Technology Education in Prospect: Perceptions, Change, and the Survival of the Profession

SPECIAL SECTION

M. Ray Karnes

with

Thomas R. Baldwin
Elazer J. Barnette
M. James Benson
David C. Bjorkquist
Sharon A. Brusic
James J. Buffer
Rodney L. Custer
Paul W. DeVore
William E. Dugger
Michael J. Dyrenfurth
Thomas L. Erekson
Rupert N. Evans
Dennis Herschbach
Daniel L. Householder
Everett N. Israel
Scott D. Johnson
Theodore Lewis
Donald G. Lux
G. Eugene Martin
Jerome Moss, Jr.
Stephen Petrina
David J. Pucel
Willis E. Ray
Mark E. Sanders
Ernest N. Savage
Michael L. Scott
Kendall L. Starkweather
Sam Stern
Leonard F. Sterry
Jerry Streichler
Richard A. Swanson
Tim L. Wentling
Brenda L. Wey
R. Thomas Wright
Karen F. Zuga

While this Special Section focuses on issues related to one of the professional fields served by Epsilon Pi Tau, there is much of value to students and practitioners in the other fields of technology, particularly as we realize our connectiveness. Whatever goes well or poorly with any one of our professional family undoubtedly affects the others in the clan. This Special Edition is based on a November 12, 1998, presentation to the 85th Mississippi Valley Technology Education Conference (MVTTEC) in Rosemont, Illinois. The details of the concept and its implementation are best told from extracts of presenter Karnes' introductory remarks at the conference. **JS**

Thirty-five respondents submitted statements for inclusion in this paper after listening to the mournful pleas for assistance embedded in telephone messages and in the letter addressed to each of them. To reveal the context and the climate within which these contributors were "invited" to prepare their statements, the following paragraphs from that letter have been made a part of this report:

> I am absolutely thrilled that you have agreed to submit a brief statement for inclusion in a paper to be presented for the primary purpose of stimulating discussion at the 85th Mississippi Valley Technology Teacher Education Conference at Rosemont, Illinois, on November 12 and 13, 1998. I would not wish to disrupt your demanding schedule, but I hope you can let me have your contribution by *October 15*. To get you started right away, here is the message that is going to each person who has agreed to help with the paper. (Of course your name topped the enclosed list of distinguished contributors until the Microsoft Word alphabetize button was stroked inadvertently!)
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> Enclosed are copies of: Tom Erekson's letter of March 13, the MVTTEC program to which he refers, and Jerry Streichler's letter of September 14 in which he expresses an interest in having a copy of the proposed paper presented for review.
>
> You will note that Tom [*MVTTEC chair Thomas Erekson's invitation to him to present*] seemed to leave the door wide open when he put my name on the program but did not pose questions as he did for the other two presentations scheduled for the morning of November 12. He concurred, however, with my suggestion that the following is an appropriate and compelling question to be addressed as we approach the year 2000: ***What are the most critical changes or improvements which must be made if technology education is to be an integral component of strategic importance in the total educational enterprise of the new century?***
>
> While the many experiences enjoyed during my 26 years of retirement from the University of Illinois have been rich and rewarding, that length of time away from the fray makes it presumptuous of me to attempt a response to the preceding question without a great deal of assistance. I am therefore, with Tom's approval, taking advantage of this delightful opportunity to call in chips from former students and colleagues! I have the unmitigated gall to suggest that each of you recall your joyous days of graduate study as you respond within the range of *450 to 550* carefully chosen words to the preceding question under the assumption that your answer is to account for a critical share of the total score on your comprehensive doctoral examination!
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> During the 1998 ITEA conference in Fort Worth I sensed a disturbing degree of the anxiety, desperation and defensive posture with which many professionals in our field reacted during the late 1950's to the rather sudden and drastic curtailment of industrial and other practical arts and elective subjects in favor of increased emphasis on science, mathematics and foreign languages as a hasty, knee-jerk response to Sputnik. The signals sensed in Fort Worth prompt me to enclose a copy of one of my papers written in the threatening environment of the post-Sputnik era within which my election to the presidency of AIAA occurred. The enclosed copy of John Gallagher's 1993 paper in response to my 1960 piece should be of particular interest as you prepare your statement.

All but a few of the contributors responded promptly. The gentle and genteel powers of persuasion employed on the tardy ranged from absurd forms of flattery to threats of violence. One was told that without his scholarly input the 85th Conference would have to be cancelled. The few who attempted to bolster their plea for additional time with that old and badly frayed bit about being under attack from the rear by infamous predators of southern waters were reminded that draining the swamp is the prerequisite to victory in alligator combat! The last two contributions arrived only a few minutes before the

Dr. Karnes is Professor Emeritus at the University of Illinois and Professor Emeritus at The University of Southern Mississippi. He is a member-at-large of Epsilon Pi Tau and holds the honorary's Distinguished Service Citation.

"Send Now" button would have transmitted messages containing subtle references to their respective ancestors. My hope is that the few respondents who made rather extensive use of flattery in their papers will not be offended upon learning that nearly all of their glowing remarks were deleted before any attempt was made to evaluate their contributions and record grades. I have asserted prerogative to offer remarks, which follow the thoughts of the 35 gracious respondents.

Thomas R. Baldwin, Dean
College of Technology
Pittsburg State University

The Challenging Road to Oblivion

The first issue that must be addressed is perception. What are we, what are we about, and why is studying technology important? Technology and technology education are concepts that need a clear, generally understood and accepted meaning. We have undertaken this effort, but its completion is on a distant horizon. People still puzzle over the question, What is technology, who are technologists, and what do they do? There is a lack of understanding among engineer, technician, scientist, and the fields they work in. What is the relationship among the bio technologist, chemical technologist, medical technologist, engineering technologist, media technologist, mechanical technologist, and the many others that share the concept of technology and its applications? When we have people educated to the point of explaining the significance of these relationships, they will be able to understand the need for technology education.

The second issue is attraction. If we cannot attract significant numbers of bright young students into the field of technology education and then keep them in education, we will cease to exist and this will no longer be an issue. The value we place on education is evident by the salaries we propose to attract the brightest and best to work with our children. Until beginning teachers' annual income moves them from the poverty level to a point significantly above that of their fellow graduates, we will continue to slide toward oblivion. This will leave the door open for inadequately prepared people to fill the void or for school personnel and the public to assume that a generous supply of computers in the school will meet fully the need for technology education. The shortage of qualified people for our university programs is a major deterrent to progress in our field. We need to encourage more quality teachers to go back to school and prepare to be the university instructors for tomorrow.

The lack of an accepted and representative curriculum of high quality is another compelling problem. The completion of the Technology for All Americans Project and resulting curriculum will hopefully nullify this as an issue, but the many industrial arts courses with name changed to technology education leave me cautious with reference to prospects for the future. Tight local control of the school in many states will probably continue to stand in the way of the curricular developments in response to technological advancements.

Elazer J. Barnett, Interim Dean
School of Technology
North Carolina Agricultural &
Technical State University

Critical Changes in Technology Education

The new millennium will usher in many changes and challenges for the educational enterprise that will educate the youth of this nation. Many of the new millennium educational activities will be centered on the need for enhanced computer skills, development of tools to assess the level of learning, and committed to improving the quality of the student performance. Several learned societies are addressing these educational activities and developing standards for preparing students in their respective disciplines for the 21st century. For example, standards have been developed for science and math. For the discipline of technology education, the standards project Technology for All Americans is nearing completion.

It is critical for the survival of technology education that leaders of the discipline understand the reality of what is happening in the total educational enterprise. Technology education teachers and administrators should spend less time debating issues such as technology education versus trade and industrial education, technology education versus educational technology, and other issues that have been around for many years. More time and energy should be directed toward broader issues related to the total educational enterprise. The success and acceptance of technology education as a discipline integral to the total educational enterprise depends on how we (the members and leaders of technology education) interact with others outside our discipline.

The membership of technology education can begin this interaction by asking to what extent is technology education positioning itself to be integral to the U.S. Department of Education's Strategic Plan 1998-2002 as set forth by Secretary Riley of the Department of Education. This strategic plan is framed by seven educational initiatives. The first three are a direct response to President Clinton's Call-to-Action for American Education in the 21st Century, and the last four are strategies for implementing the first three initiatives.

These seven educational initiatives will define the educational enterprise for the new century. If technology education is to be an integral component of strategic importance in the total educational enterprise of the new century, it is critical that leadership of technology education include in its strategic plan elements of the seven educational initiatives and thus help ensure that all children will be able to: (a) read independently by the end of the third grade; (b) master challenging mathematics, including the foundations of algebra and geometry, by the end of the eighth grade; (c) be prepared for and able to afford at least two years of college by age 18 and be able to pursue lifelong learning as adults; (d) have a talented, dedicated, and well-prepared teacher in their classroom; (e) have their classroom connected to the Internet by the year 2000 and be technologically literate; (f) learn in strong, safe, and drug-free schools; and (g) learn according to

challenging and clear standards of achievement and accountability.

The following statements and questions for technology educators to ponder evolved out of the last four educational initiatives. All students should:

- Have a talented, dedicated well-prepared teacher in every classroom. Secretary Riley (1997) stated in his back-to-school speech that 2.2 million teachers will need to be recruited in the next decade, and he issued specific challenges to higher education, communities, states, local districts, and Congress. Will technology education be proactive or passive and thereby continue to see technology education classrooms with teachers who are not certified to teach technology education?
- Have their classrooms connected to the Internet by the year 2000 and be technologically literate. Technology Innovation grants totaling $30 million are available to help support the challenge of preparing new teachers and supporting existing ones to teach effectively. It is clear that the Secretary focuses on technology and the use of computers; but he stresses the importance of enhancing teacher skills and their professional development, especially in the use of computers and advanced learning technologies in their classrooms. Technology education must obtain the funding required to educate students who will be technologically literate. To accomplish this critical change, there must be more involvement of secondary school technology teachers, local and state technology education supervisors, and technology education teacher educators at the national level where funding decisions are made.
- Learn in response to challenging and clear standards of achievement and account-ability. Secretary Riley stresses the importance of voluntary national tests that show what students have learned and what they have not learned. Is the Technology for All American Project being shared and discussed with key leaders in the Department of Education who can promote the cause of standards for technology education across disciplines?
- Learn in strong, safe, and drug-free schools. This fall there will be three regional conferences on Improving America's Schools. These conferences will be held in the following cities: Portland, OR; Denver, CO; and Nashville, TN. Will the leadership of the discipline of technology education attend one of these conferences to network with leaders from the total educational enterprise?

I have been involved in technology education for 25 years as teacher, state consultant for technology education, teacher educator for technology education, department chair, and now interim dean of a school of technology. From all of these positions, I have seen the discipline progress rapidly. I have also seen the discipline become stale and at times stall. Technology education must be dynamic and thus prepared for change. We should not forget our history. There in lies the foundation for the future of the discipline. We must understand how technology is impacting the discipline from many angles. We must determine the course of technology education at all educational levels and how it relates to other disciplines. If the profession is to be an integral component of strategic importance in the total educational enterprise in the 21st century, the discipline must anticipate and respond rapidly to accelerating technological and sociological changes.

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M. James Bensen, President
Bemidji State University

Invent the Future Rather Than Reinvent the Past!

If technology education is to be an integral component of strategic importance in the total educational enterprise of the new century, it must embrace change at a rate never even conceived of in the past! Change must be central to the way that people think, act, and assess. Technology, by its nature, is the engine of change. It is essential that the very core of the technology education curriculum leads and encourages students to be change agents. Harry Quadracci, CEO of Quadgraphics, once stated, "Change is our bread and butter, doing it better than everyone else is our job security!" Mr. Quadracci understands very well that the lifeblood of his enterprise is the ability to move at lightning speed and to deliver quality service to satisfied customers. Imagine a technology education program that is devoted to excellence, willing to never teach the same content twice, and enables students to grow to levels of excellence in performance that dazzle the rest of the school and community!

The amount of know-how, or content, in the study of technology doubles about every 18 months. To keep our students engaged in relevant learning experiences dictates that we teach through the design approach, use experiential, first-hand involvement in solving problems, and engage them in inventing the future. Price Pritchett stated that "the best way to predict the future is to invent it." This suggests that the best way to know what's coming is to put yourself in charge of creating the situation you want. Be purposeful. Look at what's needed now and set about doing it. Action works like a powerful drug to relieve feelings of fear, helplessness, anger, uncertainty, or depression. Mobilize yourself because you will be the primary architect of your future. One of the keys to being successful in your efforts is to anticipate. Accept the past, focus on the future, and anticipate. Consider what's coming, what needs to happen, and how you can rise to the occasion. Stay loose. Remain flexible. "Instead of changing with the times, make a habit of changing just a little ahead of the times" (Pritchett, 1998, p. 40). So it must be in leading technology education into the new millennium.

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David Bjorkquist, Professor Emeritus
University of Minnesota

Learner-Centered Education in Technology

It is my intention to suggest changes and improvements for education in technology inclusive of technology education, vocational-industrial education,

human resource development in industry, and industrial technology. These are the several areas that generally encompass the responsibilities of members of the Mississippi Valley Technology Teacher Education Conference.

Many of the goals of public education focus on development for adult life including preparation for one of the universal activities of adults; world wide, that is work. Work, both paid and unpaid, occurs in places of employment, homes, and throughout communities. Much of the school's curriculum is designed to prepare young people for work, and justification for subject matter is often economic. School curricula are keenly attuned to the suggestions of business and employers.

When long-term, mutual commitments were made by employers and employees, business needs were perceived to serve individuals as well. Today, lifetime employment is unlikely. Worker needs differ from those of employers. Many who are entering today's labor force will be temporary or contract workers, and many more will experience layoffs and unemployment as part of their careers. Employers will not guide the career advancement of workers and will not be responsible for insurance plans, pensions, vacations, and sick leave.

With employers playing a reduced role in the lives of workers, the locus of planning can be shifted from the workplace. For many, the home can become the center of attention. Holistic planning (considering the family's resource base, lifestyle, and what it wants to produce) can include the work of the home, community, and employment. As disembodied employees hired because of talents appropriate to complete an employer-defined task, individuals cannot afford to plan around the needs of a particular employer or established occupation. Within the context of this psychology and economics, individuals should know and develop those skills that are most satisfying and are performed best.

Important learning can occur in all forms of instruction in machine-based, political-social, and other technology. Knowledge of technology used to organize work and define jobs, to control processes and persons, and to return power to individuals are examples of critical social-political technologies. The discovery, exploration, and development of talents can be realistic in classes where tool-and machine-based technology is taught. Many lessons of technology will be economically important and others will enhance the satisfaction of daily living.

Control of a learner-centered curriculum in technology cannot be given over to those with self-centered interests. Business leaders and employers, to whom a continuing supply of able, cost-effective workers is important, should be heard but should not dictate. Vendors who sell enticing packages of instructional materials and equipment are more likely to be motivated by sales prospects than by the learning needs of students who use their products. A routine course of instruction created by outside powers runs counter to the decision-making and controlling skills that learners need.

If instruction in technology is to be strategically important, it must be of worth to its clients. At present, the conditions and impact of work make that an important focus for all citizens. It is of comfort to know that employers, families, and communities will be well served by a learner-centered study of technology that produces independent, self-assured, problem-solving citizens.

Sharon A. Brusic, Assistant Professor
Technology Education
Virginia Polytechnic Institute & State University

Commitment to a Cure

Most technology educators would agree that technology education *is* general education and that general education *is intended* to meet the needs of *all* students in the school. But, any keen observer can clearly see that the vast majority of technology education students and teachers represent only about half of the population. Technology education is clearly not meeting the needs of *everyone* when the overwhelming majority of its students, teachers, administrators, and leaders is dominated by one gender: males. Can a program truly be recognized as general education if it chiefly attracts males and seemingly caters to the needs of only one half of the population?

Despite some attempts in the past decade to broaden the appeal of technology education to both males and females, there is still an incredible gap in female representation in technology education at all levels. Why is this the case? Is it because girls and women are not interested in technology? Are females less capable in technology and therefore less apt to participate in technology education? Does technology education need to change or do females need to adapt? How can we explain and rectify this representation gap in technology education?

Technology educators are remiss if they continue to overlook the seriousness of this incessant problem in technology education. Just as alcoholism, dysentery, heart disease, and tuberculosis require appropriate and aggressive medical attention, this chronic gender representation problem in technology education requires *appropriate and aggressive* remedial therapy in order to correct the situation. A multifaceted approach that involves critical analyses of K-12 curricula, teaching strategies, facilities, and public relations efforts will likely lead to finding a cure for this chronic problem. But, it won't happen unless dedicated researchers and educators make a *commitment to finding a cure* by soliciting assistance and guidance from experts. This problem is not likely to be solved from within by technology educators alone. It will undoubtedly require external evaluations, courageous changes, and bold attempts to alter ingrained patterns of behavior and entrenched practices in technology education programs and organizations.

As educators critically assess the role of technology education in the total educational enterprise, this persistent problem demands forthright attention and positive action. Technology education will never *truly* be general education—an integral and meaningful component of *every* student's educational experience—unless this obvious flaw is remedied through whatever means is necessary to do so. In so doing, it is just *possible* that technology education may finally be recognized as an educational program that serves the needs of *all* students in the next century and beyond. Moreover, this focused approach may also be the much sought

after an tidote to ailments such as declining enrollments, teacher shortages, and program closures that threaten the future of technology education.

James J. Buffer, Jr., Professor and Associate Dean Emeritus
The Ohio State University, and
Horace G. Fralin Professor and Dean Emeritus
Virginia Polytechnic Institute & State University

For years, I've been plagued with a recurring dream that I was scheduled to submit a written report to one of my former (not old) professors, and not knowing how I would find the time to fulfill the commitment. Now, after arriving home after traveling for several weeks and needing to catch up with personal and professional commitments, I find myself with a similar dilemma. Time constraints withstanding, I am humbled by Ray Karnes' request that I participate in his professional rodeo and submit a contribution for the MVTTEC. Besides, this may be the way to bring closure to my recurring dream. The good Lord knows that one should not tempt the wrath of M. Ray Karnes.

Addressing the assigned topic is, in itself, a major challenge but also an opportunity to provoke thought and dialogue among those responsible for influencing educational policies and programs that will help ensure technological literacy in our society. Thirty-nine years ago, Karnes (1959) demonstrated his vision for the improvement of technology education in his classic work, "Improve or Perish." A number of very capable professionals, many with whom I had the privilege of working with, were influenced by Karnes' recommendations as evidenced by the direction of their professional initiatives and accomplishments. So why are we revisiting?

Issues and Concerns. One might respond that we are interested in continuous improvement since, as educators, commitment to achieving quality and excellence in our endeavors is a high priority. Given the status of the technology education profession today, such action seems prudent. A reality check suggests major if not alarming decreases in K-12 enrollments; closing and curtailment of teacher education programs; shortages of qualified teachers; and lack of understanding among practicing educators (K-12 and collegiate), lay people (parents, students, and community leaders), and policy decision makers (elected and appointed government officials) of its mission and goals. Too often, the typical response from the general populous is that technology education is the study of computers. Wow, this is like suggesting that 30 years ago industrial arts was the study of wood- or metal-working machines. Bottom line is that the sum of these factors equals less-than-desirable support for technology education by our customers.

Can we assume that the major research and development efforts of the past 30 years, many funded by federal and state agencies, that focused on curriculum development, learning and human behavior, teacher preparation, leadership, and technology along with a few thousand papers presented at local, state, and national conferences were misdirected or unheeded? Or, were there other reasons for the apparent decline in technology education programs that we should consider when seeking ways to ensure that technology education is to be an integral part of the educational enterprise in the next century?

From my perspective, too many industrial arts educators were following their own agenda without concern for the opinions of the total professional community. Some went forward and programs became disparate units without any unifying theme. The end result is that technology teacher education enrollments declined, "leaders" have embraced quasi-engineering programs at the collegiate level, and enrollments and support for K-12 programs declined. And to fill this void, our colleagues in mathematics, science, and instructional technology (the area most lay people and educators seem to equate with technology education) are now providing the leadership for technology education.

Recommended Changes and Improvements. Many popular books on the best sellers' list, which focus on re-engineering and leadership practices to improve individual performance and corporate outcomes, might be of some benefit in addressing this challenge. But, rather than scan the menus of the day for a quick or popular fix, allow me to recommend some basic leadership and management principles that might be effective in helping to achieve our desired goal.

1. Focus on what are perceived as the unique mission and goals of technology education and develop consensus among the profession to limit educational initiatives under the sponsorship of technology education. Consensus of what this unique mission is or should be appears to have eluded the profession; and as a result, there appears to be a conflict between what the leadership sees as being the mission of technology education and the mission as perceived by the field's customers. These differences suggest that the customers are not satisfied with the product created by the leadership and have chosen to direct their loyalty and funds elsewhere. My hope is that the ongoing Technology for All Americans Project will provide the compass to redirect and energize future technology education initiatives.

2. When formulating the mission statement, remember the historical roots and foundation from which technology education has evolved and recognize the enduring values students derive from its diverse instructional programs. Consider policies and goals that are supported by historical precedence but are also educationally and technologically relevant to the 21st century. While the materials, tools, equipment, and processes that have been part of our programs are ever changing, the basic technological principles and concepts remain constant, thus providing continuity and integrity to the discipline.

When considering this second principle, build upon the strengths of the profession and its many accomplishments. We have a lot to be proud of and need to capitalize on these positive aspects. This includes technology education's rich historical record of laboratory-based curriculum and instructional programs; quality professional and scholarly publications; outstanding professional associations and affiliations with government, business, and other professional organizations; and its unique contributions to education and society.

3. When developing curriculum guidelines for K-12 and collegiate programs, focus again on technology education's central mission. Decide

whether technology education is a method of teaching and used to enhance the teaching, understanding, and application of other established disciplines such as mathematics and science. Or, is it a discipline or subject that focuses on the study of technology?

Hopefully, the latter statement will be chosen and the profession will then determine how technology may be modified to limit the parameters of its curriculum. My analysis of the articles appearing in the profession's publications and of the presentations and exhibits at its national conferences suggests that the profession has chosen to focus instruction on the study of technology, broadly defined with a plethora of such modifiers as manufacturing, textiles, medical, engineering, ad infinitum. Frankly, this "we're anything you want us to be" approach will see the demise of technology education as a discipline with integrity and value that earn it an important position in the educational complex of the next century.

The middle of the road approach assumes that technology education is a hybrid and is used as a method when appropriate to other educators and policy makers. It becomes a discipline or subject when a teacher is successful in delivering instruction that provides added value to the curriculum as evidenced by student choice or recognition by other colleagues. I would hope that the former is not the primary choice of educational leaders since this perception of the field would certainly curtail the expansion and continual evolution of technology education as a recognized program area.

4. Recognize the value and need for technological studies in our society that will enable citizens to understand and cope with the myriad of changes occurring in our daily lives. Build curriculum and instruction on those unique technological concepts and knowledge that affect our social, economic, and political well-being, but without replicating the domains of other disciplines or subjects.

5. And finally, be proud of your profession and make a commitment to work collectively for a common goal—that of promoting the advancement of technology education as a viable and integral component of our educational fabric. Above all, remain passionate about your profession and do not sell out to the whims of others riding a bandwagon derived from the menu of what looks good today. Hopefully, the collective wisdom of the professionals participating in this scholarly symposium will work to achieve a win-win situation. In reality, the winners will be the future students and citizens who will provide the leadership for the next century.

In summary, my wish is that future technology education programs will be framed to represent the fundamental values as espoused in the Seven Cardinal Principles as well as the national goals of America 2000. And, more important, all learners will have opportunities to further their development in active learning environments (laboratories) that involve doing and the application of technological knowledge and skills to achieve desirable goals. Empowerment and independence (self-reliance and resourcefulness) will be the ultimate outcomes and community benefits of this goal.

The attainment of these goals cannot be adequately achieved primarily through instruction limited to computer simulations or toys such as Tinker Toys or LEGGO blocks. Rather, students need to have experiences with real tools, materials, equipment, and processes in laboratory settings that enable them to achieve technical skills and competencies to solve problems confronted in daily life experiences.

Rodney L. Custer, Chairperson
Department of Industrial Technology
Illinois State University

Prospects for the Future: It's Our Call

Our charge was to identify needed changes. However, it would be a mistake not to address the areas where we should persist with current practice before recommending changes. I will address these and then switch to several items that will require substantial change. Much of the genius and appeal of technology education-related programs over the years has been our "hands-on" orientation. High percentages of students learn best when they are actively engaged in meaningful activity. At all cost, we must resist and reject a move to simply talk and think about technology (its history, role in society, implications for the future, etc.). It is also vitally important that the profession do everything that can be done to capitalize on the soon-to-be-released standards derived from the Technology for All Americans Project. This should include an array of spin-off activities including curriculum development and teacher in-service, as well as assessment and program standards. We must find ways to make the most of this vitally important effort. A third thrust is to continue to find ways of providing in-service programs for teachers. A number of teachers, while open, interested, and willing to learn new content and skills, will not be able to do so without help. The old axiom that "we teach how we were taught" persists. Our teachers who want to change and grow need to be given the opportunity to learn from the profession's best.

Needed Changes. Three major problems must be resolved if the profession is to become and remain viable. First, we are on the brink of a crisis in technology teacher education. Shrinking numbers of universities and colleges are offering technology teacher education. If this pipeline issue cannot be addressed, the profession will starve from a lack of supply. A second change is more of an opportunity. Tremendous opportunities exist to partner with science, mathematics, and other teachers to deliver technology education. The evidence of a new openness is clear. Technology education is represented at NSF. The National Research Council's Science Standards contain a significant technology education component. Growing numbers of principals, parents, and policy makers are becoming aware of the value of technology education. If we can find ways to work creatively and collaboratively with teachers from other academic areas, our future in the schools could be very bright. We're likely to fail if we attempt to add yet another item into the already crowded curriculum. The key to inclusion is genuine collaboration. Competition and exclusion simply will not work.

Finally, if we are to become a viable force in the schools, we must learn how to speak a language that the rest of the world understands. Most people under-

stand technology, but some of us do not. The Standards should be a major help, but they will not be enough. As a profession, we must find ways of talking about and, probably much more important, showing the public what we mean by technology education. In order to value our contribution, people must first understand who we are.

Paul W. DeVore, Professor Emeritus
West Virginia University

Resistance to Change

The question you raise assumes that technology education should be an integral component of strategic importance in the total education enterprise. You may be able to get away with this assumption among the technology-education-true-believer crowd while relaxing at the hotel lounge, but not in the real world. Just because the true believers say technology education is of strategic importance does not make it so. We do know that technological invention and innovation are the keys to economic growth and development. And we know that a technologically literate and creative citizenry is essential in a global competitive market. We also know that technological knowledge and know-how are vital ingredients in any scheme of national and civil defense.

Institutions, governments, and bureaucracies do not change themselves. They are changed from the outside. So, as much as we might believe we can change the profession from within, the lessons of history are against us. Nonetheless, since I was asked to respond to the question, I offer the following possibilities to a few courageous leaders about how change can be attained to meet the challenge of the next century.

One way is to obtain national legislation that makes technology education the "integral component" referred to in the question. I doubt that this is possible, given the current state of affairs. There are too many weak sister programs out there. Who would want to support legislation that merely perpetuates the present? We might have a chance if we agreed to include, as part of the legislative goal, a program that eliminates all weak undergraduate and graduate teacher education programs, public and private. These weak programs only perpetuate the problem. There is precedence for this suggestion. The medical profession, with heavy outside pressure, made the move to eliminate weak programs over 100 years ago. The result of the change was the creation of a medical profession that today provides health care second to none in the world.

Seeking a political solution through national legislation, however, will only delay the inevitable. The problems the profession faces require long-term efforts outside the control of the present structure. The problems faced by the field of technology education are too complex to be left to the shifting views of peripatetic school administrations and the changing agendas and commitments of colleges and universities. A better way is to create a free and independent, dedicated national academy or center of exceptionally high quality. Linked to the national academy or center would be a number of regional centers. These regional centers would replace current antiquated teacher education programs. The academy and the regional centers would be staffed by the brightest and best within and outside the profession, none of whom with permanent tenure but all of them detached from reactionary influences.

The establishment of the national academy with regional centers would enable the profession to attain the critical mass so necessary in the complex field of technological studies. National and regional centers will provide the profession with greater political clout, prestige, and visibility. And, if linked appropriately with the private sector, the field will be supported more adequately in all ways. Moving in these directions will make for a dynamic and prestigious profession capable of meeting the needs of our youth in technology studies in the next century.

William E. Dugger, Jr., Director
Technology for All Americans Project
International Technology Education Association

Technology Education in the Millennium

Technology education has the greatest hope and vision of any school subject in the next millennium. It can help every citizen of the future develop technological literacy that will prepare them for an era of certain change and innovation. Having a technology education is as important as being able to read a sonnet or determine the square root of a number or knowing the effect of soil erosion in Asia.

As we move into the year 2000 and beyond, it is important that technology education become an academic subject. In doing this, the profession must verify the intellectual domain (knowledge base and process base) that is essential for everyone to be technologically literate. Also, it is important that we become close relatives with science, mathematics, social studies, and humanities in the public schools. As a result of this, we must distance ourselves from the traditional vocational offerings because of the misconception that we are only in public schools to prepare people for job-entry skills.

In terms of our content, we must identify what every child should know and be able to do in order to be technologically literate. This means that we must divorce ourselves from an industrial content base and move to a technological content base. It is also important that we become aligned with offering such topics as introduction to engineering at the late high school level. Engineering concepts may also be included in earlier grade levels at the elementary and middle school.

It is imperative that technology education courses comply with standards relevant to the future. The *Standards for Technology Education: Content for the Study of Technology* must be used as a means for developing curricula in grades K-12. Also, as a result of Phase III funding, hopefully our profession will embrace standards for student assessment, teacher enhancement, and teacher preparation, and meet fully the new program standards. It is important that the profession rally around these standards as a means for propelling technology education into the next millennium.

Finally, we must develop a research agenda for the study of technology. This research agenda should be actively pursued in the future so that we are able to provide quantitative and qualitative answers to questions pertaining to the effects of teaching and learning in tech-

nology education. In addition to strengthening research in universities as we plan for the future, it is vital that classroom teachers be prepared to promote and pursue classroom-based research on a day-by-day basis.

All of the above items are most important in moving us from an elective area in the public schools to a required subject and an integral part of the core education of all students. Only through much work and change can we be viewed in the future as an essential part of education for everyone in the new millennium.

Michael Dyrenfurth
Professor & Graduate Coordinator
Department of Industrial Education & Technology
Iowa State University of Science & Technology

Ensuring the Future of Technology Education

Technology eduation will have a future regardless of whether we will be a significant part of it! We seem to be seeing only parts of the puzzle. Where is our profession's perspective? The same perspective that has engaged us so actively in conceptualizing models of technology that enable us to understand and develop understanding of technology seems to be missing in our own welt-anschauung when it comes to our view on technology. Why don't we see a continuum of programs, each important in its own right, linked in a multitude of ways to form a comprehensive network of opportunities for each member in our society?

We seem instead to be doomed to a perpetual panoply of attempts to "position" our individual facets of the profession in a futile attempt to outmaneuver other facets of education. With all the characteristics of braggadocio, we seek to develop rationales that are intended to drive home our importance to others who we apparently think are decision makers. This is like whistling in the dark to muster our courage! We seem to think that we are relegated to an ongoing inferior position. Clearly we need to raise our own self-image!

But what else needs to happen? In my view, it seems we should concentrate on the task at hand, namely, helping people develop an understanding of and capability with technology. This would require that we actively collaborate with our partners in technical education, vocational education, elementary education, industrial and engineering technology, engineering and science, and industrial training. You say we are doing that already! Really? If so, then why despite our acknowledged nationwide shortage of technology teachers can we not see a single joint initiative where the combined efforts of the ITEA, NAITTE, CTTE, TED of the AVA, and others are converging on this crisis?

Thomas L. Erekson, Director
School of Technology
Brigham Young University

There is an old saying that the more things change the more they stay the same. This is the case with technology education (and its predecessor, industrial arts).

As a profession, we have experienced significant changes in the transition to technology education. However, the issues confronting us are strikingly similar to those we faced decades ago. It is troubling to realize that the general conditions of our profession that existed in 1959, when M. Ray Karnes penned "Improve or Perish," appear to be prevalent today. As in 1959, technology education currently faces reduced budgets, increased competition from required courses in the curriculum, and to some extent a lack of recognition and acceptance. Why? The profession seems to lack focus, evidenced by a wide variance in programs: some have remained industrial arts shop programs, yet others are on the cutting edge of the information age. Why?

The complexities of the situation do not lend themselves to simple answers. However, from my perspective the answer is grounded in leadership, or the lack thereof. In years past there was strong state and local education agency leadership for technology education (industrial arts), as well as dynamic leadership in universities involved in preparing technology teachers and supervisors. This leadership also found expression in strong state and national professional associations. We can review our history and name the strong leaders of the past and, to some extent, lament the perceived dearth of strong leaders today.

Did former leaders lay a foundation that assured technology education's place as an integral component of strategic importance in education in the 21st century? If they did, why are we still trying to identify the critical changes or improvements needed to secure a place for technology education in the next century? We had strong leaders in the past, but there was little unity in the profession. The philosophical conflicts among the past university leaders, and to some extent the state supervisors, is well documented. Strong leaders, with their devoted disciples, often created conflicts within the profession. We spent our energies infighting rather than communicating to the education community and to the public at large the great benefits students accrue through technology education. To assure that technology education is an integral component of strategic importance in education in the 21st century, our profession needs unified leaders who will develop a shared vision for our future. Without a shared vision, technology education will never fulfill its potential in educating the youth of today for the world of tomorrow. In his book *The Fifth Discipline*, Peter Senge (1990) noted that "…few, if any, forces in human affairs are as powerful as shared vision" (p. 206). He further stated that "when people truly share a vision they are connected, bound together by a common aspiration" (p. 206). People with a shared vision "create a sense of commonality that permeates the organization and gives coherence to diverse activities" (p. 206). Technology education needs a shared vision—a vision that will provide coherence within our profession.

Senge (1990) noted that a shared vision is "a force in people's hearts, a force of impressive power" (p. 206). However, the vision must be shared. A vision developed by an individual, or a small group, that is imposed on an organization (or a profession) tends to "command compliance—not commitment" (p. 206). Perhaps trying to "impose" their personal visions is why our past leaders, and their disciples, were unable to secure a foundation for our programs (and profession) as an inte-

gral component in education.

The benefits that students derive from technology education are critical to preparing them for life and work in our technological society. We must realize, however, that sometimes even the best ideas fail to gain recognition and acceptance. Senge (1990) indicated that "new insights fail to get put into practice because they conflict with deeply held internal images of how the world works, images that limit us to familiar ways of thinking and acting" (p. 174). Senge indicated that the "familiar ways of thinking and acting" are mental models. Mental models are very powerful as they affect how we view things, and we tend to view new things through the lens of our past experiences. Womac (1998), when speaking of mental models, stated that "we need to be open to new ideas and share our mental models." Vision, mental models, and unity are needed in our profession.

If technology education is to become an integral component of strategic importance in the total education enterprise of the new century, we need to: (a) learn from our history, but not be controlled by it; (b) be willing to move out of our personal comfort zones; (c) change our mental models, if you will, as a precursor to developing a shared vision for our future; (d) develop a shared vision; and (e) develop and support leaders who can guide the profession in achieving that vision.

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Rupert N. Evans, Dean Emeritus
College of Education
University of Illinois at
Urbana-Champaign

This is a tribute to Dr. Harvey Dean of Pittsburg, Kansas, who has done more than any other person to change the face of technology education in the last quarter of the 20th century. Unfortunately, he is not a member of the Mississippi Valley Conference, and he may even be unknown to some of its members.

What has Harvey Dean done? He has designed a system of equipment, furniture, and instructional materials for technology education in the middle school. He did not do this in a university, but through his own company, Pitsco. He has plowed back the profits from the sales of these teaching modules into further development of his system and into its dissemination. The result is that more than 1,500 middle schools are using his curricula, far more than have ever adopted the recommendations of tax-funded curriculum studies conducted by universities.

As do all innovators, Dr. Dean owes great debts to some of his predecessors. In the second quarter of the 20th century, William Warner developed the concept of a "Laboratory of Industries" at The Ohio State University. His organization for instruction rotated students from one instructional position to another. It used space and equipment efficiently, but few instructors seemed able to cope with teaching such a wide variety of simultaneous tasks.

In the third quarter of the century, Don Maley of the University of Maryland developed a revised curriculum based on testing and experimentation rather than the construction of take-home projects. During the same period, Henry Ziel, at the University of Alberta, used a similar curriculum but improved the effectiveness of instruction by providing self-teaching media at each teaching station, thus conserving instructor energy and supplementing the instructor's personal knowledge. He worked to disseminate his concepts, but few professors were willing to learn.

As the last quarter of the century began, Harvey Dean began to use his company as a vehicle for curriculum development. I do not know why Professor Dean left a university setting to develop his innovations, but I do know that few universities have been involved in studying, let alone promoting, his ideas. Other commercial firms certainly are aware of his successes. One company after another has begun to sell modules that have more than a faint resemblance to the Dean (and Ziel) instructional materials and processes. Are universities not involved because they are afraid of using technology in technology education? Or because of the "Not Invented Here" syndrome? Or because university faculties are less in touch with what is really going on in schools than are Dean and his competitors?

A key question facing the Mississippi Valley Conference is "How should universities be involved in technology education?" At one time, many members of the conference worked hard to reshape industrial arts and all of them prepared teachers for secondary schools. Today, the members are much more likely to be training technologists or instructional administrators who work in business or industry. However, in response to the recent increase in demand for technology education staff in secondary schools, some universities have revived their teacher education programs. Intermittent attention to teacher education is understandable, but it is not desirable.

There is an even more basic problem than periodic teacher education. Major changes are occurring in technology education, but they have little relationship to what universities have been doing in the last quarter century. If universities are to be involved in technology education, they also must be involved in curriculum development that consists of more than preparing endless lists of goals. Harvey Dean has set an example for us. Are we willing to accept the challenge?

P.S. I have no relationship with Pitsco or any other company producing instructional materials for technology education.

Dennis R. Herschbach
Associate Professor
Department of Educational Policy
Planning and Administration
University of Maryland

Looking Past 2000

Subject fields in the school do not have an inalienable right to a secure and permanent niche in the curriculum. They maintain their place in the school through the support of an educational public that values what the subject has to offer. For this reason, most subject fields are constantly balancing their own professional identity with changing public priorities, altered perceptions

about schooling, and a larger pedagogical climate that itself is changing. Subjects that continue to project value to the educational public prosper; those that do not reflect value cease to exist. Some subjects simply totter along for an extended period of time, unable to fully articulate their educational importance until they lose so much support from the educational community that they, too, sink into oblivion.

Technology education has considerable potential to generate substantial public support. However, the subject field is floundering in uncertainty. It has not been able to define itself in terms that appeal to the educational public's deeply held beliefs and values concerning what should be taught, why, and to whom. There are at least three major challenges that must be successfully confronted in order for the field to continue to play a significant educational role in the next century.

First, and most important, technology education has to focus on how best it can serve students. Less time has to be spent on speculating about technology itself, and more in finding out what parents and students expect from the field and how we can translate these expectations into programs that will address their immediate and concrete education concerns. How does technology education, for example, help youth achieve in school, prepare for jobs, pursue postsecondary education and training, and enter successfully into adulthood? Unless the field can respond satisfactorily to such concerns, it will not be able to mobilize public support behind technology education. The beginning point of programming is not technology. It is parent and student concerns.

Second, the field has to build on what is probably its strongest educational suit. Technology education best can be conceived as an interdisciplinary, activity-based subject field that offers students the opportunity to apply knowledge to the solution of practical, technological problems. The words *interdisciplinary* and *activity* need to be stressed. Perhaps no other subject field in the school offers such an opportunity for students to integrate knowledge from interrelated fields of study as they engage in self-directed activity situated in a real-world context. However, the profession has been painfully slow in making its case to the educational public.

And third, it is crucial to generate support within the larger educational community of which technology education is a part. The field has been too inward looking and self-occupied. One is struck, for example, by a seeming lack of rigorous, systematic thinking about curriculum planning that largely ignores current educational reform efforts and emerging learning theory. Yet, if the field is unable to engage in meaningful dialogue with the greater educational community, it cannot expect to draw on support from this same community as it struggles to define its place in the school curriculum.

Daniel L. Householder, Professor
Department of Educational Human Resource Development
Texas A&M University

If technology education is to be an integral component of strategic importance in the educational enterprise, the profession must:

1. Expand the intellectual foundation of the field beyond design, manufacturing, construction, communication, transportation, engineering, and architecture to include the full range of techniques for changing and controlling the natural and human-made world.

2. Explicate a recognizable body of technological knowledge and practice to serve as a resource base for designing instruction.

3. Evolve unique comprehensive curriculum development strategies to integrate knowledge and practice with contemporary understanding of the way learners acquire knowledge and skills.

4. Explore and value the differing meanings individuals and groups ascribe to technology so that appropriate programs may be designed to integrate within their individual and cultural frames of reference.

5. Examine the impacts of technology within and upon contemporary civilization with a clear and critical vision to ensure the highest quality of life for future generations.

6. Explain the contributions of technological studies in more effective ways, targeting key stakeholders who can position the field at the center of the educational endeavor in communities, states, and nations.

7. Expand teacher education to provide and implement a comprehensive scheme to prepare teachers who can excite young people about the study of technology.

Everett N. Israel
Professor of Industrial Technology
Eastern Michigan University

The Future of Technology Education: Meeting the Challenge

At no time period in our history has there been such recognition that all elementary, middle, and high school students must understand the role of technology in society and culture to be well-educated citizens. The general public and subject matter experts are beyond giving lip service to this universal tenet; they want action. Many national curriculum projects and standards are implementing the study of technology in the general education curriculum. Parents are being turned on by outstanding technology education programs. The ITEA has been successful in developing collaborative relationships with major national associations and developing long-lasting relationships with key shakers and movers.

The time is right for the technology education profession to generate the critical mass needed to have technology required as part of general education for all K-12 students. The questions are, Can the technology education profession work together and with others to develop and implement a strategy in which parents, educators, professional associations, business and industry, and government will demand education programs that will help future citizens to understand, be able to apply, and appraise the role of technology in everyday life? Will the technology education profession create the critical mass that results in others demanding that the study of technology be required of all students? One can't push a string to move an object, but others can be motivated to pull a rope to create a critical mass.

Once the study of technology becomes a part of general education, can the technology education profession ensure that teachers are able to deliver

quality technology programs? Can the profession develop creative ways to ensure that teachers from a number of different subject matter areas will join with technology education teachers in developing quality programs and keeping them current?

Will technology teacher education programs make the necessary changes to prepare teachers to develop and teach quality stand-alone and integrated units of instruction, curricula, courses, and programs about technology? Will current and future technology teacher educators remove the blinders of the past and create new and effective solutions for preparing and certifying teachers? Make our dreams become reality! The time is right to take action, to work together and meet the demand for quality teachers. An optimistic attitude leads to creative solutions and creates a positive and productive professional work environment.

Scott D. Johnson, Associate Professor
& Graduate Programs Coordinator
Department of Human Resource Education
University of Illinois

It is difficult to imagine the field of technology education component of strategic importance in the total educational enterprise. While we in the field have devoted our professional careers to making this happen, we have made little progress this century and the prospects for significant change in the future appear bleak. The biggest barrier that prevents technology education from becoming an indispensable component of the school curriculum is, in my opinion, society's perception that technical courses and nonprofessional jobs are desirable only for those who are less bright and less affluent. Parents expect their children to attend college because they believe that good jobs are available only to college graduates. School boards and superintendents promote their school systems by publicizing the college acceptance rates of their graduates. Universities further support the public's perception by raising academic requirements for admission and refusing to accept high school coursework in applied physics and mathematics. This is a deeply rooted societal problem.

Unless there is a dramatic economic decline in the future, it is unlikely that the public's value for technical work will change without significant effort on the part of the profession. At the very least, three major initiatives need to be implemented if technology education is to become a truly valued component within America's schools. First, critical alliances with industry, professional associations, and government agencies will need to be established. At the national level, ITEA has made progress toward such alliances in recent years, but more must be done, especially at the state and local levels. Such alliances will provide the critical mass of influential leaders and decision makers needed to sway public perception. Second, technology education must gain a foothold in the elementary curriculum while children are still self-motivated to learn and where parent involvement in schooling tends to be greatest. Technology education can become a foundation in the elementary curriculum by providing a motivating, hands-on interdisciplinary learning experience that fosters creativity, motor skill development, and an understanding of basic principles of science through the application of technology. In addition, a strong elementary school presence will enhance future enrollment in secondary-level technology programs. Third, technology education needs to better serve all students, college bound or not. The unfortunate battles of the past argued the benefits of a general education versus a vocational focus for industrial arts. This hindered the opportunity for technology education to evolve into a multifaceted program that provides occupational skills for those who will enter the workforce upon graduation, appropriate experiences for those who will pursue technical programs in community colleges, and a pre-engineering emphasis for those who will attend university-level engineering programs. Technology education should model its curriculum breadth after other programs such as mathematics, where a range of courses, such as basic math, technical math, and college math, serve all students.

These three initiatives, establishing critical alliances, creating a presence in the elementary curriculum, and broadening the program emphasis to serve all students, are the critical events needed to establish technology education as an integral component of strategic importance for education in the next century. Each of these initiatives can help build public support for the study of technology through a proactive process of collaboration, networking, and systemic educational reform.

Theodore Lewis, Associate Professor
Department of Work, Community & Family Education,
University of Minnesota

From This Day Forward

Technology education will have to admit to both general education and vocational purposes. The field has to do this for the following reasons. The nature of work and vocations is changing. Work today has to be infused with knowledge. Workers have to be as educated as they are trained. We need not fear that a vocational purpose means narrowly conceived programs. Indeed, vocational education has been striving to recast itself through integration with academic education. Technology education can offer children their first glimpses of careers and, more generally, of work life. This is not new, of course. Calvin Woodward had offered a similar analysis in 1863 when he wrote about the benefits of manual training. Children in technology education classes, especially in the high school, should become technologically capable. That is, they should become proficient in the use of computers and in applications where computers interface with machines. They should also be reasonably proficient in tool use. In summary, technological literacy and technological capability are to be the goals, where literacy means disposition and capability means competence.

All education is ultimately vocational. It is always unnecessarily idealistic to pretend that forms of schooling are impervious to the labor market. For example, competence in mathematics is much sought after by employers. Technology educators need to seek to connect their discourse within the mainstream of education. We generally talk among ourselves. As a result, the field remains an outsider despite more than a century of solid existence in the public schools.

Technology education has to look to nontraditional ways of recruiting teachers. Many mid-career engineers would be good candidates for teaching positions. We have to figure out ways to do this. I think that in Wisconsin and Florida there are such programs. At Stout, Len Sterry is involved with non-traditional certification. This is the future.

We should pay more attention to connections between technology education and art. William Micheels used to emphasize this with us at Stout. The point is still valid. The focus has to be on creativity. We need to spend more time helping children identify and define as well as solve problems. Recognizing and defining the problem should be given as much prominence as solving it. Let children look around their homes and communities for problems that they think require a solution. If we can inculcate that disposition, we would be helping them to better understand the work of technologists.

Finally, technology education can provide context for other areas of the curriculum beyond art. We can take advantage of the widespread interest now in "situated cognition," that is, the need to place learning in context. We have to move out of the shops and reach out to others.

Donald G. Lux, Professor Emeritus
Technology Education
The Ohio State University

Change Imperatives

Technology is a body of knowledge that has been instrumental in determining the winners and losers in the search by humanity for a more secure, efficient, and rewarding way of life. Most simply put, it is the body of knowledge of efficient practice, whether that practice be harvesting, making music, healing, and so forth. Given its role in mankind's very existence, it is indeed puzzling how its role in formal education has been almost completely overlooked. Perhaps this may be attributed to the fact that throughout much of mankind's history one either became an accomplished student of technology or was short lived. The value of knowledge of practice was taken for granted, and the belief that it would be absorbed by simply growing up in our culture confounded the situation. Even today technology largely is not seen as a part of basic formal education.

If the above is true, then the first and perhaps most important change technology advocates must effect is to create a compelling information program that will convince the public of the importance of knowledge of practice and of public literacy in this body of knowledge. Concurrently, a massive effort must be made to gather examples of existing programs that can be seen to contribute to technological literacy and to liberal education in the 21st century. These must be given wide exposure as an essential component of the public information program. These demonstration programs must be laboratory based if they are to be believable as examples of students studying knowledge of practice. Actual participation or practice is an essential element of knowledge of practice. Just as music appreciation classes do not teach one how to play music, listening to verbiage about technology and/or watching others practice technology will not result in learning technological knowledge. Our pictures must make it clear that we teach skills as an integral part of technological knowledge.

If this program is effective, the public will come to see that technological literacy is essential to our survival, to the protection of our freedoms, and to the advancement of our culture and prosperity. There is nothing wrong with technology education in concept. Our fault lies in our inability to present a clear and convincing explanation of what technology is and what it can contribute to effective liberal education programs.

The ultimate end of these changes should be to make knowledge of practice (technology) the core of public liberal education from preschool throughout life.

G. Eugene Martin, Professor and
Dean
School of Applied Arts & Technology
Southwest Texas State University

Where Are Our Leaders?

Technology education professionals nationwide will argue that there are many critical changes or improvements that must occur if technology education is to be an integral component of the educational enterprise. However, there is one change or improvement that reigns supreme above all others. Today, there is a lack of sound and substantial leadership among the rank and file within the profession—we are becoming a leaderless profession.

The technology education profession in the United States (and probably internationally as well) needs a mass of people at all levels of education, whether they be at the local, state, or national levels, who are willing to step forward to provide a new level of leadership. The profession is in dire need of people who want to lead, who want to learn how to lead, and who are committed to leading throughout their professional careers. Developing professional leadership teams is very important, if not mandatory, for our survival.

The profession needs to make sure that every future technology educator is a leader. It needs people who know how to frame the critical problems facing the profession and then lead other people in the development of plausible solutions to these problems. This will require that leadership development be a very important part of the teacher education curriculum. Leadership training must start now, not tomorrow, if there is to be any significant change in our position in the educational enterprise. There must be a heightened concern about the need for leadership development within the profession. Leadership, or the lack of it, must be addressed immediately if the profession is to play a critical role in the educational enterprise of the new century. This problem deserves the undivided attention of *all* people in the profession. Unfortunately, at this point in time, I do not sense an uprising in the profession to address this issue. Is it possible that I am incorrect in my analysis of the need for leadership and the role strong leadership could play in leading the profession into the coming century?

Jerome Moss, Jr., Professor
Emeritus
University of Minnesota

Connections

The defining characteristic of the field of study we now call technology education has always been to make things using the tools, materials, and processes that illustrate selected technologies of the times and their implications for the individual and society. As the field has evolved since the late 19th century, many attempts have been made to justify its place in the K-12 curriculum by reinterpreting its benefits in terms appropriate to extant cultural conditions. And yet, despite these efforts to remain educationally and socially significant, other educators and the public persist in perceiving the field, and justifying its value, in terms of limited utilitarian benefits to the individual: boys (mainly) learn to make and fix useful things, and they sometimes (incidentally) benefit occupationally from the experience.

What reinterpretation of its potential benefits might improve the field's perceived and actual value in the K-12 curriculum during the next century? One promising approach is to capitalize upon the field's many opportunities for building "connections" within the school curriculum. Technology education needs to be seen as important, not only in its own right, but also for its contributions to the greater effectiveness of other subjects. By using its methodological practices as well as its content, technology education can become viewed as a gender-free, integral, and critical part of a coherent total school curriculum.

Offering hands-on, realistic experiences in technologies is the methodology of the field. It supplies the functional context for demonstrating the applications and enriching the meaning of many abstract concepts taught in mathematics and the physical sciences. The method provides opportunities for building cognitive capabilities. Simulated experiences can also enliven both civic and ethical education by illustrating how technological change can be used either to facilitate or to block progress toward the goals of a democratic society. This integration (or more accurately, coordination) of subject fields can only be accomplished when technology teachers see other fields as opportunities for collaboration rather than as competition for curricular space, when they are willing to expose their ideas to the scrutiny of teachers in other fields, and when they are able to plan cooperatively.

As vocational education redefines itself, vocational curricula are becoming less specialized. At the same time, the academic subjects are becoming more concerned about practical applications beyond schooling. The time is propitious to exploit, rather than resist, the natural connections between technology education and the world of work. The occupational implications of technologies and technological change provide a rich resource for exploring a wide variety of careers. Technology education teachers should deliberately plan and provide for a wide range of experiences that help students learn about themselves in relation to relevant occupations. And the planning should be done cooperatively with vocational teachers so that the overall career development of students can be accomplished as efficiently as possible.

The idea of "connections" for technology education is, of course, not new. Some scholars have written about various aspects of it, and some teachers are attempting to practice parts of it. But if technology education is to make a significant impact on the school program in the next century, then *connection* needs to become the norm rather than the exception.

Stephen Petrina, Assistant Professor
University of British Columbia

It's 1999: Are We Part of the Problem or Part of the Solution?

"What's past is prologue," Shakespeare wrote. Neither a historian nor a citizen of the 19th or 20th centuries, Shakespeare had a prescient grasp of humanity. In our time, we in the industrialized world walk the thin line between Shakespearean self-destruction and fulfillment. We've been wretched in our continuation of gross inequities between cultures, in our mismanagement of our knowledge, and in our annihilation of much of our natural inheritance. We've also been able to recover from our most self-indulgent acts and are learning to celebrate our capacities for compassion, conservation, and love. We are learning to attend to our past along with reassessing our myopic and often technocentric visions of the future.

At this particular juncture in time, education is situated in a precarious position. With a checkered past of educating for cultural imperialism, competitive, patriotic nationalism, religious intolerance, and "progress" at any expense, it's uncertain whether schooling is part of the solution. In the United States, a separate system of industrial schools has maintained separate funds of knowledge for African descendants, Asians, Hispanics, and Native Americans on one side, and for European whites, generally, on the other side. Less racially diverse, Canada maintained a separate industrial education system for their aboriginal children that, as in the United States, was inferior to that for White children. The legal system changed segregation practices in both countries during the 1950s and 1960s, but by no means were conditions altered. A recent documentary by Jonathan Kozol showed that in the late 1990s, "savage inequalities" continue in the technology education of suburban and inner-city students of the United States. In the Cleveland area, for example, suburban districts such as Maple Heights enjoy new modular technology facilities and a large budget for consumable supplies. The Cleveland inner-city shops continue to limp along with leaky roofs, warped floors, and surplus drill presses from the 1920s.

But along with racial inequalities, technology education reproduces gender and class inequities. A separate system of industrial education for boys and girls maintained gender differences in knowledge and mobility throughout this century. Generally and especially at the secondary level today, students and teachers in technology courses are male. The school system in both Canada and the United States continues to provide separate education for college-bound and vocational students, demonstrating class differences rooted in century-old practices. Working classes continue to be short changed, and tech-

nology educators in the United States have turned their backs. In most technology educators' discourses, it's difficult to find any references to labor (Petrina, 1998a, 1998b). In terms of class, gender, and race, it's not clear that technology education is part of the solution.

For the past century, we've managed to align industrial and technology education with economic interests. In the latter third of this century, technology education was defined in terms of competitive supremacy. In the United States, this continues unabated. The new National Standards for Technology Education were recently constructed, according to the project's director, "to enhance America's global competitiveness in the future" (Dugger, 1995, p. 4). Technological literacy was constructed in the same base, economic terms (Petrina, in press). Country is pitted against country in economic stakes that have placed incredible demands on a dwindling natural inheritance. It doesn't much matter to technology educators that 20% of the world's richest nations use 80% of the world's resources. It doesn't seem to matter that one quarter of the world's population does not have basic necessities such as clean water, food, and shelter. The average American consumes 120 pounds per day of resources and throws away four pounds of garbage each day. Every time a technology educator teaches students that winning the economic stakes is America's destiny, the path is paved for a gluttonous economy out of control. In ecological terms, it's not at all clear that we want to be part of the solution.

"Good" technology education continues to be about lifestyle changes. To be part of the solution, technology educators ought to model a reduction of consumption and production in their own lives and in their labs and shops. Good technology education means recovering "Depression-era" values such as compassion, conservation, dignity, frugality, modesty, and simplicity. Our natural inheritance is not ours to exploit. Those of us teaching in privileged countries ought to encourage our peers and students to live simply so that others may simply live. Good technology education means taking equity seriously and sharing power with our sisters and brothers of color. Those of us in positions of power ought to muster the will to say "no" to competitive economic stakes, to exploitive practices of globalization, to homophobic aggression, to racist structures, and to sexist displays of masculinity. Good technology education means that our fair, gentle, and just practices of the past are the prologue for tomorrow.

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David J. Pucel, Professor
Department of Work, Community & Family Education
University of Minnesota

Technological Literacy: An Essential Ingredient for Life and Careers

Technology and its impact have been acknowledged as major concerns of society. "It is...commonplace that modern science and technology...are leading forces..." (Rapp, 1989, p. x). Technology, defined as "the application of knowledge, tools, and skills to solve practical problems and extend human capabilities" (Johnson, 1989, p. 1), impacts all of us. However, when asked to define technology, most people think of such particular objects as computers, the space shuttle, or cellular phones. They are fascinated with what technology produces, but few have an understanding of what technology is as a field of study or how technology evolves. Brockway (1989) suggested that people who cannot adequately understand and deal with technology are "techno-peasants," serfs of technology rather than masters of technology. This suggests that technological literacy must be viewed as part of general cultural literacy if people are to be able to fulfill their roles as citizens within a technological society.

Within this evolving context of the increasing importance of technological literacy, the most important change that can take place in the field is for technology education professionals to clearly communicate the importance of technological literacy to society and the important role technology education can play in providing that literacy. Such literacy is foundational both to citizenship and to becoming economically productive citizens. However, in order to deliver the type of education required, technology education must adopt philosophical and methodological premises, which can actually facilitate the preparation of technologically literate individuals. Teaching strategy can no longer be limited to the use of lock-step modules of instruction in which students have little or no chance to innovate or to truly understand the technology underlying the activities. We must teach basic technology principles and provide students with opportunities to produce innovative but workable technical solutions to real problems. It also means clearly relating technology to students' visions and expanding their perceptions of what the future may hold for them. Since work and careers are a substantial portion of most students' visions, technology educators must discontinue the view that technology education and career education are antithetical. Current leadership needs to abandon past feuds with traditional vocational education and create new models for viewing the role of technology education in career preparation. Neither technology education nor vocational education based on industrial or information-age views will meet the needs of students as they enter the new knowledge/imagination age. Technology education should provide basic skills and understandings of technology, which obviously are required and applied in careers.

A major challenge to the prospect that technology education will assume this major role in the future education of society is the preparation of teachers. Teachers will need to be prepared with increased understandings of the sciences underlying technology and with the technical skills involved in applying technology. If technology education is going to make a claim that it is funda-

mental in the education of students who will be able to understand and apply technology in imaginative and innovative ways, teachers must be able to facilitate student innovation. The current practice of diminishing the role of the teacher by providing modules leading to pre-determined solutions and suggesting that the teacher only needs to be a facilitator, only makes mockery of the true essence of technological literacy, which suggests the ability to apply technology in innovative ways to solve human problems.

There is a major role that society needs to have filled regarding the development of a technologically literate society. Can technology education deliver?

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Willis E. Ray, Professor Emeritus
The Ohio State University

Rather than attending to tactical queries such as "What are the most critical changes or improvements that must be made?" this mini-treatise addresses an often used, more comprehensive framework of higher order questions. Leaders in the profession, especially those who are members of the MVTTEC, should seek answers for and create solutions that relate to these four strategic questions: (a) Where are we going? (ends question); (b) How are we going to get there? (means question); (c) How will we know that we have arrived? (valuation question); and (d) What are the optimum support systems that are required? (sustenation question). These questions are as critical for technology teacher preparation curricula as they are for school-level, other collegiate, and adult-continuing technology programs.

Due to an imposed "carefully chosen words" restriction, what follows will not meet with the approval of those who wish to read full sentences and/or contemplate the thrust of properly drawn paragraphs. The words and phrases below are meant simply to provide flashes of light, which may cause even greater thoughts. Consider taking some of the following actions to help produce a viable program for 21st century technology education.

The Ends Question. Promote technology as a significant and growing domain of knowledge ("know how" to do efficiently) and distinguish this knowledge from the products and services such knowledge produces. Differentiate technology from language and mathematics (formal knowledge), the humanities (prescriptive knowledge), and the sciences (descriptive knowledge). Exploit the supportive relationships between and among the humanities, science, mathematics, and technology. Expound upon the general, liberal education functions of technology as well as the pre-employment and employment education purposes. Codify a distinct set of concepts, principles, and generalizations of technology that may be reinforced through doing experiences for each level of schooling (i.e. primary school, middle school, high school, postsecondary vocational, technical, and engineering studies, and adult and continuing education). Establish "technology" as a schooling curriculum organizer, with content and subject matter distinct from other schooling programs.

The Means Question. Develop public support for technology education at all levels by planning, organizing, and controlling public awareness promotions. Organize student groups (TSA and TECA, for example) as integral extensions of our instruction. Improve applications of traditional teaching methods of lecture, discussion, demonstration, discovery and problem solving through experiments and projects. Create instructional materials (comprehensive courses as well as modular units of study) that sample, systematically, at equal levels of generality or specificity, the total matrix/array of the technology knowledge base. Prepare teaching/learning units for Internet/Web delivery by personal computers (the IACP staff dreamed about such delivery systems, but the world and we were not ready). Experiment with "virtual learning" approaches and "distance technologies." Approach corporate media groups to place in cyberspace organized treatments of technology education.

The Valuation Question. Adopt/adapt, but make use of, the Standards for Technology Education Programs covering the program elements of philosophy, instructional programs, student populations served, instructional staff, administration and supervision, support systems, instructional strategies, public relations, safety and health, and evaluation. Improve all approaches to assessing learner achievement in technology. Encourage statewide testing programs, which include technology as a program area. Promote technology as a program area within a voluntary national testing program. Sample, periodically, the reaction of school administrators and other professional colleagues to our efforts to define, promote, and improve our discipline.

The Sustentation Question. Participate in the program of work of the ITEA. Support the Foundation for Technology Education. Contribute to other national, regional, state, and local councils and associations. Interact with administrators of schooling at all levels. Encourage adequate staffing and financial support for program supervision. Plan and have constructed/remodeled laboratory facilities that are flexible. Patronize and encourage new and existing commercial organizations that publish and distribute instructional materials focused on technology subject matter. Support commercial companies that sell innovative curriculum and laboratory materials, equipment, and devices. Continue to upgrade teacher education programs, using NCATE and ABET standards, among other accrediting agencies. Support publicly-funded, experimental charter schools if they include an innovative technology education program area. Seek to encourage/enact legislation at the state and federal levels that would be "umbrella" to the concept of technology in *all* of its schooling manifestations.

Postscript. Surely, by now, you have recognized that these comments have come from afar, both in distance and (lack of) recent professional experience. But if what is suggested above sparks an

idea or two in current leaders' thoughts, the profession just could make some changes and improvements as we move toward the next century.

Mark Sanders, Associate Professor
Virginia Polytechnical Institute and State University

Politics as Unusual

In an era in which technology rules, technology education offers one of the most compelling curriculums in all of education. Yet, few outside our field see technology education as an important—let alone essential—school subject. This is our identity crisis; and when the subject turns to this, someone invariably suggests a public relations campaign. The author has been guilty of doing so on more than one occasion. But the truth is, we simply do not have the capital to mount a public relations campaign capable of convincing the masses to vote "yes" for technology education. Rather, we must identify the relatively few who possess *real* influence (power) and gain their attention and political favor. If technology education is to realize its potential in the 21st century, we simply *must* become aggressively and outwardly political. Very little of real significance will happen in our field until we re-direct our energies and resources toward this task.

As we go about this business, we should be aware that science education is working to incorporate technological education, as we know it, into the science curriculum. Content Standard E of the *National Science Education Standards* promotes technology education objectives and activities for the science classroom (National Research Council, 1996; Sanders, 1996). Such major competitions as the NSTA/Duracell Scholarship Competition, the NSTA/Toshiba ExploraVision Awards, and the Craftsman/NSTA Young Inventors Awards Program utilize millions of dollars of corporate support to promote hands-on technology *as science* (Sanders, 1997). We should be aware that tomorrow's technology teacher is more likely to be certified in science than in technology education. Keeping that in perspective may allow us to be more effective in our struggle for technological literacy for all Americans.

We *have* made some strides in various political arenas over the past five years. The author recently surveyed state supervisors of technology education to assess the extent of political activity taking place (Sanders, 1998). Fifteen of the 22 states responding described political activities underway. Massachusetts and Texas have hired lobbyists. Florida has received more than $55 million from the state legislature over the past five years to fund technology education initiatives. Connecticut, Massachusetts, Minnesota, and Virginia have worked directly with state legislators to promote the inclusion of technology education in educational reform legislation. Connecticut and New York are formulating new strategic alliances with the corporate sector and the engineering community. New Jersey is working with the Chamber of Commerce to influence state-level policy. Virginia has successfully lobbied for high school science credit for such courses as Principles of Technology.

The ITEA has also stepped up its efforts in this regard, having identified 80 different associations with whom the Association interacts during the year. The "major players" with whom they interact regularly include NSTA, NASA, NCTM, NRC, NAE, NAS, NSF, NASSP, and NAESP (K. Starkweather, personal communication, August 11, 1998). And of course, the Technology for All Americans Project is the most comprehensive political activity in our field to date, having begun to command the attention of many different influential parties.

These efforts are a good beginning, but we must, as a profession, embrace the notion that *educational change is the direct result of political action*. Lacking the resources to sway the masses, we must focus instead on two key political constituencies: corporate executives and state politicians. We should woo corporate executives because they provide the clout to influence the politicians. And we must lobby our politicians because state legislation focused on educational reform is currently motivating change in education all across America. But even when we cannot muster corporate clout, we should carry our tune to our politicians. Because, after all, "technological literacy for all" is a message most Americans not only want to hear, but facilitate.

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Ernest N. Savage, Interim Dean,
College of Technology
Bowling Green State University

The most critical changes that must be made for technology education to become an integral component of strategic importance in the total educational enterprise relate to image and teacher mainstreaming. Our image is not clear, neither to ourselves nor to our profession. In discussions last year with representatives of ITEA and TfAAP, it became clear that we chose the wrong name a few years ago. Why are we always trying to clarify the difference between technology education and educational technology? Perhaps our name should be technology studies, paralleling social studies. (Everyone knows what that means.) Then we could further clarify our context and content under that umbrella. Of course there would be much discussion about these names. Would it be physical, information, and bio-related technology? Or perhaps, chemical and biological technology? Regardless of the final outcome, I believe that progress must be made on the clarification of the image of our field of study.

Of greater concern is the subject of teacher mainstreaming. We must inform our teachers of their place in the emerging research on the brain-based approach to learning and teaching and the delineation of multiple intelligences. Many of us can relate to the difficulties that we experienced as learners in a mathematical/analytical and verbal educational setting. However, when given the opportunity to learn in a spa-

tial, tactile, musical, kinesthetic, interpersonal, or intrapersonal setting, we excelled. Finally, we are supported by research relating to dominant and multi-intelligence modes. We must understand this research because it relates to our learning and teaching styles in as significant a fashion as Deweyism supported our philosophy of education.

As the educational enterprise becomes dissatisfied with the limited role that technology is playing in teaching/learning, we must be prepared to demonstrate how technology can touch every sense, every intelligence, and every real opportunity to allow learners to use resources, systems, and processes to understand the natural and human-made environment.

Michael Scott, Associate Professor
Technology Education
The Ohio State University

Education: A Good Beat But Still Hard To Dance To

In a chapter in the Symposium II monograph, Bjorkquist and Swanson (1981) used a title similar to the above to describe the concept of technology education that then was being promoted by members of our profession in a transformation from the use of the term *industrial arts*. While their paper was intended to provoke thought, it is intriguing that the questions they posed then are just as relevant today. After nearly 20 years (and the development of a conceptual framework, rationale, and structure), why are we still grappling with the concept of technology education?

Those who take a defensive posture claim that the problem is not with technology education but with those who perceive technology education as being something lesser than real formal education. They claim that we suffer from the Rodney Dangerfield "I Don't Get No Respect" syndrome.

What is technology education? How must it look in the next century? Our literature is replete with examples of technology education being "all things to all people." There are those, for example, who claim that the hallmark of technology education is problem solving. While problem solving is a desirable outcome of any good technology education activity, it is no more unique to technology education than it is to math, science, or any other discipline. Others focus upon the integration possibilities for technology education. They claim that the integration of technology education with subjects such as mathematics, science, and/or social studies education is a prescription for survival in the next century and beyond. While several recently developed efforts are showing positive results of the integration with mathematics, science, and technology education, too often such confederations result in big "M," big "S," and little "t."

Further, all too often today when one mentions the term *technology education* in educational institutions, the public assumes that we are referring to instructional or educational technology. Clearly, we suffer from a serious identity crisis from the perspective of those outside our profession. In the 1960s, 1970s, and 1980s many of us ran from any thought of being associated with vocational education. While history makes such phobias clear and sometimes justified, could it be that we have run too far and too fast? Such other nonvocational school disciplines as mathematics, science, and social sciences have found new connections with school-to-work initiatives that are contributing to a more vital and competitive workforce. By and large, technology education has been a small player in this game and has suffered greatly for it.

In summary, technology education professionals need to quit trying to be all things to all people. The field should establish a clear and unique vision. But, more important, we need to clearly communicate who we are to those outside of the profession in terms that they understand. Technology education can and should be a vital part of educational enterprise for the next century.

Kendall N. Starkweather,
Executive Director
International Technology Education Association

Teacher Shortage. One of the most immediate problems facing our profession is teacher shortage. This is a problem not only in our field, but in most areas of education. Technology educators know of the problem and what caused it. They are now working on solutions for the problem of filling 13,000 vacancies by the year 2001. It is difficult to get everyone in our field to understand that the critical shortage of teachers is a problem for all of us. Classroom teachers often think that the problem for universities and many university personnel are not willing put forth the effort required to recruit a sufficient number of prospective teachers. There are many other perspectives on this issue. The bottom line is that recruitment of prospective technology education teachers is everyone's problem. It is a problem that requires considerable attention by educators at all levels. The challenge will be to get enough qualified technology teachers in the workforce to continue to move the profession forward and thus avoid having programs either closed or staffed by unqualified teachers.

Professional Development. The profession is struggling to provide strong leadership across the country. Gone are many university programs of the 1960s that gave teachers a variety of avenues to satisfying careers in the profession. Gone also are many of the strong philosophical leaders or advocates who in days past placed their brands on developments in the field.

A variety of programs needs to be promoted by university technology educators who give direction to innovative developments. Currently, ITEA is pursuing many professional avenues to give direction and add strength to the profession. However, for the profession to be strong, universities throughout the country should be taking the leadership in professional development by promoting ideas, research, methodologies, and programs that will guide teachers in their pursuit of excellence in the profession.

Standards Implementation. The ITEA has led a nationwide effort to create a rationale and structure for the study of technology followed by content standards for the field. That will be just the beginning of the work. The profession must now work on the technology programs and courses that will properly teach the identified content of what students should know and be able to do as it pertains to technological studies. Many model programs need to be formulated and tried. Research needs to be advanced that will tell us the worth

of our field to the overall education of students in our country.

Every technology educator must become a developer of content and ideas that will further the goals of the field at both the elementary and secondary levels. Critical segments of our profession are starting to fall into place: (a) rationale and structure for the study of technology and (b) rigorous standards. The worth of our profession in the years ahead will be tied to how well we will be able to implement and measure our successes.

Learning Strategies. The way that technology delivers information to the classroom has changed the way research will be conducted by students. Strong technology educators are using the Internet in their instruction in order to obtain and apply the latest information available. Teachers will have to be skilled in designing meaningful instruction that utilizes the latest resources in learning how to learn with on-site instruction. The skilled teacher of the future will have ready access to facts and information that was never before available. Technology educators must be leaders in the use of educational technology and make full and effective use of the electronic world to stay on top of technological developments. They must become experts in teaching with technology as well as teaching about technology.

Program Positioning. Technology education will not approach its potential until it is considered an indispensable core subject within the school curriculum. If the tradition of keeping technology education under the vocational umbrella as a skills career area is continued, its acceptance as a legitimate core subject will always be suspect by fellow educators.

Traditionally, our field has not had a rationale and structure for the study of technology as a content area. We have considered ourselves a career exploratory technical skills activity. We must move beyond that mentality and embrace our own content and methodology that is evolving. We must position our subject area for its maximum impact on education. For some, this is bold thinking! For others, it is simply the way that the educational system should have been set up in the first place.

Sam Stern
Professor of Technology Education
Oregon State University

The most critical changes that must be made to improve the standing of technology education are those that will clarify and strengthen comparative advantage. As a subject area, technology education is part of a competitive marketplace. In a very real sense, technology education competes with other subjects for class time, space and materials, teachers, and, most important, students (and their attention). As the educational marketplace has opened up, the relative position of technology education has worsened. When administrators, students, and prospective teachers find they have a choice, they rarely choose technology education.

Consider the changes being made in my state of Oregon. Like many other states, Oregon has undertaken a number of ambitious initiatives intended to improve schools. One of these initiatives has been the development of standards for all subjects, including technology. To earn what is called a "Certificate of Mastery," future Oregon high school students will need to demonstrate mastery of these curricular goals for the area of technology: (a) understand the nature and evolution of technology; (b) understand that technology can be used to solve problems and meet needs; (c) assess the impacts and consequences of technology; (d) understand the relationships between technology and other disciplines; (e) use a variety of technological systems; (f) demonstrate how technological systems are operated and controlled; and (g) adapt technological concepts and processes to biological, informational, and physical systems to form technologies and solve practical problems.

These are indeed worthy goals. But, look at them from the standpoint of comparative advantage. Most, if not all of them, could be accomplished in other subject areas. Students in social studies classes can learn much about the nature and evolution of technology or assess impacts and consequences. I'm confident that students in all classes will learn to use technological systems (primarily computers) for a wide variety of different activities. Music students may very well be involved in demonstrations of how technological systems are operated and controlled. And, it's not much of a stretch to imagine science students studying how to adapt technology concepts and processes to biological, informational, and physical systems to solve practical problems.

Technology education has but one distinct area of comparative advantage, and it is not at all clear in the above list. Technology education's comparative advantage lies in providing a learning environment (instruction and facilities) that makes it possible for students to create with technology—to make things. The danger is not that technology education will go away. The real danger is that students will no longer have a place to be creative with technology—a place to use technology to make what can be imagined.

Leonard F. Sterry, Professor, Graduate Program Director for Technology and for Ph.D. Program in Technology Education
University of Wisconsin-Stout

Viable Mission

It has been stated over and over in our literature that we are living in a world that is influenced heavily by a phenomenon called technology. It is also said that the pace of technological development will continue to accelerate and that this will touch the lives of everyone. Therefore, it is argued that everyone must understand this phenomenon if we are going to function as participating citizens of a technologically driven global community.

All of this sounds logical, but what is technology and what is our mission? Technology is the means by which we extend capability. Our mission is to develop a technologically literate citizenry: provide persons of all ages opportunities to assess interests, abilities, and opportunities; provide transitioning opportunities that will enable persons to move successfully between levels of education and between education and work while continually enhancing the quality of life; and finally, provide an adequate base for continued lifelong learning.

Available to Everyone. Nothing re-

ally new so far! However, the challenge rests in how we attempt to fulfill this mission. First, we must understand that technology education is for everyone. This includes *all* students at all levels of education, persons in the workforce, and citizens in general. Too often we regard technology education as being just a K-12 school subject. And while it is an elementary/secondary school subject, the K-12 system of education must provide a developmentally appropriate set of experiences that consider all students regardless of age, gender, ability, learning style, interest, or choice of postsecondary pursuit. More specifically, this means programs must attract the female population, challenge the college bound, and do more than just keep disinterested kids busy and out of the principal's office. Technology is not just a male thing. It is extremely sophisticated and, therefore, potentially challenging to even the most academically able. And as for keeping kids busy, we can do even more by providing realistic experiences that help to develop skills for application outside of school. In addition, the study of technology is equally appropriate for college and university students and persons in the workforce. Postsecondary students need to study technology as a part of their general education to be broadly educated. Workers need it to better understand their organizations and to identify career and training pathways that lead to advancements and career mobility.

Must Have a Body of Knowledge. Although it is an evolving field of study, technology education needs to establish a scholarly body of knowledge that depicts technology. In the past, these efforts have sometimes been emotionally charged and political. Emotional in a sense that those willing to take time to provide leadership often determined the direction of the field. And I might add, this was positive in that at least someone tried to move the profession forward and into new and exciting possibilities. As for being political, the question was too often asked, What will the field accept? rather than What is the right stuff to teach our children to best position them for life in the 21st century?

Technology is technology. It has common characteristics that are universal; and we, the profession, must determine those attributes and design programs of study to deliver the right content. While consensus is important, scholarship is essential. Standards are currently being developed by individual states, at the national level, and in countries outside the United States. I have high hope for the standards and this rare opportunity to make a significant contribution to finding the right content for the study of technology.

Must Be Positioned. Much of what I have just said has been said before. The challenge rests with doing it. Although some improvements have been made, they are spotty. Considerable program differences can be found from one district to another and between states. As a result, we demonstrate different and inconsistent examples of technology education. It is no wonder that we are often misunderstood. We send mixed messages to our constituencies. We often write and speak one thing, but demonstrate something that is quite different. We need to keep writing and speaking the right stuff, but more important, we need to demonstrate it in classrooms and laboratories to parents, counselors, administrators, colleagues, legislators, higher education, and business and industry.

Earlier I said we need to identify content that is representative of technology, and we must. As a profession, we advocate working more closely with mathematics and science. However, if this is true, then we also must position ourselves more like mathematics and science. These fields of study are delineated by professional communities and influenced less by the interest of a teacher, principal, or local board of education. Yet, we are willing to let every school determine its own technology curriculum. While, in part, this is good, for the most part it is not good because it leads to this appearance of disarray. For purposes of study, technology is anything anyone wants it to be. We must overcome this tendency. Technology is something that can be structured for study. If we want to be a viable part of every school's curriculum, we have got to clearly demonstrate it in every classroom and laboratory. Action in the classroom speaks more loudly than our articles, curriculum guides, and speeches, as important as they are.

Jerry Streichler
Trustee Professor and Dean Emeritus
College of Technology
Bowling Green State University
Executive Director, Epsilon Pi Tau

Perhaps when recognition is achieved as a most wise elder of the profession, one can gamble. Indeed, Ray Karnes has taken a gamble by providing an opportunity for a group of us to pontificate. But he did put a leash (Should I say muzzle?) on us by allotting very little space in which to make our statements. So I have tried to meet his challenge by first raising one caution or concern, under the heading of Paranoia (?), that may be related to what must be done. I follow this with a comment under The Nobel Prize in Technology: Delusion of Grandeur (?). It is a vision that poses the challenge of what we ought to strive to realize in order to be a truly integral and effective component of the total educational enterprise.

Paranoia (?). It would be difficult to fault the International Technology Education Association (ITEA) strategy and its accomplishments in the past several years. In fact, on re-reading Karnes' 1960 statement "Improve or Perish," it seems that we are only now realizing his prescient comments through the ITEA work. But even Karnes may not have foreseen the links with NASA, NSF, and the engineering community that have been achieved along with the formation of the just-announced Center to Advance Teaching of Technology & Science (TfAAP, 1998). The former organizations are involved with ITEA's Technology for All Americans Project. The new center does have "science" in its title, and while its purpose is to "...ensure the education of technologically literate citizens," there is no mention of an endeavor to help educate citizens to be scientifically literate. Elsewhere in the description, reference is made to an interest to "enhance the teaching of technology and science in school classrooms," but my reading of the statement leaves me with the impression that the focus of CATTS is to promote technological literacy.

Room does not permit a complete presentation and analysis of matters, events, and developments that are somewhat connected with the preceding.

But a provocative list includes: 1) funded projects for curriculum development in mathematics, science, and technology; 2) the Science, Technology, and Society movement; 3) Tech prep; and 4) the high school program Engineering Principles. Also related are National Science Foundation policies and actions such as: (a) the use of the term *advanced technological education* by some NSF directorates to describe what has been widely known as technical workforce preparation offerings at the community and technical college level, and (b) the use, in virtually all NSF presentations and publicity materials, of the term *scientific and technological literacy* where some years ago the word technology was rarely, if ever, linked or included as they currently are doing.

Does this mean that we have arrived? Or could it mean that we have taught our lessons so well that those with greater influence and who are in the established disciplines and corridors of power can run with the wonderful doctrines that our profession had for so long turned into practice? The wonders accomplished by ITEA notwithstanding, and the extraordinary successes of recent years not diminished, we ought to carefully take the time to envision the scenarios that may unfold which may either result in the profession being truly established and accepted or see others delivering our carefully honed and visionary practices in the schools.

The Nobel Prize in Technology: Delusion of Grandeur (?). Let me reveal my position right off. It is that if we are talking about a profession that will be able to hold its own among the established disciplines, then we need to realize that the accomplishments of the ITEA have only to do with what is a part of the profession that ought to be conceived and built. Should we succeed in doing that, then one day that profession will produce a person who will win the Nobel Prize in Technology that the Swedish Academy will establish. In her or his acceptance speech in Sweden, the winner will look back at what contributed to becoming the person who could win the prize and would talk about: (a) becoming excited during the early years of schooling about technology as a human endeavor that holds great promise, challenge, and sometimes threat to the world's inhabitants; (b) technology learning experiences that expanded creative-thinking and problem-solving abilities and that provided a firm foundation to become an independent learner which served well throughout life and career; (c) teachers of technology at all levels, who while they had a high degree of knowledge of technology subject matter as well as mastery of learning and instruction, functioned as totally effective facilitators and thus contributed to the student becoming an effective independent and lifelong learner; (d) a recognized technology sequence in the schools that branched off into workforce and career preparation offerings at appropriate levels and the understanding, respect, communications, and mutual support that existed between and among teachers, faculty, and administrators of all these programs that was clearly projected to students, parents, and the citizens of the wider community; (e) the extraordinary teaching and research and contributions of university technology faculty that embraced the general consequences of technology in society, the society of the future as affected by technology, and specific areas of concern that drew upon the specialized components of technology such as engineering, industrial technology, design, biotechnology, technology assessment, and teaching and learning in technology with all involved enjoying a sense of equality, mutual respect, and support; (f) the fascination that those involved in preparing technology teachers for the public schools, unlike the case in other disciplines where teacher preparation faculty only possessed a shallow preparation in their subject matter discipline that they taught, were capable productive scholars, not only of the art and science of teaching and learning, but capable, in their own right, in engaging in highly complex technology research requiring sophisticated knowledge of the science, mathematics, and engineering relevant to the project; (g) the enormously effective work of the umbrella organization, The International Association for the Advancement of Technology, to which organizations such as ITEA, NAIT, NASTS, ASEE, ATEA, divisions of AVA, and counterparts in other countries belong, and which is credited with exerting significant influence in establishing and strengthening technology as an academic field and its acceptance in society; and (h) how by dropping the confusing term *technology education* in favor of simply using *technology*, the leaders contributed significantly to founding the profession that includes elements that are described in the preceding 6 items and which characterize the profession that produced the speaker, the winner of the Nobel Prize in Technology.

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Richard A. Swanson,
Professor and Director
Human Resource Development
Research Center
University of Minnesota

It's the Theory, Stupid

In a recent presidential election we heard the refrain—"It's the economy, stupid!" Beyond the knee-jerk reaction to the use of the word *stupid*, the motto was a blunt message as to the importance of the economy versus the smaller issues being debated. It served as a splash of cold water in the faces of everybody. The following comments are intended to have the same effect on our topic.

The thesis here is that technology education must make significant scholarly advances in establishing the theoretical and disciplinary foundation of technology in order for it to realize its potential. Without a sound technology theory and disciplinary focus that is recognized by those in and out of the profession, technology education will not be taken seriously by society or by the educational enterprises it supports.

A theory simply explains what a phenomenon is and how it works (Torraco, 1997, p. 115), while "a discipline is a body of knowledge with its own organizing concepts, codified knowledge, epistemological approach, undergirding theories, particular methodologies, and technical jargon"

(Passmore, 1997, p. 201). The idea is widely held that technology is a discipline that draws upon many theories. This overly generous idea has served as fools' gold to the profession. In the attempt to be inclusive of so many theories—staking its claim so broadly—it has come up with no theory.

Models of technology education have been developed and disseminated through books, seminars, and consulting projects that are little more than diagrams based on the author's most recent consulting or curriculum development experience. Armed with a technology concept diagram and a description of its components, technology education professionals march into the educational arena hoping to affect change. While the technology education model may be powerful enough to guide change in that situation—primarily through the persistence of the leader—it is most likely too superficial to explain the complex dynamics of technology itself or be broadly accepted.

You can have a model and no theory, you can have a theory with no model, and you can have a theory accompanied by a supporting model. This can be said of *technology* and *technology education*. Furthermore, espoused theories are not theories. Espoused theories are mostly narrative versions of models and do not pass the scholar's test of what a theory or discipline is. Theory-building research is hard work and needs to be done.

In short, a model derived from logic is no substitute for sound theory based on theory-building research that establishes the discipline of technology. Full and research-based models of technology theory can guide improvement efforts through validated relationships and the ability to test those relationships. Once established, the work of bounding technology education will be relatively easy.

Tim L. Wentling Grayce Wicall Gauthier Professor of Education & Head, Human Resource Education Department University of Illinois at Urbana-Champaign

The challenge that emerges from the question posed by my colleague M. Ray Karnes is not a minor one. We are in a constant state of change, and as they say, if you are not changing, everyone is passing you by. Technology education is not exempt from this phenomenon.

The arguments for technology education are obvious to all of us who are connected to the profession. The ones that stand the highest in my estimation are related to orientation to a technological society, learning problem-solving skills, learning teamwork and other work-related skills, and learning the nature of technological change (if not change in general). We all know how fast technology is emerging and changing. New microchips every 12 weeks, new and improved (and cheaper) computers every three months, and so on. The school is a place where our citizens of the future learn how to deal with new technology and how to embrace the technology for their benefit. However, still having young children, I see students doing the same things they have always done: reading, listening to broadcasts from teachers, doing worksheets and written assignments, and the other normal things kids have done for the last century.

The computer, they have said, will change the way our children will learn. But, since the development of the personal computer in 1981, little has changed in the way students learn. Matter of fact, most contemporary advances in learning strategies (emerging from the work of cognitive scientists) are related to teacher-led strategies in the classroom. Interestingly, many of these "new" strategies have been in use by technology educators for decades.

If Tapscott is right in his prognosis in his book *Growing Up Digital*, the current and future generation will be very different in the way they play, socialize, learn, and work. Technology educators can be leaders in this evolution by providing guidance to children and adults in learning adaptive strategies for this new era. For this to happen, I believe technology education must become an integral part of the curriculum. Recent concepts of stranding content may be one wave. Another might be the art education model where art teachers move around school buildings from classroom to classroom. It might be that there is no such thing as a technology teacher. Maybe all teachers need to teach technology.

The problem, of course, with some of these notions is that we may be afraid to lead such a charge because we may end our discipline as we know it. We might lose our identity, have no proteges, go out of style. Our challenge is to think "outside the box" and to think about what the next generation needs and how their needs might be met while setting aside our selfish interests. When we can do that, we can lead technology education into the 21st century.

Brenda L. Wey
Department of Technology
Appalachian State University

Technology education is a holistic body of knowedge and experiences, and touches every aspect of the individual and our society. Understanding and applying technological principles is intrinsic to our future success as a country in a dynamic world economy. But acheiving this is complex and ever changing and has presented a constant challenge for the technology education teacher and educator. As the knowledge base changes, we must also change, and change is not always easy. The profession is confronted with many questions: What should we teach? What is our common body of knowledge that defines our discipline? What are the best techniques for delivering the information? How can we communicate, to those inside and outside our profession, the importance of this knowledge as an essential element of basic education for all students? How can we develop a vision that will carry us into the 21st century?

This week we had the pleasure of having James Burke as a guest lecturer on our campus. His presentation was advertised as being about how society should prepare for a future with the Internet. But the actual presentation topic, the Internet, only briefly surfaced a couple of times. The importance of innovative thought, nonlinear thinking, was what he talked about. Burke presented a web of seemingly unrelated artifact connections that reflected the importance and reality of technology: a clear vision for technology.

As a profession we may learn something from the connections that James Burke has made for society and technology. We need to link these connections in the web of new technology to be created and used in the future. As technology teachers we need to pro-

vide the foundation for innovative thought and an understanding of technological processes and their impact on society. Technology is a body of knowledge essential to our success in the next century. Unless our profession can come to a clear understanding of our vision and future goals, how can we clearly communicate and share our vision with others?

Tom Wright, George & Frances Ball Distinguished Professor of Industry & Technology
Ball State University

Defining Technology: A Prerequisite to Acceptance

The first and most critical step in becoming accepted as a core subject is to develop a clear vision of who we are, who we are not, and what we are about. This involves embracing the idea that technology is a discipline of knowledge. It meets the criteria presented by King and Brownell in their book, *The Curriculum and the Disciplines of Knowledge*. Technology is a community of scholars who share a domain of inquiry or discourse and a concern for efficient and appropriate action using tools and materials to create human-made systems and structures. Technology is an instructive community that includes information that is useful to people. It has a tradition: a history of events, discoveries, and personalities. Technology has its own mode of inquiry: a creative process to gain new insight that we call invention and innovation. It has its own language: a unique vocabulary and way of communicating ideas (engineering and architectural drawing). Technology has its own domain: a body of accumulated knowledge about practice with tools, materials, and engineered systems. And technology is an expression of human imagination; it is not discovered but it is created.

Karen Zuga, Associate Professor of Technology Education
The Ohio State University

It has been almost 40 years since Ray Karnes challenged the profession to improve or perish, and technology education and educators continue on a downward slide to oblivion in the United States. We have reorganized our deck chairs as curriculum at least once and we are embarking on another attempt to do so through the new standards, and the ship is still sinking. While many of our international counterparts are experiencing either new or resurgent interest and growth in technology education, technology education efforts in all types of schools in the United States continue to decline. How could this be happening to such an important idea, teaching about technology in an increasingly technological world? I don't believe it is the idea, I believe it is us, collectively, because we still view the problem myopically. We continue to look inwardly, at ourselves, wondering what is wrong, if we aren't dressed appropriately for dinner at the captain's table, and what we need to do for ourselves in order to secure our future. We are not taking a stand on the concerns and issues facing all students and educators; instead, we stand in the background worrying about ourselves.

After all these years, we have yet to demonstrate to the average citizen and to the educational community that technology education is of value in the general effort to educate all children. In this country, educational value for all is still placed upon the academics, while experiential education, such as technology education, is viewed as "frills." The battle to secure a place for technology education is the battle that other subject matter educators have had in our schools with respect to gaining acceptance for activity-based teaching and instruction. The terms have changed over the years, education as experience, hands-on, problem solving, contextual learning constructivism, situated learning—they all point to the realization on the part of some educators that teaching children through problems and activities is effective. Other than parroting the mantra of problem solving, technology educators have done little to join with our colleagues in mathematics, science, and other school subjects in order to bring this goal and their ability to contribute to achieving it to the attention of the educational community, much less the general public.

We have little to no evidence of the value of teaching all children in laboratory settings about technology and the relationship that may have in teaching children to be literate, successful, innovative, and self-renewing adults in our society. We lack the research and researchers who could help us. Based upon historical practice in technology education, we lack the population base of having all children in our classes, and, therefore, we have a lack of support from the entire population base of the country. We simply lack a world view that sees us as a part of the whole effort, and this leads us to myopic activity, such as curriculum reorganization, as we ignore both the icebergs lurking in the treacherous waters in which we choose to sail and the potential partners with whom we could sail as we strive to improve education for all students.

CONCLUDING STATEMENT

Several contributors elected to limit the response to one or two problems or issues while others preferred to cover a wide range. A few concentrated on such singular solutions as an aggressive and sustained public information program, the definition of technology education and its role in the education of all students, leadership development, and the major problem of preparing large numbers of highly qualified teachers and other professionals in the field of technology education. Several lent support to the Technology for All Americans Project and expressed high hopes for the positive influence the acceptance of carefully-formulated standards and the impact their implementation will undoubtedly have on technology education in the years ahead. The contributors also expressed confidence in the International Technology Education Association and its many alliances with other influential organizations and agencies. The short change afforded the American Vocational Association—Streichler and Dyrenfurth notable exceptions—came as a surprise to me after more than 40 years of involvement in both the ITEA and the AVA and in the latter's trade and industrial, industrial arts, and technical education divisions.

The following are the only changes of any consequence made in the preceding sections of this paper after it was presented at the 85th Conference: a paragraph deleted and one added to the introduction, and the addition of two

statements that were submitted in response to an invitation extended after the conference convened. From this point forward, however, major revisions have been made as intended from the outset.

Thirty-five respondents left all of us deeply indebted to each of them when they submitted statements for inclusion in this paper. Twelve of the authors attended the 85th Mississippi Valley Technology Teacher Education Conference and participated in the lively discussions that followed the presentation of papers: Custer, Dugger, Erekson, Evans, Herschbach, Householder, Martin, Pucel, Savage, Scott, Streichler, and Zuga. Before making a few observations about the pieces submitted by the contributors, let me report with pleasure that the other participants treated each of the 12 in attendance with respect.

This project has afforded me a delightful opportunity to review the numerous and varied responses submitted under rather severe time and space restraints to a compelling question about changes urgently needed in technology education. Reading the preceding statements turned out to be a thrilling and exciting experience, made me immensely proud to be associated again with former students and colleagues, and the pessimism expressed by a few of the respondents notwithstanding, generated high hopes and great expectations as the future of technology education is envisioned.

Space limitations permit brief references to only a few of the statements submitted and to a limited number of the problems and issues raised in responses to the question posed. The omission of the name of a specific author in the following observations should in no way detract from the importance of that author's contribution.

Let respondents who bemoan the fact that technology education is getting short shrift in the struggle for a position in the sun be reminded that math, science, and foreign language teachers have been registering a similar complaint for ages and are likely to enter the coming century bearing the same cross. To those who press for massive and continuous public information campaigns and aggressive political action: Go get 'em, Tiger! But before the first shot is fired, make sure that the program being promoted is worthy of your unqualified support. While several of the respondents presented excellent suggestions for promoting public awareness of the relevance and importance of technology education programs of high quality in the school, the points made by Herschbach should be afforded careful consideration as continuing public information campaigns are planned. If applied with somewhat more subtlety than suggested by their forceful presentation, the points made by Sanders could become important in developing public awareness.

To the few who seem to favor the preservation of the historical chasm between technology education and vocational education that has been cultivated all too long and far too aggressively by reactionaries on both sides of the fence, let me suggest that you as a group may be destined for a fall in the crevasse. Where is your logic when in the same breath you press for close alliances bordering on integration with generic forms of vocational education commonly known as mathematics, the sciences, and other academic disciplines, such as engineering, law, medicine, architecture, business administration, etc. Let me direct attention of all inclined to keep a respectable distance between technology education and vocational education to the entire statement submitted by Dave Bjorquist. My position on this issue is currently and always has been in harmony with the one presented eloquently by him—and reinforced by Pucel, Ray, and, especially, Moss—in the following excerpt from his contribution to this paper:

> As vocational education redefines itself, vocational curricula are becoming less specialized. At the same time the academic subjects are becoming more concerned about practical applications beyond schooling. The time is propitious to exploit, rather than resist, the natural connections between technology education and the world of work. The occupational implications of technologies and technological change provide a rich resource for exploring a wide variety of careers. Technology education teachers should deliberately plan and provide for a wide range of experiences that help students learn about themselves in relation to relevant occupations. And the planning should be done cooperatively with vocational teachers so that the overall career development of students can be accomplished as efficiently as possible.

If technology education is to have an important role in the total educational enterprise of the coming century, we must strive continually to establish and maintain close and appropriate relationships with the rest of education, especially those phases committed primarily to preparation for the world of work and career advancement. There is good reason to assume that technology educators all over the world will be encouraged by the promise and probable impact of two current developments of technology education programs of the future: the Technology for All Americans Project under the auspices of ITEA and our association's close and amiable working relationships with several very powerful and influential associations and agencies. You will surely want to join with the several contributors who expressed high hopes for these developments. For an excellent overview of the work of ITEA, refer to the executive director's paper and his list for further readings in the previous issue of this journal (Starkweather, pp. 44–47).

Sharon Brusic and Stephen Petrina elected to stress a problem that is apparently far more critical today than any of us could have anticipated at the time the following facetious observation was made nearly 40 years ago: "When the problem of evolving adaptations necessary to meet the needs of girls and women in [technology education] is studied rigorously, a very simple solution will become apparent. Two sets of toilet facilities will be provided near the shop in the place of the usual one marked *boys*" (Karnes, 1960). That statement sprang from high hopes that long ago technology education would have evolved to the point that neither Brusic nor anyone else would be issuing her current challenge to the profession: "Despite some attempts in the past decade to broaden the appeal of technology education to both males and females, there is still an incredible gap in female representation in technology

education at all levels." Petrina also made some interesting observations about the maleness factor that is in effect closing the technology education door to half the population! Do join with the Brusics and Petrinas of their respective countries and promote vigorously the attitudinal change that will open that door quickly!

Incidentally, you may wish to refer again to Petrina's entire contribution, and this time look for all of the challenges embedded therein.

Please note that Paul DeVore and Rupert Evans elected to go beyond existing educational institutions and agencies in formulating their responses to the question and issuing bold challenges to the profession. If a first reading leaves you inclined to reject their proposals as being impractical, do give them further notice. Many of the most powerful influences on the school have come from beyond the walls of the schoolhouse. A casual stroll through the exhibit hall at one of our recent national conferences leaves one with the impression that the types of instructional modules to which Rupert refers are attracting attention. Paul surely feels that a legislative mandate to ensure a place for technology education in the school is neither desirable nor feasible. However, if "linked together with the private sector" as he suggested, there could be real merit to his call for a "…free and independent, dedicated national academy or center of high quality…and regional centers [that] would replace antiquated teacher education programs."

Many other respondents joined DeVore and Evans in directing attention to the alarming state of affairs in technology teacher education, and several suggested that this is the most critical problem confronting the profession. I have elected to address directly only that one compelling problem and suggest a solution somewhat less drastic than the one with which DeVore challenges us. Before doing so, however, let me suggest some of the essential qualifications and the attributes of the technology teacher of the coming century by referring to my favorite technology teacher of the past. (While the individual described happened to have been a man, my hope is that in the near future there will be a 51–49 chance that the master technology teacher of the new day will be a lady!)

My favorite technology teacher had the temperament and the understanding to work amiably and cooperatively with students across a broad age and aptitude range. He had been a brilliant student and had learned very well indeed from his associates and from one particular mentor. He took full advantage of the most sophisticated information retrieval systems of his day to keep abreast of a broad range of technical knowledge applicable to his profession. He acquired and employed daily a wide range of skills and mastery over materials, tools, and other devices that earned him recognition as the ultimate master craftsman in his field of endeavor.

The laboratory in which he enjoyed every day of his long and illustrious career was that of an explorer, inventor, or innovator. It was in this environment that this master technology teacher designed and produced instruments adjudged universally to be the all-time, best-of-class in function, form, style, aesthetic value, and resonant response to the will and artistry of all accomplished performers fortunate enough to possess one. It was in this laboratory environment that Antonio Stradivari (1644–1737) applied what he had learned from his remarkable mentor, Nicolo' Amati, and many other associates, and from his own continuing series of explorations and experiments as he initiated the Stradivarius tradition and validated the exceptionally high standards to which his pupils (apprentices, including several of his 11 sons) responded as they extended their mentor's influence on a noble profession and perpetuated his dynasty.

My firm conviction is that every technology teacher of this day and tomorrow should be able to hold and make advancement in a demanding position as a technician in the private sector, as did Antonio Stradivari in his time, and that this capability should be validated and confirmed by at least two years of full-time employment for pay in his or her technical specialty.

Back to the urgent problem of preparing the highly skilled and technically competent counterparts of Antonio Stradivari in sufficient number to staff the evolving technology education laboratories of the coming century. First, I would rejoice as a current trend accelerates and then extend condolences to the remaining small, woefully weak and inadequate technology teacher education programs and the antique shops in which they became obsolete and then perished many years ago. Shut down the few remaining on the campuses of our most prestigious universities known for advanced study and research. Ignore the former industrial arts teacher education programs in many other institutions that were presumably converted to programs for training the technicians but never staffed and equipped to meet acceptable standards. Now let us turn to the few institutions in which technology teacher education might possibly find a good home and enjoy adequate support.

While this is neither the time nor the place to favor specific institutions, each of us probably knows intimately two or three of the very few vibrant colleges and universities in which a thousand, two thousand, or more students of high potential are currently receiving excellent preparation for careers as technicians on a single campus in very rigorous and comprehensive two-, three-, or four-year programs. Millions have been appropriated to each of these institutions to provide adequate space, state-of-the-art laboratory facilities and instructional resources, and to employ dozens of highly qualified faculty and staff members.

There are several institutions in this class in which a strong and dynamic professional teacher education component is already in place and in which there is a clearly established record of adequate appropriations and other forms of tangible support to keep quality technical programs current and add new ones in response to accelerating technological change. It is in these particular institutions that the technology teacher of the future can best be prepared for a distinguished career.

A critical question: How can we recruit, in sufficient numbers on any one campus to satisfy the cost/efficiency criterion, the most capable students who complete formal preparation for careers as technicians to continue in a program leading to the teaching profession? Please recall again that many of the contributors expressed approval and high hopes as they referred to the good

work being performed by the ITEA and to its close alliances with several influential associations and agencies. This is the time and place to test the spine of the ITEA, the associations and agencies with which amiable working relationships have evolved, and the will of the members of Epsilon Pi Tau. My modest proposal—in part a response to the critical question raised forcefully by Dyrenfurth and several other contributors—is that the ITEA and the AVA, in partnership with their respective and, in some cases, joint allies, seek federal legislation that provides for the following on a long-term basis:

• Funding for at least 3,000 annual, full-tuition fellowships that may be allocated, in response to application, in blocks of not less than 100 to each of a limited number of colleges and university institutions and then awarded to graduate technicians who seek further preparation for careers as teachers in the field of technology education.

• Allocation of fellowships to be limited to institutions in which there is a clear record of strong support for teacher education *and* for a wider range of programs in which large numbers of outstanding students are receiving excellent preparation for careers as technicians.

• Granting of fellowships to be limited to graduates of two-, three-, or four-year technical programs comparable to those offered by the class of institutions mentioned above and have had at least two years of work experience as a technician or will pursue a technology teacher education program that includes employment in a technical pursuit as an integral component under a cooperative arrangement with the private sector. Each fellowship recipient to teach not fewer than two years for each year the fellowship is accepted.

The National Defense Education Act of 1958 and the subsequent elementary, secondary, and higher education acts under which federal dollars by the billions were appropriated for education prior to 1970 set precedents for this modest proposal. I was right there when many of you who have achieved prominence in technology education completed your advanced degrees while not only holding fellowships awarded during the post-Sputnik era but also drawing student and dependent support stipends provided by the NDEA or subsequent acts. The institutions you attended also received federal funds in proportion to the number of fellowship recipients on campus. These student and institutional support provisions should also be included when the working copy of the bill is prepared for the Technology Teacher Education Act of 1999!

Your students and their parents, your fellow teachers and other employees in your school system, board members, and citizens of the community at large will be the primary advocates for your program and will ensure its prominent role in the educational enterprise of the new century *if* your program is dynamic and in its response as scientific and technological advancements are made and as complexities of the human experience increase, and *if* your program affords students a wide range of challenging and stimulating opportunities for the application of the many disciplines of the school as they identify and define problems, raise questions, explore, innovate, assimilate, experiment, invent, design, create, perform, build, automate, interpolate, project, extrapolate, predict, validate, produce, relate, infer, integrate, interrelate, cooperate, maintain and repair, adapt, renovate, adjust and control, and develop a wide range of finely tuned skills in a vibrant laboratory environment richly supplied with state-of-the-art materials, information access resources, tools, machines and testing equipment—all of this orchestrated by a skilled, masterful, and inspiring teacher who recognizes no limits!

And now you know why, from my own historical perspective and with high hopes for the coming century and with unbridled confidence and boundless enthusiasm, it is such a great pleasure for me to join wholeheartedly with Paul DeVore (1998) as he punctuated his scholarly and challenging piece in the preceding issue of this journal with the following delightfully optimistic refrain: "I said I want to start over. And you ask why? And I reply, because the present is so exciting and the future holds such great potential. Each of us has opportunities today that are beyond even those we envisioned in our wildest dreams when we first began our careers" (p. 2).

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