TECHNOLOGY *and* *General Education*

By John W. Sinn and Russell R. L. Laird

The signs are all around us. Productivity and quality have slipped and may be continuing to decline around the world. Energy and other resources continue to be consumed at an alarming rate, despite their obvious scarcity. The overall quality of life seems to be eroding, world wide.

The democratic social order in a machine age is impossible unless the members undertake self-cultivation on a large scale. Can this be done? Differences in brains and talent cannot be denied, and fortunately do not have to be. Individuality and excellence do not prescribe in advance any one particular combination of talents, all they ask for is the full exploitation of the capacities the person happens to have.

The great sin is not lack of brains, but lack of cultivation is a principle and a promise that the science of education is obligated to redeem, and there is reason to believe that it can redeem it.[1]

Nearly everyone agrees that education is part of the problem. Warnings about the quality and content of education appear in media reports almost daily.[2] Such reports typically call for massive overhaul of the education system in order to prepare people for the future. One report points out that low-skilled workers will not be needed in the future, no matter how hard they are willing to toil.

While it was once possible for people to succeed in this society if they were simply willing to work hard, it is increasingly difficult for the poorly educated to find jobs. A growing number of permanently unemployed people seriously strains the social fabric. A heavily technology-based economy will be unable to invest vast sums to maintain people who cannot contribute to a nation's productivity.[3]

Students must gain knowledge about the design and function of technological systems in order to understand technology and control it for everyone's benefit.

This highlights the need to make education more technologically relevant. But how can we accomplish this nearly revolutionary change in the world's educational systems?

Allen P. Splete thinks that the undergraduate program is the logical place to begin to address the problem.

Because the technological methods and problem solving techniques of the engineer are so much a part of our society, we need to educate our undergraduate students about them. This requires much more than simply making our students "computer literate." It is time for educators to rethink and refocus the traditional liberal arts curriculum to include the study of technology. In addition to introducing them to the traditional methods of inquiry of the social sciences, humanities, and natural sciences, we need to help students develop the skills of *technological* reasoning and decision making. This is important now, but it will become imperative as technology becomes an increasingly powerful force in society.[4]

One can only wonder how much more forceful technology can and should become in society! It is significant to note, however, that Splete expresses concern not only about the methods and techniques of technology, but also about its relevancy within the traditional educational system.

Two Cultures?

Equally as telling is Westheimer's observation about C. P. Snow's two cultures in relation to the undergraduate university experience:

We are educating our students to fit into C. P. Snow's two cultures: one group in humanities and an entirely different group in science and technology. But this division is lopsided; in the better colleges at least, students in science find out something about the modern technological world and in addition learn a modest amount about the humanities and social sciences. The humanists cannot make a reciprocal claim, nor can many of the social scientists. The problem is compounded because we pretend that we really are providing a liberal education for all of our students; we pretend that our graduates have a common core of knowledge that embraces both cultures.[5]

Is it responsible for colleges to be graduating a dual class of citizenry and thinkers? Shouldn't all liberally educated individuals have a reasonable understanding of technology?

Certainly this does not imply that students should cease to study humanities and the arts as part of a liberal education. The values taught by traditional liberal-arts studies must be held in high esteem. But these studies form only part of the education necessary in an age of technology. Students must also gain knowledge about the design and function of technological systems in order to depend upon technology and control it

for everyone's benefit.

General Education

The development of individual capacities and talents, often called intellectual development,[6] is what makes the general education curriculum in undergraduate education so important to society. General education can free humankind from ignorance and prejudice by providing insight into a variety of life issues.

General education should also provide a comprehensive view of human knowledge, achievements, and capacities, and help students develop an insight into typical human values. Further, general education must facilitate the development of organized, dynamic thinking and creative processes.

Educators have always believed that the more liberal the general education, the richer will be an individual's personal life. Persons with this broad education should develop further vocationally, and make a greater contribution to society than those who are not well founded in general education.[7] Greene says:

> The educational process is well structured in proportion as it teaches the basic disciplines not as dead facts to be memorized but as vital tools to be mastered and put to use.[8]

He adds:

> In proportion as it is truly liberal and vital, all its members, as younger and older scholars will be intensely concerned with the most urgent problems of mankind—with scientific and technological advance, with political power and social justice, with the multiple moral rights and duties, and with the challenges of religious aspirations and belief.[9]

As general education attempts to train students to understand and solve humanity's most urgent problems, it must deal with science and technology, as well as the liberal arts.

The Role of the University in a Technological World[10]

The university serves as a "shock absorber" for society as well as a center for innovation and creation. It both explores and explains the technological and scientific world.

The university needs to assume a pivotal role in dynamic and long-term change. This will enable individuals to achieve the maximum quality of life possible.

One key role of general education is upgrading the general populace over time. This includes the need to teach people to interact with technology and shape it to serve humankind. The university that does not take seriously its obligation is acting irresponsibly.

The general upgrading of the populace spoken of above requires far more than for the university simply to talk about technology, or even to include it in the general-education programs. Universities should sponsor research by technologists. Through the use of systematic approaches to solve problems and create innovative proposals these researchers can help upgrade the general citizenry.

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The University as Agent for Change

Change is a particularly important technological behavior, one that is not easily studied or controlled. The university must aid change rather than place obstacles in its path. It can serve either as the pacesetter for society, or it can slow down the pace of change in order to enable other institutions to adjust and make orderly transitions. Both roles are appropriate at various times.

This raises several questions: (1) Should the university create the technology, if it has the responsibility to teach about it? (2) Should the university curriculum change with each advance in technology? (3) Who has the primary responsibility for teaching about technology? If entities outside the university ought to handle this responsibility, then (4) What is the role of the university in a technological world?

Preparing Students for the Future

If the university is to prepare people for the future, it must see its task as extending far beyond student memorization of facts and figures or even completion of lab exercises. Universities need to provide students with hands-on study and conceptual understanding of technology.

The university must train both thinkers and doers. However, doers must have the ability to ask, Why are we doing this? Is there a better way? Conversely, thinkers also need to be action oriented. In the areas of mathematics, science, and technology, theory needs to be combined with application. In the university setting, thinking and doing must be viewed as complementary tasks.

The university must help people to believe in themselves and their capabilities. It must teach them to be self-sustaining in their search for truth, to continuously ask questions, and to probe ever more deeply into ways to control technology and effectively convert world resources for the benefit of humankind.

Training Ethical Problem Solvers

As today's university students enter industry and various cultural institutions, many of them will control or direct resources and processes with significant potential for good or evil. A key role of general education must be to teach students and others both the technical know-how and the ethical principles they need for decision-making in the world of tomorrow.

To do this, the university must train innovative problem solvers. These future leaders need a broad education that includes mathematics, their mother tongue and other languages (both written and spoken), science, humanities, and multicultural education—as well as

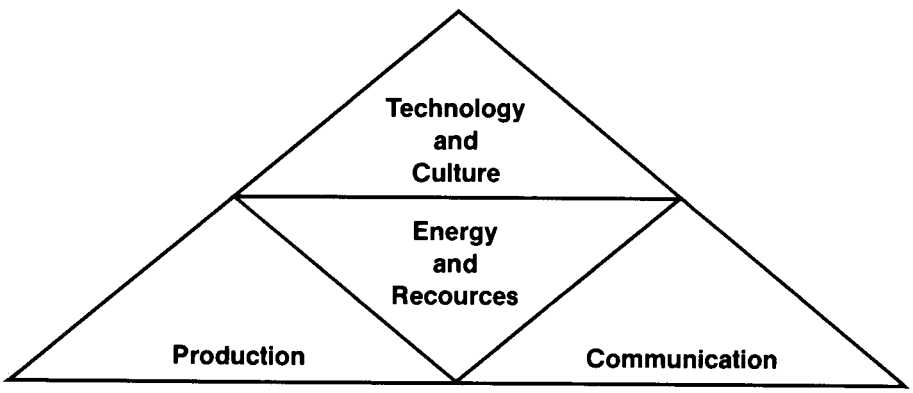

Figure 1. Model for Integrating Technology

analysis of economic, social, and political structures.

People in all capacities and at all levels in the workplace must understand quality and productivity. Related issues include, among others, costs, inspection, time and motion, safety, reliability, automation, motivation for quality and methods improvement.

Study of these areas must occur in an applications-oriented environment. This will require more than a discussion of quality and productivity. Study must take place in an actual production environment.

Failure to teach these topics will result in continued industrial and technological breakdown in organizations as well as products. As the quality of products continues to degrade, and as worker productivity declines, these issues will become more critical, causing reduced competitiveness in the world market.

Making It Happen

How can we add a technology emphasis to general education at the university level? How many courses should be required? Who should teach them? The answers are rather complex. However, some recommendations may be appropriate.

First, the integrative technology approach should only be attempted in a school with a college or department of technology, applied sciences, engineering, or a similar program.

Second, technology should be studied from an applications perspective, which requires an appropriate lab environment.

Third, technology education should utilize an interdisciplinary approach. This will provide a coordinating environment for mathematics, science, verbal and written communications, computers, social interaction skills, ethics, business and management, and other theoretical courses.

The curricular framework of general education in technology could encompass broad areas of study such as energy and resources, production, and communication. The basis for these or similar areas of study has been provided by several professional organizations, including the International Technology Education Association[11] and the National Association of Industrial Technology.[12] These groups interpret the content somewhat differently, but the basic tenets of their studies seem to be quite similar.

The three lower-level introductory courses would combine lecture/discussion and lab, while the 300-level course would consist of lecture only. The basic premises of the three-course introductory approach would be as follows:

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Technology should be studied from an applications perspective, which requires an appropriate lab environment.

1. To provide students with an overview of major areas of study in technology.

2. To provide an academic format, thus enhancing the likelihood of attracting traditionally oriented students.

3. To encourage the organization of content within technology programs under the new headings of production, communication, and energy and resources.

4. To enable students to enroll in a "package" of courses that provide an efficient overview of technology. At the same time students could select one of the blocks (or any combination therein), including the technology and culture course.

5. To lure students currently unwilling to commit more hours to traditional courses in individual areas of technology, while at the same time providing a broad overview of the subject.

6. To provide an opportunity for each area of study to put its best foot forward. Senior professors should instruct these courses to ensure optimal quality.

Introductory courses should include selected laboratory activities, with an applications orientation. For example, students could be challenged to manufacture and produce a prearranged product, conduct experiments with motors, create computer applications for energy and resources, or solve a communication problem relating to graphics, design, or electronics.

At the introductory level, courses would outline broad areas of technology through selected applications. Subsequent, higher-level courses would focus on specific areas of technology and their applications.

Course Objectives

The courses would have three basic objectives:

1. To introduce students to concepts and content commonly associated with industry and technology.

2. To teach about relationships among technologies, with specific emphasis on

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Technology should be studied from an application perspective, which requires an appropriate lab environment.

their systems, materials, processes, and design functions.

3. To help students understand the evolution and future of technologies commonly associated with industry.

Course Descriptions

Typical course descriptions would be as follows:

Communication. Communication processes and methods will be defined by the technology systems model. Problem-solving techniques will be introduced and developed. Students will use several microcomputer software packages to solve communication problems.

Production. The study of technology systems, elements, and applications to meet industrial or commercial objectives. Course applies the technology systems model and explores the basic human adaptive skills required to operate, build, maintain, test, and develop technology systems.

Energy and Resources. An overview of current world energy and resources with emphasis on how we arrived where we are, as well as current energy and resource approaches. Alternatives and applications for the future are emphasized, along with current methods.

The 300-level technology and culture course should address values, attitudes, and general cultural issues related to technology. Ideally, the class would be team taught by instructors from technology, liberal arts, and other programs or disciplines.

In general, the upper division technology course should reinforce the applications orientation as indicated earlier, providing a point of focus for business, science, mathematics, writing, and other more theoretical courses or programs in the university curriculum. The 300-level course should not only challenge students to apply theories from other courses, but also help them consider the ethics of their discipline within the context of technology. The course description and context might be described as follows:

Technology and Culture. Current issues and their relationship to technology and systems in various cultures throughout the world; emphasis on explaining technological behaviors, and on showing how technology permeates all human affairs. Prerequisites: TECH core and junior status, or consent of the instructor.

Upper-division technology courses should help general education to apply theories, principles, and concepts in order to provide a rich cultural experience across campus. Students from various programs should not only have the opportunity to apply content from other courses to technology courses, but they should also have have some hands-on exposure to technology.

Summary

Technology must be viewed as a liberalizing area of study, necessary for every educated person. While general education must not neglect math, science, and language, it also needs to include technology awareness. Everyone needs to be generally literate as well as technology literate in order to participate in controlling and shaping technology.

Based on its unique knowledge and relationship with industry, industrial technology can help integrate technology into the general-education curriculum. To prepare citizens for the 21st century, institutions of higher learning must make technology literacy a high priority. □

Dr. John W. Sinn is Associate Dean and Associate Professor of the College of Technology, Bowling Green State University, Bowling Green, Ohio. Dr. Russell R. L. Laird is Chairman and Professor in the Technology Education Department at Pacific Union College, Angwin, California.

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