Practical Issues Involved In Introducing Technology Education Into The Nation's Schools

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A number of impediments have thwarted efforts to institutionalize technology education programs in the nation's schools and have mitigated against its establishment as a core discipline in the United States.

Some of these obstacles relate to public perceptions. Some, to politics. Others, to the difficulty in making structural change within a system as tradition-bound as the educational system. This brief paper attempts to identify and clarify the issues.

PUBLIC PERCEPTION ISSUES

Issue 1. Technology is not well understood.

Technology is a word in common parlance which is used in different ways. Sometimes we use the term to mean 'technical means'. Sometimes we refer to *artifacts* (aspirin, chairs) as technology. Sometimes we mean sets of procedures. The popular culture confuses science with technology and unfortunately does not assign value to technological literacy.

The general public has minimal understanding of technological ideas. Most people have only an *appliance operator's* level of technological capability; the pervasive influence of technology on society and culture is not well understood.

A common misconception is that technology is synonymous with computer hardware and software. The institution of computer literacy programs satisfies most educators' and parents' perceived need for technological literacy. The public has very limited awareness of Technology Education as an emerging school discipline.

Issue 2: Technology Education is tainted by its traditions.

Precursors to Technology Education in this country were manual arts, manual training, and industrial arts. In the schools, these were commonly known as *shop* programs. Typically students learned to use tools to fashion resistant materials (woods, metals, plastics, etc.) into consumer products.

World wide, Technology Education (or Design and Technology as it is called in the countries that were part of the British Commonwealth), has likewise sprung from the roots of crafts teaching. In the UK, there has been a Herculian effort toward gaining respectability for the discipline. In 1989, a new National Curriculum was written and design and technology is one of the foundation subjects at all levels of the curriculum. Nevertheless, Design and Technology has garnered only limited political support in the UK.

In a 1998 study of programs in Australia, Japan, Korea, Mainland China, Malaysia, New Zealand, the Philippines and Taiwan by the respected Taiwanese educator, Dr. Lung-Sheng Lee, conclusions were drawn that (1) the evolution of the discipline in those countries also progressed from handicrafts to technology, and (2) that technology education was still commonly seen as a subordinate subject.

In the United States, many teachers have been traditionally trained as Industrial Arts teachers and are still teaching in their comfort level. Many courses are still on the *crafts end* of the *crafts to engineering* continuum. Thus, teacher capabilities and new millennium student needs are mismatched.

New leadership in Technology Education is coming from science and engineering educators. There is a growing alliance among math, science, and technology educators across the country; and an expanding interest in technology education has been shown by the engineering profession.

Recommendations

Technology Education has undergone a considerable metamorphosis within the last decade, and many programs are now in transition. Support must be forthcoming for pre-service and inservice teachers, and university teacher educators as they attempt to match their teaching practices to contemporary philosophy.

Educational initiatives should include new programs that help teachers become more mathematically and scientifically literate, conversant with general (transferable) technological principles (e.g., systems, modeling), and familiar with new and powerful information technologies.

Current pedagogical ideas (methods of engaging and assessing the learner) must become embedded in the culture of technology teaching. Constructivist philosophy (which conceives the learner as the active participant in the transaction between teacher and student -- actively making meaning, rather than being a passive receptor of knowledge) should influence teaching practice. The design of performance-based assessments (student portfolios, presentations, projects) should complement more traditional testing methods.

Instructional materials should be developed that reflect knowledge of the learner, best pedagogical practices, and content based on state and national standards.

POLITICAL ISSUES

Issue 3: There is limited policy-level support for Technology Education programs.

The need for technology education has not, in the main, been internalized by policymakers. There is a lack of support from school administrators and parents for the introduction of yet another school subject into the curriculum, particularly where assigning time in the limited school day would mean competing with and replacing disciplines with longstanding traditions.

There is only a limited base of legislative and industrial support for Technology Education. Although TechEd could serve to further the mission of the engineering and industrial communities, there is little formal advocacy and virtually no lobbying.

When commissions are formed to look into educational issues, rarely does Technology Education receive the attention it deserves. The well publicized TIMSS Study (Third International Math and Science Study) addressed mathematics and science issues but did not include TechEd Programs.

Last April 28, the full Committee on Science of the U.S. House of Representatives held hearings on the topic "K-12 Math and Science Education." The most recent case in point is Richard Riley's newly created National Commission on Mathematics and Science Teaching for the 21st Century. Technology Education does not have equivalent national visibility.

The emerging national standards in Technology Education (Technology For All Americans Project, funded by NSF and NASA) should serve to focus national attention.. Organizations such as NAE and AAAS have provided pivotal leadership to this effort.

Issue 4: Funding for Technology Education programs is limited.

Within the last decade the National Science Foundation has made Technology Education a funding priority. As a result, a number of large-scale projects have been funded which have advanced the state of the profession and given it higher national status. A noteworthy endeavor is the Technology For All Americans Project, funded by NSF and NASA to support the development of K-12 national learning standards for Technology Education.

Despite the leadership shown by NSF and NASA, the large federal funding streams: GOALS 2000, Title 2 Dwight D. Eisenhower, Chapter 1, Chapter 2, and Title Six, still have not identified Technology Education as a funding priority. Technological Literacy Challenge grants are focused on instructional technology. VATEA funds support vocational education programs and are a mixed blessing for Technology Education programs, since in states where these programs are eligible for funding, the view of Technology Education as *occupational preparation* (as opposed to fundamental education), is perpetuated.

Recommendations

Legislators and educational policy makers should be encouraged to link mathematics and science *with technology* in future legislation. This linkage would support the NSF vision of a coordinated and integrated SMET (Science, Mathematics, Engineering, and Technology) educational delivery system The linkage is tenable in that technology can provide an engaging and meaningful context for students to deepen and retain their math and science understandings. Those concerned with broad-based technological literacy might approach the leadership of Richard Riley's new National Commission to lobby for attention to Technology Education.

STRUCTURAL CHANGE ISSUES

Issue 5: There is a nationwide teacher shortage in Technology Education.

There are about 190 institutions nationwide offering teacher preparation programs in Technology Education. Teacher education programs have been "retrenched" in significant numbers. Thirteen programs closed in 1996 alone. The teaching population is aging. Salaries are not at high enough levels to attract quality and quantity. Technically capable individuals typically can find higher paying work elsewhere. When districts are unable to find technology teachers, they close programs and turn laboratories into classrooms or offices. Once this occurs, programs are rarely reopened. It is estimated that 13,000 additional teachers will be needed by 2001. In the last three years, the number of teacher preparation graduates has averaged only 727 teachers per year and presage a shortfall of over 9000 teachers by 2001.

Recommendations

Incentives should be offered to attract new teachers to enter the field of technology education. For example, Massachusetts offers a “signing bonus” of $25,000. Florida forgives $10,000 in educational loans.

Alternative career paths should be opened for technical professionals (e.g., engineers and architects) to become certified as technology teachers.

Issue 6: The instructional delivery system is uncoordinated.

There is at present, no coordinated instructional delivery system, K-12, which provides articulated study in technology, as there is in English or Social Studies. Very few children have the opportunity to engage in technological design at elementary school levels. Elementary school teachers receive precious little science education and virtually no technology education in their own preparation. The emphasis is typically on reading and mathematics.

At secondary school levels(particularly in the high schools), technology is normally an elective, studied only by a small percentage of students.

Only three states (New York, Nevada, and Maryland) require that students study technology education. A necessary component in educational reform is the support and advocacy of state departments of education in initiating required programs in Technology Education (top-down support for bottom-up reform). Without such mandates, there is not a level playing field. Elective subjects cannot compete with requirements. Without required courses with accompanying state assessments, districts will continue to offer technology programs sporadically. Without public accountability old line crafts-based programs will continue to chug along.

Recommendations

There is little chance that the entire educational system will be retooled to make technological literacy an educational priority, however there are numerous opportunities through which technological content can be taught and learned and these should be exploited.

Technology content can be taught in stand-alone courses (e.g., electronics), taught as a component of an team-taught course (with math, physics and technology teachers sharing the teaching), integrated into other subjects, or used as a context for interdisciplinary learning. Technology can become a most effective integrator of knowledge in the schools, as solutions to technological problems often involve aesthetics, language, math, science, history, and politics.

All elementary school teachers should receive a technological component in their undergraduate and graduate education (and be offered inservice education in technology) so that children can develop a base of technological literacy in their earliest school years.

Although flexible delivery systems must be implemented, certified specialist teachers with broad-based technological backgrounds should comprise the primary delivery system in secondary schools (as certified science teachers are the primary delivery system for science education) but teachers in other disciplines should be encouraged to address technological concerns and applications within their own courses as well (e.g., chemistry teachers should devote attention to chemical technology). Sharing the responsibilities clearly has implications for the way all teachers are educated.