CTTE Monograph 14

Quotations In Support Of Technology Education: A Compendium of Positive Outcomes That May Be Attributed To An Effective Program In The Area of Technology Education

Compiled by:
Donald Maley, DTE

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Council on Technology Teacher Education
An affiliate council of the International Technology Education Association
1914 Association Drive
Reston, Virginia 22091

Appreciation is expressed to Goodheart-Willcox Company, Inc. and to the persons who earned a doctorate in the department which Dr. Maley headed for many years for their generous financial contributions which provided support for the publication of this monograph.

Table of Contents

Foreword

This work has been compiled in an effort to provide the technology education professional with documentation of the value that may be attributed to an effective program in this area of study, Kindergarten through grade twelve and into higher education. It is intended to be used as a working document by the professional in promoting and developing an advocacy for the inclusion and/or expansion of technology education at the various levels indicated above. Both the material and its format were developed for use as a resource for the advocate of technology education. It may also serve as a tool to reinforce the value of the work of the technology education teacher, supervisor or administrator from a broad range of perspectives presented by a number of respected authorities.

The specific categories under which the values are listed were selected because of their meaning and relevance to the broad educational community. It is here that the struggle for inclusion and/or enhancement must be won. These materials were developed on the common grounds of the general educator as well as around those central issues (academic, personal, societal) that are in the forefront of coeducational debate and need.

Acknowledgments

This publication was accomplished through the efforts of a number of people. (1) There were those who provided a good deal of encouragement for the need as well as usefulness of the project. (2) Considerable assistance was received from those members of the technology education profession who identified quotes as well as providing some of their own. (3) A third group includes the writers and authors whose published literature provided numerous useful quotes relevant to the value of technology education with respect to their contribution to personal enhancement, societal advancement, and academic achievement.

A special note of appreciation must be extended to Simone Legacy who typed the original document and made numerous constructive format suggestions. Finally, a hearty comment of thanks to my colleague, Dr. Charles Beatty, for his contributions to the reproduction of this work.

As a somewhat different form of acknowledgment it is fair to say that the real value of technology education is not totally expressed in the comments in this document. A complete expose of the positive statements regarding the contributions of technology education in this period in history would require volumes of writings and statements.

September 1991
Donald Maley

Commentary Regarding This Work

It is ironic that one must go to such lengths (as per this document) to promote and develop advocacy for the study of technology in an advanced technological society. Technology is one of the most pervasive elements affecting modern living in all civilized parts of this planet Earth. Yet it is a rare instance where one can find technology education as a required area of study in high schools or higher education institutions in the United States.

The content of this document was organized and constructed to assist members of the profession (technology education) in their responsibility to promote this 21st Century imperative in education. However, it is important to note that this monograph is just one dimension of the needed and vital outreach process. The material in this presentation takes the language, principles and perspectives of the educational profession and provides a form of documentary evidence of the role that technology education has to play.

It is also important to note that the materials included in this writing do not cover all of the contributory dimensions of technology education with respect to the categories of personal, societal, and academic values. This is only one step in the process of gaining recognition and acceptance of technology education as a vital and contributing area in the American educational system.

Editorial Note:

Final editing of this document was completed by the CTTE Publications Committee after Dr. Maley's death in 1993. We hope that this document will serve as a fitting tribute to a person dedicated to advancing both technology education and technology teacher education. It was developed to provide its readers a ready source of useful quotations supporting technology education. This document provides a start for you to continue Dr. Maley's work in telling others about the benefits of technology education. The sources of the quotations have been split into two groups. Those quotations directly attributed to conversations various people have had with Dr. Maley are listed in the individual contributions list. The reference list contains the information about the sources of citations for published works. Individual contributions have only the contributors last name, while citations from published works list the date of publication and appropriate page(s).

Chapter 1

Technology Education: An Interpretation

Technology education as a dimension of the educational program in the public schools of these United States deals with one of the most pervasive elements affecting society today and in the future. That element is technology in its many and diverse forms. There are very few (if any) aspects of human existence, advancement or prosperity that are not impacted or influenced by technology. Yet the almost unbelievable paradox at this point in the twentieth century is the fact that the educational establishment has chosen to ignore a systematic study of it.

> We are quite frankly disappointed that none of the schools we visited required the study of technology. More disturbing still is the current inclination to equate technology with computers. (Boyer, 1983, p.111)

In order to deal more explicitly with the matter of an interpretation of technology education it would appear advisable to present what it is and what it is not. The following definition is directed at what technology education is —

> Technology education is a comprehensive, experience based educational process designed to develop a population that is knowledgeable about technology, its evolution, systems, techniques, its utilization in industry and other fields, and its social and cultural significance. (Maley)

The following comments and documentation are intended to dispel some misconceptions about technology education and to present a point of view with respect to what it is not.

> Technology is not to be confused with science. Science is what the universe, macrocosm and microcosm consist of — stars, planets, galaxies, cells, atoms, particles. Technology is tools, machines, power, instrumentation, processes, techniques. (Gies, 1982, p. 17)

Another perspective dealing with the technology–science issue comes directly out of the science community itself.

> . . .Technological literacy is quite different from scientific literacy and mathematical literacy. An understanding of scientific and mathematical concepts doesn't automatically result in an understanding of technology. (National Science Board, 1983, p. 73)

The preceding material is presented as a background statement to clarify the nature of technology and technology education as a prelude to the development of the "value" or "rationale" dimension of this discussion. In order to provide further background for the material to follow, it is felt necessary to provide some descriptive statements regarding the nature of technology education. The following statements describing Technology education are consistent with the best teach-

ing and learning practices. Technology education is:

1. a firsthand learning experience.
2. a program and a process with a strong experiential and involvement format.
3. a multi–sensory learning process.
4. a natural candidate for an interdisciplinary approach to education.
5. a program with great potential for establishing relevance, meaning and significance in content and methodology.
6. a program that has enormous potential for taking the school out into the world and bringing the world back into the school.
7. a program that is based on a fundamental requirement for citizen participation in an advanced democratic technological society.
8. a program (content and process) that can be built around the developmental and growth needs of young people.
9. a strong historical and cultural base.
10. a pervasive and ever–present dimension of life and living in this part of the twentieth century.

Chapter 2

Value In Technology Education

The use of the term "value" in this presentation is intended to mean those positive outcomes that may be attributed to technology education as an integral part of the total educational process.

The documentation of value associated with technology education is based on the premise and conviction that this area of study has an important role to play in the present and future educational programs at all levels (K through 12 and into higher education). The value of technology education is enhanced by 1) its relevance to the present and future needs of citizens in an advanced technological society; 2) its potential for the integration of mathematics, science, social studies, language arts and other disciplines; 3) the experiential nature of the educational processes associated with this instructional area; and 4) the opportunities it provides for individual and personal contributions associated with the physical, social, and psychological development of the student. The materials presented in this work are centered around three broad categorical headings. They are: **personal values, societal values,** and **academic values.** The following is a brief clarification of each of these category headings.

Personal Values – Those contributions directly related to the physical, psychological and social development of the individual.

Societal Values – Those contributions that enhance and strengthen the individual's capabilities of functioning effectively as a citizen in a democratic, technological society.

Academic Values – Those contributions that provide for an enrichment of the academic experience as well a its relevance — personal and societal.

Each of these categories (personal, societal, academic) is further divided into more specific areas of contribution. Each of the statements or subdivisions of the main topics are followed by one or more quotations that support the item which has been identified as a value. These statements are framed in the context of "opportunities" provided by technology education.

Chapter 3

Personal Values

The following is a listing of personal values of technology education as stated in the form of opportunities for the student.

1. **. . . To become a somebody among one's peers through a broad range of experiential activities.**

Educational practices should be gauged not only by the skills and knowledge they impact for present use but also by what they do to children's beliefs about their capabilities, which affects how they approach the future. Students who develop a strong sense of efficacy are well equipped to educate themselves when they have to rely on their own initiative. (Bandura, 1986, p. 417)

Technology education develops a sense of community within the classroom. Working together on problems and projecting encourages awareness of interdependence. (Petrina & Volk, 1991, p. 25)

2. **. . . to explore one's self with respect to likes, dislikes, strengths, weaknesses, motivations, and aspirations.**

. . . the ideal aim of education is creation of self–control . . . (Dewey, 1938, p. 75)

Technology education is humanistic. It focuses on those learning experiences that, when coupled with other curriculum areas, assists the individuals in identifying who they are and who they want to be. Through mental and manual skill development, students are afforded opportunities for in–depth introspection. (Martin)

Technology is the "know–how" and creative process that extends human potential of each individual. Technology education can be the central educational experience that maximizes this critical personal development. (Bensen)

3. **. . . to achieve a feeling of success in a broad range of human involvement.**

People need encouragement to stretch, to go for their dreams, to be confident of their decision–making capabilities, and to risk success. (California Task Force, 1990, p. 36)

Technology education provides one of the few opportunities in academia where a student is able to practice divergent thinking methods, to be creative. (Pytlik)

Technology education provides an opportunity to complete activities that lead to achievement, success, and self–respect. (Petrina & Volk, 1991, p. 24)

4. **. . . to strengthen one's self concept.**

If you don't do anything for an individual help him/her to be a somebody. (Derthick)

Self–esteem and responsibility must be woven into the total educational program. (California Task Force, 1980, p. 65)

In any activity, skills and self–beliefs that ensure their optimal use are required for successful functioning. If self–efficacy is lacking, people tend to behave ineffectively, even though they know what to do. (Bandura, 1986, p. 425)

Because technology education is an activity that enables one to think and do — at the same time it provides that person with a stronger self–concept as a learner. Having the type of self–perception the person is able to address himself or herself to all academic pursuits with confidence and even avidity. The student becomes an active participant in learning and not simply an indifferent reactor to intellectual matters. (Waetjen)

Technology education gives all students opportunities to apply their knowledge and understandings from other academic disciplines while solving technical problems. While working separately or in groups, these successes will increase our students' self–esteem. (Lucy)

5. **. . . to develop problem–solving capabilities.**

Technology education assists individuals in the identification of problems and appropriate solutions. These skills will help individuals be pro–active in the development and use of technology. (Lauda)

Technology education is a fertile field of study for problem–solving in an applied and realistic context. (Maley)

Problem–solving is a fundamental teaching and learning process in technology education where the realities of issues related to construction, manufacturing, communications, transportation, power and energy provide the tangible bases for real problems facing society and the world beyond the school. (Maley)

The processes involved in problem–solving are essential elements in a well–designed experience in this dimension of technology education. The processes by which the students achieve the results or answers may be more important than the answers one gets. (Maley)

6. **. . . to develop interpersonal skills through participation in group projects, seminars and team activities.**

The nature of technology education provides extensive opportunity to develop interpersonal skills of students. This may consist of working on teams, serving customers, leading groups, negotiating, working well with people from culturally diverse backgrounds, and teaching others. (Williams)

Technology education programs provide the context for students to learn cooperative and group skills by working with others in a meaningful way in the design, construction and evaluation of technological devices and systems. (DeVore)

7. **. . . to experience activities contributory to the achievement of the developmental tasks of youth.**

A good school program is one that makes a maximum contribution to the performance by children of their developmental tasks. (Havighurst, 1977, p. 104)

. . . the development of young people in the holistic sense is to crucial to the caliber of future adults that for school programs to impede adolescent development in any way would be an enormous net minus for society. (Peters & Waterman, 1982)

The pupil's . . . curiosities, confusions, imaginations, loves, and hates, with regard to themselves, their parents and others belong in a world almost totally ignored by the school. Their real problems remain more or less concealed. (Cantor, 1961, p. 92)

Technology education will further the development and growth of all students who will inevitably interact with technology on a daily basis. (Lauda)

8. **. . . to broaden one's involvement in the learning processes.**

Provides students opportunity and challenge to explore, experiment, and, in essence, replicate ways and means by which people of all times and places increased their capability by using their unique human skills to innovate, improvise and invent adjuncts, prostheses which extend and amplify the capacity of organs, senses, muscles and mind, thus attaining greater strength, increased acuity, dexterity, reach, mobility, speed and endurance. (Hammond)

Technology education prepares learners to understand, apply and evaluate technology. (Gemmill)

Technology education prepares individuals to apply technology to meet changing human needs. (Technology Education, Association of Pennsylvania)

Technology education enables the individual to look, listen, formulate and reflect upon ideas and systems that shape the world in which they live. (Vaglia)

9. **. . . to exploit one's interests, aptitudes learning styles and motivations.**

It is impossible for the average boy {or girl} to grow up and use his {her} remarkable capacities they are in very boy {girl}, unless the world is for him {her} and makes sense when it understands that its chief wealth in these capacities. (Lepkowski & Parker, 1969, p. 4A)

Technology education can help students realize their inherent capabilities. (Petrina & Volk, 1991, p. 24)

10. **. . . to sense an immediate feedback from the experiential learning activities.**

Beyond all practical reasons we encourage the study of technology

by young people strictly for the simple joy of it for the great satisfaction that comes with an understanding of how the world works. (National Science Board, 1983, p.84)

. . . students get immediate feedback on how well they are performing. (National Commission on Secondary Vocational Education, 1984, p. 5)

11. . . . to develop a level of technological literacy enabling one to function effectively in a technological society.

The curriculum area of technology education contributes to an individuals understanding of our technical means and empowers citizens to make rational decisions to life's technological challenges. (Gilberti)

A growing number of citizens are technologically illiterate and thus are being disenfranchised economically as well as politically from participating effectively in the governance and management of their community, state and nation because of the increasing technological component of the society. (DeVore)

Technology education gives students additional insight into the world they will live in, assists them in acquiring drive to reach their potential, instills a sense of efficiency and purpose to their actions, and prepares them to make significant contributions to society. (Starkweather)

To be truly free and in control of one's destiny, we must be personally literate within the culture in which we live. Technology education is the one discipline that directs its total effort to contributing to technological literacy. (Bensen)

Our secondary school students . . . want to see themselves as participates in the world they live in . . . they want the world to be in the school and the school in the world. (Foshay, 1970, p. 352)

Technology education contributes to the "universal" knowledge necessary for life in the 21st Century. (Rosser)

12. . . . to develop a broad sense of career awareness.

Technology education provides the background so individuals can appropriately make citizenship, consumer, and career decisions. (Wright)

Technology education helps students develop values and generate the foundation for employability and future educational success. (Petrina & Volk, 1991, p. 25)

13. . . . to develop a sense of pride and contribution in the educational setting.

. . . The psychologist, Ernest Becker . . . argues that man is driven by an essential "Dualism;" he needs both to be a part of something and to stick out. . . (Peters & Waterman, 1982, p. xxii)

> The more things that you can do, the better you feel about yourself — the ability to fix something, to understand something because you've taken it apart. That positive self–image spills into every other thing you do. You may become a medical doctor, but that self–confidence helps you in school in interpersonal relationships. (Copa, Plihal, Scholl, Rehm, & Copa, 1985, p. 19)

Chapter 4

Societal Values

The following is a listing of societal values of technology education as stated in the form of opportunities for the student.

1. . . . to develop technological literacy in keeping with the needs of a citizen in an advanced technological society.

> There is an enterprise explicitly directed toward altering the human condition. It is called technology, and its primary purpose is to make our work more efficient, or to provide new and better methods of transportation, or to figure out how people can communicate more rapidly and accurately. If we want to get serious about using the schools as an agent for maintaining and improving the American standard of living, let's consider placing greater emphasis on technology in schools. (Atkin, 1991, p. 49)

> We recommend that all students study technology: the history of man's use of tools, how science and technology have been joined, and the ethical and social issues technology has raised. (Boyer, 1983, p. 110)

> Technological literacy will encourage greater participation by individuals in shaping public policy, which often involves the use of sophisticated technology. It will tend to encourage civic responsibility and overcome voter torpidity, which can arise out of a lack of understanding of new technologies. (National Science Board, 1983, p. 74)

> The great urgency is not "computer literacy" but "technology literacy," the need for students to see how society is being reshaped by our inventions, just as tools of earlier eras changed the course of history. The challenge is not learning *how* to use the latest piece of hardware but asking *when* and *why* it should be used. (Boyer, 1983, p. 111)

> Contributes insights, understandings and outlooks requisite to intelligent citizenship in a dynamic post–industrial society moving steadily forward toward having its elements compatible — self consistency, creating a world unlike any yet known with far–reaching effects, both direct and subtle on our lives and mentality. (Hammond)

> In today's society that is so totally dominated by new and ever–changing technology, can we really expect our leaders to be good leaders, or our citizens to be good citizens if they have no knowledge of the most significant factor in the society in which they live? (Pytlik)

> Technology education makes people aware that technology is the major institution of American society, determining societal values, the nature of work to be performed, the pattern of work and leisure, the availability of jobs, and the content of what children must learn in school. To ignore technology is to turn our backs on society. (Waetjen)

Technology education contributes directly to the human resource and competitiveness potential of a community or nation by preparing citizens capable of participating in high value–added activities such as computer–aided design and manufacturing, computer simulation, analysis of design efficiency and electronic communication and information systems. (DeVore)

Our chances of survival are clearly based on our capacity to meet the largest challenge ever offered to man. Technologies and 'know–how' are more than adequate to solve many of our largest problems. What we lack in that combination of vision, understanding, and innovative action that will enable us to use our knowledge more immediately and more effectively. (McHale, 1969, p.170)

2. **. . . to achieve skills and understandings related to technological assessment.**

. . . for only when "science and technology literacy" is understood in this broader context can there by any real hope of effectively shaping our future world by conscious public control so that scientific and technological processes truly benefit humankind. (Cutcliffe, 1989, p. 25)

In a world that is being driven onward at apocalyptic speed by science and technology, we cannot, we must not, give up the idea that human beings can control their political and economic policies . . . (Ward, 1966, p. 1)

People must know about technology in order to improve the quality of many personal and professional technology–based decisions. (National Science Board, 1983, p. 74)

The future of a global society depends on an electorate that is able and prepared to make well educated and well informed decisions. Technology education is one of the curriculum areas that makes significant contributions to this area. Through well organized and developed learning activities, students gain meaningful insights into the major issues facing a global society including the environment, transportation, energy, hunger, manufacturing, housing, etc. (Martin)

Technology systems exist because humans have created them. Yet, in the natural order of things we do not have the guarantee of continued existence, only the potential. To be fully human we must educate ourselves so we can create technological systems that are compatible with humans and the natural environment. (DeVore)

3. **. . . to develop skills in the effective selection, use, and care of various technologies.**

A technologically literate populace is necessary if citizens are to apply in a reasonable manner their values and judgments in the control and use of technology. (Johnson, 1990, p. 1)

. . . man could not have become Homo Sapiens, "man the thinker," had he not at the same time been Homo Faber, "man the maker." (Kranzberg, 1986, p. 557)

Technology is radically transforming a host of other occupations. They include health care, medical science, energy production, food processing, construction, and the building, repair, and maintenance of sophisticated scientific, educational, military and industrial equipment. (National Commission on Excellence in Education, 1983, p. 10)

Technology has provided many benefits and problems for society. The understanding and values of society dictate the development and appropriate use of technology. Technology education prepares people to capitalize on the benefits, solve the problems and promote the positive aspects of technology. (Gemmill)

The advancement of all societies stem from the development of technology to provide such basic necessities as food, clothing and shelter and range on to the highly advanced developments of communications, transportation and production. Each aspect of technology must be carefully selected, designed, developed, and implemented for the common good. Technology education is the experience needed to provide citizens the background to make decisions concerning their community, nation, and world. (Bensen)

4. . . . to develop the qualities of a responsible and dependable citizen.

We live in a technological world, rapidly growing more complex and more sophisticated. Each of us needs to know more about technology in order to participate in its development, use and control. (Johnson, 1990, p. 1)

. . . mankind, with the aid of its technology, has fashioned our physical and social environment, our institutions, and other accouterments of our society. But if ours is truly a man–made world, . . . then mankind can remake it. (Kranzberg, 1986, p. 560)

Education is not just amassing information. It also must train us how to apply this information intelligently in the solution of the problems of life. . . and it must instill in us the powers of concentration, patience, perseverance, and judgment. (Washburn, 1959)

Technology literacy prepares individuals for intelligent participation as informed citizens in the transition from an industrialized society to a post–industrialized service and information. (National Science Board, 1983, p. 74)

We need a citizenry informed about the physical world, the world of human spirit, and the artificial world we have created. (Chaplin, 1985, p. 14)

Technology education prepares people to actively participate in society as private citizens and productive workers. (Wright)

Technology education directs society towards the ancient injunction, "know thyself" and prepares a foundation of knowledge that will enable the citizens of tomorrow to understand and engage in the technological debates that will produce solutions to problems. (Vaglia)

5. **. . . to develop an awareness and concern for the social impact of technological innovations.**

The type of thinking encouraged by technology emphasizes variety and a certain divergence in intellectual effort. It is a type of thought and action seldom fostered in schools, yet it may have more to do with economic well–being than the subjects that currently dominate the curriculum. Technology, with its persistent focus on the relationship between mind and hand — with its insistence on practical work — seems closer than other subjects including science, to the knowledge and skills necessary to improve the country's commence and industry. (Atkin, 1991, p. 50)

. . . we have seen that the technological equipment of a people figures more than any other aspect of their culture when current judgments of advancement of retardation arc drawn. (Herskovitz, 1960, p. 241)

. . . communities all over the United States are depressingly familiar now with what the experts call technological, or structural, unemployment: joblessness that occurs because our workers, our factories and our technological change today seems a dark and threatening force, rather than a bright confirmation of our national genius. (Task Force on Education for Economic Growth, 1983, p. 13)

. . . ignorance of science and technology is becoming the ultimate self–indulgent luxury. (Boyer, 1983, p. 24)

A language barrier as real as any that exists in the world today separates the technocratic society from the remainder of society. And the tragedy is that little attempt is made to break down the barrier. . . (Finke, 1967, p. 49)

6. **. . . to develop an awareness and concern for the environmental impact of technological developments.**

The nation needs outstanding, rigorously educated and trained young men and women to enter careers as engineers, scientists and technologists. (Johnson, 1990, p. 1)

It is increasingly important for all students to explore the critical role technology has played throughout history and develop the capacity to make responsible judgments about its use. (Boyer, 1983, p. 111)

The brighter tomorrow will be there only if a bridge can be designed that would span the gulf of technological ignorance which exists between the vast majority of the populace and the technological elite. (Maley, 1970, p. 41)

7. **. . . to develop the capability to cope with technological change.**

Although our technological advances have yielded manifold benefits in increasing food supply, in providing a deluge of material goods, and in prolonging human life, people do not always appreciate technology's contribution to their lives and comfort. (Kranzberg, 1986, p. 417)

. . . every new technology involves questions of ethics and values, which must be judged from aesthetic, historical and philosophical viewpoints. Furthermore, technological change has economic, sociological, and behavioral implications for both the country and those individuals directly involved. (Truxal, 1986, p. 12)

The product of our schools is people — people capable of living in and contributing to a great democratic society so profoundly impacted by industry and technology. (Maley)

The new era of advancing technological change and global competition will radically change our concept of basic skills — of the minimum necessary skills for a person's economic survival. (Task Force on Education for Economic Growth, 1983, p. 15)

The intent is to strengthen young people early with the awareness and flexibility that comes with technological literacy. (National Science Board, 1983, p. 74)

Technologically illiterate citizens increasingly place a drain on the resources of our communities and nation when they are unable to function effectively or contribute in a meaningful and productive way in an increasingly technological world. (DeVore)

Two conditions that arose in the last quarter of the 20th Century have changed the terms for our young peoples entry into the world of work: the globalization of commerce and industry and the explosive growth of technology on the job. (U. S. Department of Labor, 1991, p. xv)

8. **. . . to develop a sensitivity towards the need for informed involvement in societal issues related to technology.**

Technology is too important to be excluded from a student's educational experience both prior to and following secondary school. Technology as a subject area must be required for all students in university–level education programs, particularly those who are preparing to teach. (Johnson, 1990, p.44)

. . . technology has been a significant factor, not only in the pattern of our daily lives and in our workaday world, but also in democratizing education and the intellectual realm of the arts and humanities. (Kranzberg, 1986, p. 556)

Technology, with its persistent focus on the relationship between hand and mind — with its insistence

on practical work — seems closer than other subjects, including sciences, to the knowledge and skills necessary to improve the country's commerce and industry. (Atkin, 1990, p. 32)

People must understand the limitations as well as the capabilities of emerging technologies. The technologically literate person should have a sense of what technology can and cannot do. He or she should not believe that technology can solve all ills, nor that technology is responsible for most problems. (National Science Board, 1983, p. 74)

Contributes to process of enculturation depicting how previous generations satisfied their needs through the technologies they created; compensates for the lost of social capital — the discontinuity of education within the home, family and neighborhood; acquaints students with a vital segment of their historic tradition (technology, the warp and woof of human endeavor.) (Hammond)

The realities of living in a technological society must be confronted and dealt with if society is to maintain a harmonious balance between the natural and human made environment. Technology education provides an indispensable means to meet this need. (Lauda)

If we are to prosper as a human race, general education must play a major role in our students' understanding of the resources, processes, outputs and impacts of the technological systems of communication, transportation, manufacturing and construction. (Lucy)

Technology education can prepare students for their future by placing them in the middle of processes that are currently being adapted for use in society while allowing them to anticipate future uses of their interest. (Starkweather)

The contention that persons ignorant of technology can function in a democracy to any affect when the society is a technological one is dubious. Understanding is not a prerequisite of control, it is control. (Fabun, 1968, p. 30)

. . . that he (Sir Charles Snow) feared that technological progress would eventually lead to a situation in which life–or–death decisions would one day be made by a small scientific elite 'who do not quite understand the depth of the argument.'

This is, he said, 'one of the consequences of the lapse or gulf in communication between scientists and nonscientists'. (Finke, 1967, p. 50)

9. . . . to become aware of technological changes occurring in society.

. . . there is the recognition that technological developments frequently have social, human, and environmental implications that go far beyond the intention of the original technology itself. (Kranzberg, 1986, p. 553)

Technological literacy is basic to human performance in practically all areas of living, as well as the very

existence of the individual on this planet. (Maley, 1987, p. 244)

It was the success of the simplest tools that started the whole trend of human evolution and led to the civilizations of today. (Washburn, 1962)

The new danger of ignoring technology in the twentieth century {liberal arts curriculum} is the possibility that we may be creating a nation of mandarins, isolated from the social and largely fabricated reality in which we live. (Chaplin, 1985, p. 14)

Within the information age of today people are continually interacting with technology and compelled to cope with rapid technological change. Technology education prepares our young people to be educated as citizens who can live in and contribute to our competitive and technologically–based society. It can enable the United States to maintain its worldwide lead in technology. Truly, technology education is preparing our youth for the future. (Gemmill)

By looking into our technological future through technology education, people may be more adequately attuned to the life experiences of the world in which they are about to live. (Starkweather)

The study of technology is essential for an understanding of culture, just as a comprehension of the material basis of social life is indispensable to those concerned with human group behavior. More than this, we have seen that the technological equipment of a people figures more than any other aspect of their culture when current judgments of advancement or retardation are drawn. (Herskovitz, 1960, p. 241)

10. . . . to be able to raise appropriate questions regarding technology — its use, value, and abuse.

A technologically literate populace is necessary if citizens are to apply in a responsible manner their values and judgments in the control and use of technology. (Johnson, 1990, p. 1)

. . . we are raising a new generation of Americans that is scientifically and *technologically* illiterate. (National Commission on Excellence in Education, 1983, p. 10)

Technology. All students should study technology: the history of man's use of tools, how science and technology have been joined, and the ethical and social issues technology has raised. (Boyer, 1983, p. 304)

Still others are concerned that an overemphasis on technical and occupational skills will leave little time for studying the arts and humanities that so enrich daily life, help maintain civility, and develop a sense of community. Knowledge of the humanities, they maintain, must be harnessed to science and technology if the latter are to remain creative and humane, just as the humanities need to be informed by science and technology if they are to remain relevant in the human condition. . . (Boyer, 1983, p. 10)

The convergence of circumstances in the development of technology have given us unique alternatives for today and the future. In order to comprehend and utilize technology mandates a discipline for that task. Technology education is designed to meet that need. (Lauda)

People who have experienced technology education are able to make more informed judgments about technological issues such as pollution, nuclear power generation, super colliders, etc., because they understand technology in terms of its benefits and limitations. (Waetjen)

Technology education provides society the understanding needed to make choices and direct the collective decisions in this technological world for the common good. (Bensen)

In a democracy, citizens and consumers are continually being asked to make evaluations of the applications and limitations of technology to human wants, desires and problems. By providing students with the skills necessary to evaluate the appropriateness of various technological devices and fixes, the curriculum area of technology education helps to promote a more just and sustainable future. (Gilberti)

Students must be prepared to understand technological innovation, the productivity of technology, the impact of the products of technology on the quality of life, and the need for critical evaluation of societal matters involving the consequences of technology. (National Science Board, 1983, p. 44)

11. . . . to develop the attitude and skills necessary for continuous learning in a fast changing society.

In one sense, the advance of technology in the workplace makes work easier by reducing physical demands. But inevitably the advance of technology makes other intellectual and psychological demands. Even those inventions that make calculations faster and easier — computers, for example — require a high degree of adaptability. (Task Force on Education for Economic Growth, 1983, p. 15)

Chapter 5

Academic Values

The following is a listing of academic values of technology education as stated in the form of opportunities for the student.

1. ... to integrate mathematics, science, and social studies in a meaningful and relevant way.

There must be someplace in the school where the students can put all the parts (academic disciplines) together in the context of reality and the world beyond the school. That place is technology education. (Maley)

Real problems — the products of technology — provide numerous exciting applications of mathematics and science... when technology is used to introduce scientific thinking, it will appeal to the student as more interesting and relevant, and hence be a motivator. (National Science Board, 1983, p. 73)

Technological literacy is the possession of a reasonable understanding of technological systems and requires knowledge of scientific and mathematical concepts. (National Science Board, 1983, p. 74)

The goal of increased understanding of technology becomes the primary objective towards which the interface with mathematics and science is directed. (Maley)

... indeed, I believe that improving technology education can contribute to improving science and mathematics education. (Johnson, 1990, p. 1)

Technology must become part of the K–12 experience for students. Infusing technology into the K–12 curriculum with teachers who are knowledgeable about technology as a curriculum integrator can add a sense of reality generally missing from current schooling. (Johnson, 1990, p. 44)

Technology topics need to be integrated into the present curriculum. This includes science and mathematics classes, industrial arts, social studies and the language arts, and art and music. (National Science Board, 1983, p. 75)

The idea that one can teach or learn anything to any appreciable degree within a single discipline is erroneous and foolhardy. (Maley)

The study of technological systems should be used as a basis for providing integrated and holistic learning. (National Science Board, 1983, p. 84)

It is a sound educational principle that students should be introduced to scientific subject matter and be initiated into its facts and laws through acquaintance with everyday social applications. (Dewey, 1938, p. 98)

Technology is a product of mathematics, science, and engineering. It is difficult to introduce the concept of project work and design of physical things into an academic environment. What is principally lacking is faculty experience in technology; thus, we must better prepare our teachers. The education of teachers in technology must be, in part, experiential, so that they can educate students in an experiential way. (National Science Board, 1983, p. 73)

The peculiar merit of a scientific education should be, that it bases thought on firsthand observation; and the corresponding merit of a technical education is that it follows our deep national instinct to translate thought into manual skill, and manual activity into thought. (Whitehead, 1952, p. 80)

For a comprehensive high school or junior high, you need a broad range of experiences that will fit the needs of a lot of different kids. Somewhere in that school the kid needs to find a place to have success. (Copa, Plihal, Scholl, Rehm, & Copa, 1985, p. 18)

Although technological concepts are inseparable from their natural content in the sciences and mathematics, the commission considers the topic to be of critical importance and meriting separate treatment. Appropriate instruction in technology should be integrated into the curriculum for grades K–12. (National Science Board, 1983, p. 74)

2. **. . . to engage in a multi–sensory experience in education.**

Technology education provides the finest blend and balance of all the senses used in learning. It is truly the ultimate experience. (Bensen)

3. **. . .to develop various skills and understandings related to technological literacy.**

. . . technological literacy is quite different from scientific literacy and mathematical literacy. An understanding of scientific and mathematical concepts doesn't automatically result in an understanding of technology. (National Science Board, 1983, p. 73)

The product of our schools is people — people capable of living in and contributing to a great democratic society so profoundly impacted by industry and technology. (Maley)

It is recommended that a course in technology and technological thought be developed for use either at the eighth or ninth grade level. This is an appropriate time to cover subjects in technology in–depth, rather than waiting until the last year of high school. (National Science Board, 1983, p. 70)

Technological literacy needs to be a part of general literacy and "numeracy." In a sense we are speaking of "basics" in education, and we are identifying the knowledge and understanding of technology as basic. Technological literacy is quite

different from scientific literacy and mathematical literacy. An understanding of scientific and mathematical concepts doesn't automatically result in an understanding of technology. (National Science Board, 1983, p.73)

. . . there can be no adequate technical education which is not liberal, and no liberal education which is not technical; that is, no education which does not impart technique and intellectual vision. . . (Whitehead, 1953, p. 58).

Technology education provides each student with the requisite social, academic, and technical skills essential] for success in the complex era of the 21st Century. (Oaks)

4. **. . . to develop skills in the use and care of tools, materials, and equipment.**

. . . the corresponding merit of a technical education is, that it follows out deep natural instinct to translate thought into manual skill, and manual activity into thought. (Whitehead, 1953, p. 61)

5. **. . . to develop understandings related to the social impact of technology — past and present.**

. . . a solid case could be made that technology should be included in elementary and secondary schools because the knowledge it embodies is important in its own right. Practical reasoning is a universal, productive, and distinctive human activity . . . (Atkin, 1990, p. 32)

. . . our students know that they live in a technological age, but any history that ignores the technological factor in societal development does little to enable them to comprehend how their world came into being. (Kranzberg, 1986, p. 558)

Technology education must be a part of the whole education program throughout K–12. It is not only a subject in its own right, it is a part of all subjects. (Johnson, 1990, p. 1)

. . . technology also serves as a source of concepts ranging from the technical to the social such as storage, conversion, control, impacts, and risk/benefits. (Johnson, 1990, p. 2)

Students must be prepared to understand technological innovation, the productivity of technology, the impact of the products of technology on the quality of life, and the need for critical evaluation of societal matters involving the consequences of technology. (National Science Board, 1983, p. 44)

6. **. . . to establish relevance between the academic and the applied — the theoretical and the practical.**

. . . there is no such thing as educational value in the abstract . . (Dewey, 1938, p. 46)

The symbol manipulation and abstract thinking skills required in many technical jobs today are learned effectively through a combination of practice and explicit teaching in a meaningful context. (Raizen, 1989, p. 56)

. . . it is not sufficient to teach knowledge and procedures; instruction must also focus on conditions of application of the knowledge and skills being learned. (Raizen, 1989, p. 54)

Technology is not to be confused with science. Science is what the universe, macrocosm and microcosm, consists of — stars, planets, galaxies, cells, atoms, particles. Technology in tools, machines, power, instrumentation, processes, techniques. (Gies, 1982, p. 17)

The solution which I am urging is to eradicate the fatal disconnection of subjects which kills the vitality of our modern curriculum. There is only one subject matter for education, and that is life in all its manifestations. . . (Whitehead, 1952, p. 18)

. . . education should turn out the pupil with something he knows well and something he can do well. The intimate union of practice and theory aids both . . . (Whitehead, 1953, p. 58)

But even if it weren't — even if there were not a robust link between a well–crafted technology curriculum and the country's economic well–being — a solid case could be made that technology should be included in elementary and secondary schools because the knowledge it embodies is important in its own right. Practical reasoning is a universal, productive, and distinctive human activity. Emphasizing it may have the desirable effect of helping students see clearer connections between the activities they are made to do in school and the issues that make a difference in their own lives. (Atkin, 1991, p. 50)

For a comprehensive high school or junior high, you need a broad range of experiences that will fit the needs of a lot of different kids. Somewhere in that school the kid needs to find a place to have success. (Copa, Plihal, Scholl, Rehm, & Copa, 1985, p. 18)

. . . one consideration stands out clearly when education is conceived in terms of experience. Anything which can be called a study — must be derived from materials which at the outset fall within the scope of ordinary life experience. (Dewey, 1938, p. 86)

As early as the Sixteenth Century, Francis Bacon urged craftsmen to acquire greater scientific knowledge. And, during the past two centuries, technology has been based more and more on science. Today, the two are joined. (Boyer, 1983, p. 109)

The pupils have got to be made to feel that they are studying something and not merely executing intellectual minuets. (Whitehead, 1953, p. 9)

When taught within an educational program, the study of technology in our local school systems must be given equal emphasis to other academic disciplines such as language, science, mathematics and economics. (Lucy)

Technology education provides an excellent resource for developing the student to the fullest extent. Due to the nature of its subject content and teaching methods used in this subject, it provides a exemplary opportunity for students to excel and develop themselves. It is particularly appropriate for individuals in developing skills and combining theoretical and practical applications in their educational experience. (Williams)

Technology education is more than just an acquaintance with tools, materials, and processes; it is the part of an individual's education that helps to bridge the gap between theory and practice. (Vaglia)

. . . firsthand knowledge is the ultimate basis of intellectual life. . . . the second–handedness of the learned world is the secret of its mediocrity . . . (Whitehead, 1953, p. 61)

We believe, after examining the findings of cognitive science, that the most effective way of learning skills is "in context," placing learning objectives within a real environment rather than insisting that students first learn in the abstract what they will be expected to apply. (U. S. Department of Labor, 1991, p. xv)

The antithesis between a technical and a liberal education is fallacious. There can be no adequate technical education which is not liberal, and no liberal education which is not technical. (Whitehead, 1949, p. 58)

It is a sound educational principle that students should be introduced to scientific subject matter and be initiated into its facts and laws through acquaintance with everyday social application. (Dewey, 1938, p. 98)

The "hands on, minds on" nature of technology education make it the perfect catalyst for quality academic learning for all students but particularly those who need to see a powerful association between theory and practice (real life) if they are to stay in school and succeed. (Oaks)

7. **. . . to develop understandings and appreciations related to the evolution of technologies.**

. . . the history of technology is the story of man and tool — hand and mind — working together. (Kranzberg, 1986, p. 558)

It is increasingly important for all students to explore the critical role technology has played throughout history and develop the capacity to make responsible judgments about its use. (Boyer, 1983, p. 111)

We recommend that all students study technology: the history of man's use of tools, how science and technology have been joined, and the ethical and social issues technology has raised. During this proposed one–semester course, a student might well look at one technological advance — the telephone, the automobile, television, or the microcomputer, for example — trace its development, and examine the positive and negative impact it has on our lives today. (Boyer, 1983, p. 110)

8. **. . . to develop understandings and appreciations related to the utilization of technologies.**

The need for broad–based technology education is confounded by the complexity of the required effort for the implementation that lies ahead. (Johnson, 1990, p. 44)

True learning includes first, a sense of accomplishment and satisfaction, second, an excitement which generates further exploration, and third, a desire to relate this new ability to other areas. It is our position that the study of technology can stimulate this cycle and foster true learning in science and mathematics as well. Beyond all practical reasons, we encourage the study of technology by young people strictly for the simple joy of it and for the great satisfaction that comes with an understanding of how the world works. (National Science Board, 1983, p. 84)

9. **. . . to develop understandings and appreciations related to the significance of technology in human affairs.**

It is a sound educational principle that students should be introduced to scientific subject matter and be initiated into its facts and laws through acquaintance with everyday social applications. (Dewey, 1938, p. 98)

Our secondary school students. . . want to see themselves as participants in the world they live in. . . they want the world to be in the school and the school in the world. (Foshay, 1970, p. 352)

. . . many of today's students simply do not see the relevance of history to the present or to their future. I suggest that this is because most history, as is currently taught, ignores the technological element. (Kranzberg, 1986, p. 554)

Technological literacy needs to be a part of general literacy and "numeracy." In a sense we are speaking of "basics" in education, and we are identifying the knowledge and understanding of technology as basic. (National Science Board, 1983, p. 73)

Technology education provides a commitment to a time–honored goal, that is, to merge the realities of life in a technological society with the educational system. (Lauda)

The time has come to have a new basic as a core subject in our schools called technology education. Advancing technology has dictated that we do so. It is time to break tradition and implement a subject area brought about by our society. (Starkweather)

Technology education is the "general education" of the world of technology. Technology education is the "know–how" for the future. (Rosser)

10. **. . . to develop an awareness and understanding of the contributions of technology in the advancement of civilization.**

The study of technology is essential for an understanding of culture, just as a comprehension of the material

basis of social life is indispensable to those concerned with human group behavior. (Herskovitz, 1960, p. 241)

. . . too many school children are taking the push–button world they live in for granted as though it sprung fully armed from some Jovian head. If we can teach them of the slow, heartbreaking process by which we came to be as we are, it will give them healthy pause. (Burlingame, 1959, p. 18)

We are frankly disappointed that none of the schools we visited required a study of technology. (Boyer, 1983, p. 111)

. . . there is also an indirect influence of technology on education, one which makes it more possible than ever before in human history for larger numbers of people in the industrialized nations to take advantage of formal schooling. (Kranzberg, 1986, p. 555)

A unified interdisciplinary study of technology is needed to develop an acceptable level of technological literacy within all students. Technology education contributes to understanding the development, use and significance of society's inventions and technological developments; to applying and interacting successfully with technology; to systematically approaching technological problems and effectively communicating the results; and to evaluating the impact of technology on the individual, society, culture and environment. (Gemmill)

Technology education serves as a means of developing knowledge enabling students to examine technological alternatives to societal problems, provides an opportunity to explore change as an element of life and helps students explore how they can make a contribution in a future society. (Starkweather)

11. . . . to develop problem–solving skills.

Real problems — the products of technology — provide numerous exciting applications of mathematics and science . . . When technology is used to introduce scientific thinking, it will appeal to the students as more interesting and relevant, and hence be a motivator. (National Science Board, 1983, p. 73)

Technology education should emphasize problems–solving. The posing and solving of problems, increasingly complex as students move from Kindergarten through the twelve grades. (Johnson, 1990, p. 2)

Technology is also a connector in the world of science. It is the hands–on or experiential part of science and math. Technology is process, the action part of the technical world making things — doing things. Students remember better the principles of science if they have used them to solve problems by doing things, by solving problems in technology. (Johnson, 1990, p. 2)

The development of problem–solving skills should be a fundamental goal in pre–college education. This provides further rationale for an

early introduction to technology. The early introduction to technology, giving examples of real problems, would develop important reasoning skills. (National Science Board, 1983, p. 70)

Technology education contributes to some of the most basic and fundamental processes of learning. Through the development of such skills as problem–solving, group dynamics, decision–making, leadership and followership, inquiry, and technical competence to name just a few, students engage in organized academic learning experiences that prepare them for living in a technological world. (Martin)

The problem–solving focus of technology education helps students develop creativity, decision–making and managerial skills. (Wright)

Technology education presents an excellent opportunity for unique problem–solving opportunities for students. (Lauda)

The highest order and most complex human endeavors are embodied in problem–solving and in designing our future. In utilizing the synergy of the cognitive, psychomotor, and affective learning domains, technology education can and does provide for a powerful learning environment. (Bensen)

Technology education is one of the few curricula in the schools that provides a truly multivariable complex problem–solving environment that relates directly to the real world. In this environment students learn that there are many answers to a problem. (DeVore)

Technology education with its focus on technological literacy and the problem–solving approach, is providing a means by which students can understand, live and work in an advanced technological and information based society. The interdisciplinary nature of technology education is additionally helping students to integrate knowledge from other academic pursuits to the problems facing humankind. (Gilberti)

Creativity, problem–solving and conceptual learning, are all enhanced in the minds on, hands on learning environment of a quality technology education program. (DeVore)

Learning how to study and problem solve using technology and gaining knowledge about a particular technological topic can be of much value to individuals acquainting themselves with the forces that affect their own well–being. (Starkweather)

12. . . . to develop skills in research, inquiry, and synthesis.

The peculiar merit of a scientific education should be, that it bases thought on firsthand observation; and the corresponding merit of a technical education is that it follows our deep natural instinct to translate thought into manual skill, and manual activity into thought. (Whitehead, 1952, p. 80)

. . . the processes by which the individual will be able to maintain a reasonable degree of technological literacy throughout one's life in an ever–changing technological society is one of education's greatest challenges. (Maley, 1987, p. 248)

A multi–sensory method of inquiry that incorporates several known forms of intelligence, particularly visual spatial and bodily kinesthetic; an integrating activity fusing thinking, feeling and doing in a holistic learning experience; translates abstractions into meaningful application. (Hammond)

Technology education provides people with self–educative skills such as problem–solving, critical thinking, and analytic abilities. These are absolutely essential in a society in which information is increasing at an exponential rate. Cognitive techniques for keeping up to date with new information are essential since rote memory is ineffectual. Technology education provides those cognitive skills. (Waetjen)

13. . . . to experience educational activities in a holistic manner as opposed to the usual fractional forms of instruction.

. . . there can be no adequate technical education which is not liberal, and no liberal education which is not technical; that is, no education which does not impart technique and intellectual vision. (Whitehead, 1953, p.58)

The pupils have got to be made to feel that they are studying something and not merely executing intellectual minuets. (Whitehead, 1953, p. 9)

The study of technological systems should be used as a basis for providing integrated and holistic learning. This is our reason for suggesting that all academic departments be involved. We can not afford to repeat the mistakes of the past. (National Science Board, 1983, p. 84)

Experience is the application of understanding. It builds familiarity and helps fix what has been learned so that it can be applied in future, perhaps unfamiliar situations. It is the indispensable servant of technology education. (Johnson, 1990, p. 2)

The study of technological systems should be used as a basis for providing integrated and holistic learning. This is our reason for suggesting that all academic departments be involved. We cannot afford to repeat the mistakes of the past. (National Science Board, 1983, p. 84)

. . . when technology is used to introduce scientific thinking, it will appeal to the student as more interesting and relevant, and hence be a motivator. The mathematics and science education now offered to our young people could be greatly enriched if we were to incorporate a technological content. (National Science Board, 1983, p. 73)

It is in technology education where students begin to acquire an awareness that the many diverse courses in their academic program have a common thread — technology. (Pytlik)

True learning includes first, a sense of accomplishment and satisfaction; second, an excitement; and third, a desire to relate this ability to other areas. It is out position that the study of technology can stimulate this cycle and foster true learning in science and mathematics as well. (National Science Board, 1983, p. 84)

The interdisciplinary aspects of technology education develop a sense of family within the school. (Petrina & Volk, 1991, p. 25)

The greatest benefits to society will occur when there is a clear understanding of the relationships and interactions between society, academics and technology are understood and nurtured. That is the role of technology education in our nation's schools. (Oaks)

Individual Contributors

Bensen, M. James	President, Bemidji State University Bemidji, MN
Derthick, Lawrence	Former Commissioner of Education, United States Office of Education
DeVore, Paul W.	Professor Emeritus West Virginia, University, Morgantown, WV
Gemmill, Perry R.	Professor and Chair, Department of Industry and Technology, Millersville University, Millersville, PA
Gilberti, Anthony F.	Associate Professor, St. Cloud State University, St. Cloud, MN
Hammond, James J.	Chancellor Emeritus, State College System, Massachusetts
Lauda Donald P.	Dean, College of Health and Human Services, California State University Long Beach, Long Beach, CA
Lucy, John H.	Professor, California University of Pennsylvania, California, PA
Maley, Donald	Professor Emeritus, University of Maryland, College Park, MD
Martin, G. Eugene	Dean, School of Applied Arts and Technology, Southwest Texas State University, San Marcos, TX
Oaks, Merrill M.	Associate Professor, Washington State, University, Pullman, WA
Pytlik, Edward C.	Professor, West Virginia University, Morgantown, WV
Rosser, Arthur J.	Dean, College of Applied Science and Technology, Central Missouri State University, Warrensburg, MO
Starkweather, Kendall N.	Executive Director, International Technology Education Association
Vaglia, John S.	Associate Dean, School of Applied Science and Technology, East Tennessee State University, Johnson City, TN
Waetjen, Walter B.	President Emeritus, Cleveland State University, Cleveland, OH
Williams, Rollin III	Professor Emeritus, East Tennessee State University, Johnson City, TN
Wright, R. Thomas	Professor, Ball State University, Muncie, IN

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