offer their strengths to earn the enhanced funding.

The Private Sector

Private sector initiatives in technical education are just over a decade old, and most of their resources are derived from donations and tuition fees. Their principal activity is undergraduate education, and the opportunities for additional resource generation are very limited. It takes a considerable amount of time before competence, expertise, and infrastructure are assembled and developed to such an extent that industrial research and consultancy can be offered.

It is in this context that industry partnership and sponsorship are essential for technical education. Government incentives to industry for promoting technical education and R & D are positive factors, not only for resource management, but also for making the educational processes effective, relevant, and purposeful.

IMPLICATIONS OF THE 1993 DRAFT TECHNOLOGY POLICY

This policy statement gives more importance to technology inputs and technologists than earlier policy statements. While it is necessary to increase the percentage of the GNP deployed for research and development, mechanisms must be evolved to ensure maximum effectiveness of these inputs. In addition to devoting attention to the input side, it is also necessary to monitor the outputs, both in terms of the quality and quantum of outputs and results.

The 1983 Technology Policy Statement observed that "technological advances are influencing life-styles as well as societal expectation." Technology policy should make contributions in both areas, by promoting those that result in wholesome lifestyles and tempering societal expectations in consonance with our meager resources and our ability to distribute them equitably among our people.

The recent United Nations Development Program Report on global development has bemoaned the "jobless growth" currently characterizing the economies of many countries. The principal expectation of those in our population who pursue professional education is preparation for employment. Educating and training the country's population without simultaneously creating employment potential and opportunities will lead to social and societal discontent, frustration, chaos, and anarchy. The critical index of development is the number of jobs created per thousand population, not the total number of educated and trained manpower, not even the total number of jobs created.

Our technology education system needs to be re-engineered, keeping our resources, our needs, and our goals in focus. We also need to forge strategic and organic alliances and partnerships between industry, academe, and the government to achieve synergistic results.

Dr. Natarajan is Professor of Mechanical Engineering and Director of the Indian Institute of Technology, Madras, India.
This is based on a presentation at the second Jerusalem International Science and Technology Conference in Israel, January 1996.

4. Science and Technology Education Sponsored by an International Organization

by Silvio Schlosser and Baruj Zaidenknop

ORT Argentina is an organization of the World ORT Union, the largest nongovernmental training organization in the world as well as a worldwide Jewish charity that assists disadvantaged individuals and communities to become self-sufficient. ORT is best known for educating and training people in skills that will provide them with sustainable employment in today's and tomorrow's marketplace. Founded in 1880, ORT (Organization for Rehabilitation through Training) now has programs established in more than 60 countries,including the United States, Israel, and China. It also teaches and trains more than 250,000 people in its schools and colleges annually.

ORT uses the most up-to-date methods and equipment to train students for careers that will make them independent and contributing members of their society. As a truly independent organization, ORT has the freedom to pioneer new ways of teaching and training both students and teachers. Its schools often lead the way in education, and since it is an open organization, everyone across the world can benefit from innovations.

There are two ORT technical schools in Argentina whose curricular innovations and reforms are the results of careful analysis. Experts study the social and economic situation of the country and the demands of the productive and academic sectors on the educational system, particularly the technical high school area. An important part of the curricular reform process is the application of a classroom-workshop methodology in technological education combining the contributions of technology with work carried out with not more than 15 students per teacher.

The technological process here is conceived as a process of creation motivated by man's natural wish to find ever newer and better ways of satisfying human needs. It involves decision making, the analysis of alternatives, planning design, and a careful evaluation of costs. During the stage of production proper, the product that has been designed takes form. Final evaluation includes the feedback of the entire process and whether the original motivational force has been satisfied.

But the result of the technological process largely depends on the know-how that has to be added to the wealth of techniques, materials, and devices of proven usefulness. The whole training process in the technological area is characterized by a high level of integration of technical and scientific areas by the rapid succession of modifications required by society. Science-Technology-Society (STS) forms an inseparable unit in current technical and techno-

logical education.

In our technological junior high workshops, students aged 12 through 15 become acquainted with processes designed for widely varied applications. They learn to handle materials and transform them into final products in a carpentry workshop; embark on the process of technical design in a science and technology workshop; and develop a creative attitude toward technology as a creative process in expressive workshops. In a mechanic workshop they develop psychomotor aspects using techniques and dexterities related to metalwork, with very strict "tolerance limits" and safety measures. They learn to design, produce, operate, and troubleshoot electric circuits in an electrical workshop, and they engage in observation, analysis, and production of electronic devices in an electronics workshop.

ORT Argentina's technical schools have other unique workshops. The computation workshop deals with important attitudes. As computers are increasingly used in all the branches of human activities and hardware and software evolve, creative attitudes of adaptation are required. A mass media workshop teaches the creative and critical appreciation of the messages of social communication. In an integrated technology workshop, independent work stations are equipped for the design and development of experiments, problems and possible solutions in numeric control, industrial automation, automatic control of continuous processes, flexible production systems, and robotics. The work done here is considered "integrated experimental science" and includes mathematics, mechanics, electricity, electronics, computers, and science and technology. The final project workshop, another ORT innovation in Argentina, is an integrated activity: the students go through the stages of conception and design, feasibility, documentation, programming, manufacture, evaluation, and feedback. Under the watchful eye of the workshop teacher, the student chooses a subject and integrates the information and skills learned in different areas and subareas of the technical junior high.

We believe that a solid background of ethics and moral values is needed to complete the education of our youngsters. Therefore, together with technological training, our schools deal with ethical codes by which to regulate their decisions, mostly through Jewish education. Here again ORT's programs are unique, since ours are the only technical schools to include such subjects in the official curricula and to attach equal importance to science, technology, humanities, and ethics.

The changes wrought by this new technical junior high since 1988 have been enormous, and after some years the time was getting ripe for further changes.

Growth of ORT Argentina's Technical High Schools

ORT Argentina's first technical school, now operating within the Argentine network of private schools for well over 30 years, originally offered just one track—electronics—and a curriculum similar to the other technical schools. This was the first of a series of purely technical and technological tracks, very much consistent with ORT Argentina's mission.

ORT Argentina's two technical schools, each of which serves 2,000 students, currently offer the following tracks:

- **School No. 1**

  Electronics, chemistry (laboratory and biotechnology), construction, business studies, musical production, computers.

- **School No. 2**

  Business studies, computers, electronics, mass media, industrial design.

Among those listed are four innovative and creative options introduced in the last 10 years to respond to the needs of the students' new reality: mass media, industrial design, musical production, and business studies.

Some Characteristics of the New Tracks

The students in the mass media track are taught skills in planning and developing program production for the various media, which implies the general elaboration, filing, and the systematic preservation of audiovisual material. They learn to produce programs; design and produce different communications pathways; analyze and evaluate communication programs and establish patterns to improve them; handle graphic, sound, visual, and linguistic communication codes; design and project the suitable productions by means of new codes and contents; and work in communication systems (photography, radio, cinema, television, magazines, newspapers, etc.) using all sorts of languages. To make this possible, the school offers a state-of-the-art television studio with an editing island, a photo lab with 16 work positions, and four radio studios with professional consoles and other first-class equipment.

The business studies track confronts the students with learning situations and up-to-date criteria for the use of computer science as a tool for their professional and technical training. Students are trained to do clerical work in industrial and commercial enterprises, banks, and public administration offices; to serve as assistants to certified public accountants in market or business research; and to give support in home and foreign trade to public and private entities.

After three years with a very intensive curriculum of over 50 class hours per week, the industrial design graduates can enter the marketplace and/or continue their studies at colleges or universities. They are expected to understand the basic contents and applications of science, to recognize the value of scientific processes for problem solving, and to understand the relationship between science and technology and between the need to know and the satisfaction of needs, combining their logical capacities and scientific skills with the use of the ever-changing technological tools of their specialization. They can use mathematics, understand and make themselves understood in two foreign languages, and handle expressive languages and information in order to gain access to, produce, and convey technical and cultural production. Students come in contact with professional practices at school through situations that are similar to the ones they will encounter in their technical and professional life. They can design and carry out the production of objects that respond to different demands through the application of new technologies and analyze the requirements for the realization of products of all sorts. Such a strict preparation is related

to a series of fundamental distinctive features in training: students are taught to analyze and synthesize; to use formal logical and mathematical reasoning; to form work teams; to develop visual representation and graphic, verbal, and written expression; and to plan and anticipate results, unexpected difficulties, and alternative solutions.

The fourth special track is musical production. The economic and cultural transformation of contemporary society all over the world has given rise to new demands and requirements from the school systems as well as new occupational profiles that were unknown in society barely a few years ago. The musical production projects increasingly require state-of-the-art technologies both for the process of musical creation itself and for the production of records, cassettes, laser, video-laser, sound tracks for videos, moving pictures, and "live" productions. The action of a technician in musical production is becoming increasingly necessary for the planning, production, and diffusion of music. The musical production track makes good use of educational technology during the learning and teaching processes. It also applies the classroom-workshop methodology and combines technology with work in small groups: not more than 15 students per teacher. The technological impact is very clear in this track and redefines and demands the permanent updating of the curricular contents and methodology of work.

In these four special tracks as with all the other tracks, students must successfully carry out a comprehensive work before graduating (usually in response to the needs of some outside institution or enterprise), integrating the knowledge and the methodological instruments acquired during their senior high. This is also innovative in Argentina. Exhibiting mature and professional attitudes, students develop projects they propose, seek advice from experts, do research into the relevant field of knowledge, and discuss their project with other people in an atmosphere of responsible freedom, supervised by a teacher. By the end of the year the student's project is evaluated by a panel formed by the teacher, other experts and/or users of the project's products or results, external professionals, or experts from the enterprise the project has been designed for. For a project involving devices with medical applications, for example, a doctor reviewed the work. Every year the schools exhibit the work of the students, even beginners, in an open exhibition that has proven to be increasingly successful.

Teaching Materials and In-Service Teacher Education

ORT's program is also unique in that it prepares the teaching materials it does not readily find, and experts in the Jewish Education Department, for example, together with experts from ORT Argentina's Teachers Training College of Jewish Education, have prepared books on the Bible and Jewish history, including very specific materials for the 500th anniversary of the expulsion of Jews from Spain. These books were widely appreciated within the Jewish educational network in Argentina, while Brazilian, Uruguayan, and Venezuelan Jewish schools have also asked for copies for their students and teachers.

Two other departments of ORT Argentina are specifically devoted to the production of teaching materials: the Creative Education Department and the Technical and Pedagogical Office. To these we have to add all the pedagogic resources and teaching materials produced by the teachers of the schools themselves, particularly in the areas of science, technology, and integrated experimental sciences.

In view of our fast-growing student body, the new tracks offered by our senior high, the incorporation of new teachers and new equipment, with ever newer and more modern technology, the changes in the curricula, and the new teaching modalities—in short, the growth and development of all the branches of its educational activity—ORT Argentina came up with still another new proposal: the creation of a summer school inservice for teachers. The objectives were many and varied:

- To establish a systematic mechanism to upgrade ORT Argentina's 750+ teachers.
- To consolidate and spread ORT Argentina's methodology.
- To update curricular contents, improve techniques, and facilitate classroom work.
- To foster an attitude of permanent education in the teachers.
- To contribute to the self-esteem of the teachers and to their sense of belonging to the institution.
- To improve the quality of the teaching-learning process and the interpersonal relations in classrooms, labs, and workshops.
- To retain the better teachers in ORT Argentina.
- To foster research work and permanent education.

Status Achieved

ORT Argentina's work has been tremendously successful. Originally a small technical school with lower-than-average students, it is now the leading technical school in the country: a leader in curricular modifications, in number of students, and in the creation of new tracks. This has been achieved through serious thinking, fore-thinking, and administration.

Summing up, the following are the noteworthy elements of ORT's uniqueness:

- A classroom-workshop methodology.
- Its technical junior high.
- Four special workshops: computation, mass media, integrated technology, final project.
- The introduction of humanities in technical schools.
- Four pioneer tracks: mass media, business studies, industrial design, musical production.
- The special curricula and teaching materials.

We have managed the following in our schools:

- To succeed in transferring scientific concepts to the classroom, which necessarily implies a continual exchange with scientists to help our teachers and students process the information accurately and respectfully.
- To establish a suitable environment beyond the formal and informal regulations issued by the authorities. The concept of institutional environment must include the student, not only in his or her capacity as a learning individual but also as a subject who can interact and generate knowledge.
- To assist the teachers in the ORT Argentina network to gain greater professional esteem through up-

grading and updating courses and seminars.

It has been said that in order to reach development and economic power in the 21st century, manual work and a good supply of raw materials won't be enough: we will need to apply the resources of the human mind. Knowledge is never depleted, as are capital and raw materials. There is no single recipe to produce the sought-for economic changes and social welfare. Whatever the strategy, the solution will have to be achieved through education, research, and the development of technology. And this is the road that ORT Argentina has chosen.

Mr. Schlosser is General Director of ORT Argentina, Buenos Aires. Mr. Zaidenknop is Deputy Director of ORT Argentina.

5. Preparing Technical Educators for Interactive Instruction

by Patrick H. O'Neill

This paper highlights new methods in teaching strategies utilizing state-of-the-art technologies. It is based on experience in classroom instruction and learning at a regional vocational school and is applicable at various levels of education in technology and for work.

BACKGROUND

At Southeastern Regional Vocational-Technical High School, a regional comprehensive secondary school located in South Easton, Massachusetts, students graduate with a diploma from the Department of Education, Commonwealth of Massachusetts, and a competency-based trade certificate. The school serves some 1,300 students who come from multicultural backgrounds as well as various socioeconomic communities ranging from high to low income and high to low crime influence.

The guiding concept for the developments is to position the school to meet the demands of a rapidly changing workforce. Recently, the school began Phase 2 of a 5-year strategic plan to integrate all academic offerings with vocational-technical programs. This includes eliminating the general track and introducing more outcome-based practical application course content. An ongoing part of the strategic plan provides for the faculty to receive advanced technological training and interactive tools and strategies to create the environment of a 21st-century classroom.

This is done because we believe that effective teaching should mirror effective learning. Unfortunately, educators have not mounted a serious effort to organize teaching around the learning process. Instead, education has been viewed as an institution or an administrative system or set of instructional techniques. The ultimate act of restructuring is to change the process of instruction and its related acts (planning, curriculum design, and assessment) so they best reflect what we know about learning.

STAFF DEVELOPMENT FOR INTERACTIVE TECHNOLOGY

Faculty training initiatives include the establishment of a Teacher Technology Center that provides training in both Macintosh and PC operating systems and applications. Over 200 teachers attended courses in 1996. In addition, courses in current education research and trends and techniques of updating classrooms are offered on-site by several nearby institutions of higher education.

Faculty and staff are encouraged to explore innovative programs and methods, a strategy which leads to teacher empowerment. Teacher empowerment has led to the creation of teams that design strategies to correct recognized problems in an efficient manner. One instance resulted in students successfully taking ownership of their own learning and daily performance. Class work has become more personalized or customized so students could find lessons more interesting and rewarding. An element of cooperative learning was introduced to increase students' responsibility for learning by holding the student accountable for group participation and requiring the student to assist in helping others learn.

Planning for technology implementation has been an ongoing process at the school since 1992. Community members, faculty and staff, current students, and graduates all serve as advisors on the application of technology in both academic and vocational areas. Consequently, Southeastern has planned to include interactive technology into its system until every program and teacher is equipped to deal with the technological demands of classrooms of the future. The school has utilized talents and expertise from within and has researched the product line of many vendors to assemble a system that will grow with its needs as it advances into the 21st century. A key to planning lies in the belief that the best vision of technology in education is one where technology is used to support the overall mission of the school system.

EXEMPLARY PRACTICES

The Graphic Communications program with state-of-the-art equipment is comparable with today's industry standards. Each component in the production process is computer generated with Prepress, once done in a darkroom, now done in a chemical-free computer room. Prepress system assignments are generated by the instructor in Quadra 700, and students use Power Macs to set print and lay out design. A display on 21" monitors allows for clear interpretation of the print. Tektronix color printers, QMS tabloid printers, and an AGFA Imagesetter produce quality print that meets industry standards. Software used in the program is of current industry standard and includes Adobe Photoshop, Adobe Illustrator, Corel Clip Art CD, and Kodak Photo CD. The CD output can be viewed by students on a 27" JVC monitor as well as LCD overhead panels and a 4000 Lumen overhead.

Students in Building Trades receive