motivation, reducing tension in the classroom, developing self-confidence, team-spirit and problem solving skills etc., cited above clearly point to the urgent need to embark on a massive effort to exploit these advantages to improve educational systems in developing countries. It is unfortunate that in many of these countries the use of games and other playway methods is still limited to kindergarten and primary schools and has not made much headway even in secondary education, let alone Higher Education and the University sector excepting in Management Education and partly in Social Sciences. Massive industrialization efforts in many developing countries have in recent years shifted the focus of attention to technician and vocational education, where the need for working in simulated industrial/shop floor environments and development of problem solving skills is critical. The use of simulations and games to develop these higher order abilities in a relaxed atmosphere by facing realities through a game exercise is hence all the more greater in technician courses.

Use of Games/Simulations in technician courses

Judging from the vast potential of simulations and games in Education as discussed above and analyzing the nature and content of technician courses currently available in developing countries, it appears that these strategies could be used in Technician Institutions in the following broad areas:

(*a*) To develop a deeper understanding of concepts, principles, laws, procedures and practices in technological subjects through simple Frame Games (card games, crossword puzzles, snakes and ladders games, mazes etc.)

(*b*) To enhance design, fault finding and problem solving skills through games, simulating live field and shop floor situations.

(*c*) To develop appreciation for industrial safety, team-work, proper work attitudes and habits through competitive group games.

Some suggested applications in each of the above areas with reference to the main Technician disciplines available in developing countries are presented in Table 1 with a view to stimulate thinking in this direction. Examples of some games already available are also provided for reference and these could be procured and used in the original form or modified suitably to meet local curricular requirements.

Conclusion

Before concluding, it may be emphasized that "gaming is serious, it is too important a pedagogical tool to be treated as a fad or allowed to go unchecked, uncriticized and unevaluated". The growing interest in this area gives a positive hope that it will be soon established on a sound footing with proper theories and supporting evidence. Yet, the scope and need for utilization of games and simulations, especially in Technician Education appears to be much more in developing countries than in the developed Western countries where much of the research is now concentrated. It is hoped that educationists in the developing countries would soon come forward to contribute and benefit more from the potential of this powerful educational tool.

TABLE 1: Some possible applications of Simulations and Games in technician education.

Subjects	(*a*) *Frame Game*	(*b*) *Simulation Games*	(*c*) *Appreciation Games*
1. *General Subjects* Languages, Mathematics, Physics and Chemistry	1. Games to enchance technical vocabulary — Card games to improve grammar.	—	—
	2. Mathematical games to develop concepts of differentiation and integration, solution of equations etc. (Ex. Magic Squares, Tic-Tac-Toe, Dominos, Bingo etc.)	Games for practising manipulative skills and problem-solving approaches.	—
	3. Games in chemistry on Periodic Table, Chemical Formulae etc. (Ex. Chemsyn, Formula, Ionic etc.)	—	—
2. *Civil Engineering*	1. Games to teach structural properties of materials and their relationships.	1. Simulation games to study alternate plans and room arrangements for residential flats.	1. Games to develop appreciation for ecology, urban planning, land usage etc. (Ex. Urban Simulation, New Town, Land Development, Rapid Transit etc.)
	2. Games to teach different types of Brick bonds.	2. Games to consider factors affecting design for irrigation works, water supply schemes, R.C. structures etc	
	3. Games to teach procedures for Surveying, Estimating, Road and Railway Construction etc.	3. Games to analyze failure of structures to locate causes	

Subjects	(*a*) *Frame Games*	(*b*) *Simulation Games*	(*c*) *Appreciation Games*
3. *Mechanical Engineering*	1. Games to teach correct procedures (dos & dont's) for basic machine operations in the workshop, assembling and dismantling of equipment etc. 2. Games to develop concepts in Thermodynamics and Theory of machines. 3. Games to teach principles of Hydraulics and Hydraulic machinery.	1. Games to teach Fault Finding in Automobiles, engines, mechanisms etc. 2. Simulation games on Hydraulic and pneumatic controls. 3. Games to stress factors affecting design of machines and machine elements.	(*a*) "In basket" games to teach Management Skills. (*b*) "Prisoner's Dilemma" to stress need for co-operation and team work. (*c*) "Crisis Games" to impart survival techniques in case of crisis. (*d*) "Fish Bowling" to develop problem solving skills.
4. *Electrical Engineering*	1. Games to teach operational principles of electrical machines. 2. Games to develop understanding of Power System Operation and economics of transmission & distribution. 3. Games to develop ability to analyze electrical circuits.	1. Group games to teach logical procedures for fault-find ing in electrical equipment. 2. Games to teach factors affecting substation location and layout design. 3. Games to stress effects of power tariffs and their implications.	Same as above.

5. *Electronics Engineering*	1. Games to develop understanding of electron motion, dynamics and semiconductor principles. 2. Games to emphasize basic principles of Radio, Radar, T.V. and Computers. 3. Games to match component properties and their applications. 4. Games to stress principles of control, stability etc.	1. Games to develop skills in fault-finding in electronic circuits. 2. Games to study implications of component criticality in electronic circuits and systems. 3. Games to assess impact of electronic gadgets and systems on society, Economics, Living Standards, Entertainment etc.	Same as above.

REFERENCES

1 BETTY WATSON-"Games and Socialization" in "Gaming-Simulation:Rationale, Design and Applications" by Cathy S. Greenblat and Richard D. Duke, Sage Publications, 1975.

2 GEORGE HERBERT MEAD-"Mind, Self and Society" University of Chicago Press, 1934.

3 JEAN PIAGET-"Play, Dreams and Imitation in Childhood" W. W. Norton, New York, 1962.

4 JOHN DEWEY-"Democracy and Education" Macmillan, New York, 1928.

5 RICHARD D. DUKE AND CONSTANCE J. SEIDNER-"Learning with Simulations and Games" Sage Publications, Beverley Hills, California, U.S.A. 1978.

6 GREENBLAT, CATHY S. AND RICHARD D. DUKE-"Gaming-Simulation: Rationale, Design and Applications" Sage Publications, 1975.

7 Coleman, James S-"In Defence of Games". *Ibid* (6).

8 JOHNSON DAVID W. AND JOHNSON ROGER T-"Learning Together and Alone—Cooperation, Competition and Individualization" Prentice Hall Inc., U.S.A. 1975.

9 BREDEMIER, MARY E. AND GREENBLAT, CATHY S-"The Educational Effectiveness of Simulation Games: A Synthesis of Findings" in Simulations and Games Vol. 12, No. 3, September 1981 pp. 307-332.

10 GREENBLAT, CATHY S-"Gaming Simulations for Teaching and Training", *Ibid* (6).

11 CHANDRAKANT, L. S-"Polytechnic Education in India" D. B. Taraporevala Sons & Coy, Bombay-1971.

12 T.T.T.I., CALCUTTA-"Profile of Polytechnic Teachers in India" Research Report under UNDP Project-1984.

RESEARCH ABSTRACTS

B. G. Barki, Effective Student Participation in Laboratory Work, TTTI Madras 1983.

Objectives

The objectives of the research project were

1. To find out the extent of student involvement in laboratory work.
2. To find out the reasons, if any, for the lack of effective student paticipation in laboratory work.
3. To suggest ways and means for improving the extent of students' participation.

Methodology

The study was limited to only polytechnics in the State of Kerala. 205 students were randomly selected from the four Polytechnics. Questionnaires were used to collect the relevant data. The questionnaire was designed to elicit information about the adequacy of equipment and maintenance, guidance received from the faculty in respect of laboratory work and assessment procedures. Some students were also interviewed. The data obtained covers only three disciplines viz. Civil, Mechanical and Electrical.

Findings

The following were the main findings of the study:

(*i*) Student participation in laboratory work in polytechnics is far from satisfactory. Students are not fully satisfied with the extent of their participation and have expressed a desire for better participation.

(*ii*) The following are some of the important causes for ineffective student participation:

(*a*) inadequate teacher guidance

(*b*) unsatisfactory assessment scheme followed for practical work.

(*c*) unsatisfactory grouping system

(*d*) inadequate opportunity for individual work in the laboratory.

The following steps have been suggested for improving the participation of students:

(*i*) To evolve a scheme of assessment of laboratory work taking into consideration the records maintained, procedures followed, objectives of the exercise and attitude exhibited.

(*ii*) The equipment must be properly maintained. Cleaning and servicing the equipment should be attended to. Top priority should be given for this.

(*iii*) The number of students in each group should be reduced to six per group for effective laboratory work.

(*iv*) Teacher guidance must be provided for all aspects of laboratory work, not merely in doing calculations and writing the record. □

BHAT N. R. and BRAHADEESWARAN D., Evaluation of the course on 'Instructional Design and Implementation' for Vocational Teachers of Vietnam, T.T.T.I. Madras, 1985.

Objectives

A course on 'Instructional Design and Implementation' was conducted from 7th January 1985 to 27th April 1985 by T.T.T.I. Madras for the teachers of the Vocational School of the Vinh Phu Pulp and Paper Mills, Hanoi, Vietnam. An evaluation study of the programme was conducted with the following objectives:

1. To collect and provide evaluative information to the course faculty and the participants for making the necessary mid-course modifications to improve the effectiveness of course implementation (Formative Evaluation).

2. To provide evaluative information to the Institute and sponsors of the programme about the overall effectiveness of the course (Summative Evaluation).

Methodology

The evaluative information was collected from the following sources:

- Course participants
- Course faculty
- Consultants representing the sponsors
- Course materials and outputs.

The methods and tools used in evaluation were:

(*i*) Individual discussion with course faculty of each subject on completion of one-fifth of the total number of sessions allotted to the subject.

(*ii*) Interview with a sample of 40% of the participants before discussion with the faculty, using an interview schedule.

(*iii*) Feed back questionnaire to the participants on completion of each subject.

(*iv*) Feed back questionnaire to the participants on completion of the whole course.

(*v*) Feed back questionnaire to course faculty on completion of the course

(*vi*) Periodical discussions with the consultants representing the sponsors.

(*vii*) Analysis of the course materials and outputs by the evaluators along with the Course Director.

Both qualitative and quantative methods were used for data analysis, as required. The information collected from various sources was triangulated to validate the conclusions drawn.

Findings

The salient findings are given below:

(*a*) *Formative evaluation*

Certain specific aspects that required modifications in course implementation and which were conveyed to the course faculty for necessary action were:

(*i*) Provision of a glossary of key terms along with each or a set of handouts in the subject 'Principles of Learning'.

(*ii*) Extensive writing of key points on the chalk board during lecture/discussion sessions.

(*iii*) Repeating the class room questions two or more times to facilitate comprehension.

(*iv*) Formation of small groups for observing demonstration of photographic processes in the Educational Technology Laboratory.

(*v*) More emphasis on 'display techniques' in the subject 'Instructional Media and Materials'.

(*vi*) Provision of more time for micro lessons in the subject 'Instructional Techniques' in view of the communication difficulty of participants.

(*b*) *Summative Evaluation*

(*i*) The participants agreed with a high degree of consistency that, with regard to all subjects, the course content was relevant and adequate, course duration was adequate and scheduling was appropriate.

(*ii*) In certain subjects (which are identified), provision of a little more time would have facilitated easier learning.

(*iii*) The language of the instructional materials in certain subjects could be simpler.

(*iv*) The participants were unanimous in stating that all aspects of course work were useful and interesting, grading was objective and the course objectives were achieved.

(*v*) The course outputs of participants were of good quality and were expected to have good utility value in their own local setting.

(*vi*) On the whole, the course was conducted well and was effective in meeting the requirements of the sponsors. □

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The first issue of the JOURNAL has been well received. The response to the second issue from the various contributors is very encouraging.

Contributions are now invited to the NEXT TWO issues on any topic relevant to the objectives of the Journal. These may be sent to the Managing Editor to reach him by MAY for the *Summer* issue and OCTOBER for the *Winter* issue.

NOTES FOR CONTRIBUTORS

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The authors are requested to note that the Journal aims at a wide international readership of varied societal and cultural backgrounds. They are, therefore, encouraged to point out in their contributions the relevance of their results and insights to technical and vocational education systems, other than their own.

In the case of research reports, the emphasis should be on applicable research of national and international interest.

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Manuscripts for publication should be sent to Prof. T. Subbarao, Managing Editor, by name. Only original articles will be accepted and the manuscripts should be in English. They should be typed on A-4 size paper, double-spaced, on one side only with wide margins and submitted in triplicate. Normally, the manuscripts should not exceed (20 typed pages) 3,000 words.

Photographs, drawings, cartoons and other illustrations are welcome. All illustrations and tables for publication should be submitted in separate tracings suitable for printing.

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