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A Technology Education Inventory Among Northern California High School Principals And Recent Graduates

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A TECHNOLOGY EDUCATION INVENTORY AMONG NORTHERN CALIFORNIA HIGH SCHOOL PRINCIPALS AND RECENT GRADUATES

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FORMULATION AND DEFINITION OF THE PROBLEM

Introduction

Resistance to change, be it gradual or rapid, optional or forced, has been a malaise which has afflicted humankind for many centuries. Since it is normal for people to fear the unknown and cling to traditional methodologies, change often stimulates negative responses (e. g., rebellion, anxiety, withdrawal from situations, confusion, loss of identity, etc.). Toffler (1970) attempted to explain these maladies when he introduced the term "future shock" to the world's vocabulary in 1970. He noted that "future shock is a time phenomenon, a product of the greatly accelerated rate of change in society" (pp. 10-11).

On a more positive note, all by-products of change need not be adverse. Both social and technical change can induce favorable results. Given the opportunity, individuals may often accept change both intellectually and psychologically if they receive the necessary education enabling them to cope with change. People may also be more responsive if they understand present-day changes and are counseled to develop analytical and positive attitudes toward the changes they will encounter in the future.

Throughout the history of the human race, individuals have confronted various types of change. Recognizing this phenomenon, educational institutions, for the most part, have generally assumed the role of "change agent" in society. Educators in today's schools are increasingly being called upon to prepare their students for existence in a future world. Seif (1979) noted that "a major goal of the schools should be to develop *self-directed people with knowledge, skills and attitudes for fully functioning future living* (italics in original)" (p. 84). He further opined that the current school curricula do not focus adequately on these competencies. The present research project examined this dilemma through an investigation of the extent to which technological subject matter is included in present high school curricula and the degree to which educational leaders perceive themselves to be technologically literate.

Recent studies have indicated that present curricula do not discuss technological advancements that are relevant to everyday living and tend to minimize emphasis on both the history and future of technology (Blackenbaker, 1980; Laudicina & Laudicina, 1977). Proponents note that educational institutions continue to lag behind industry in adapting to the present technetronic age. Laudicina and Laudicina (1977) concur and surmised that "if it is true that colleges have lagged behind industry in creating innovative forms, it also may follow that higher education has not geared a student's educational growth to changing technological developments" (p. 25). Informal conversations with students enrolled in post-secondary programs would most probably reveal the fact that many of them do not feel that what they are being taught has had any value in teaching them how to live (or in fact survive) in the technological world of the future.

Educational administrators, at all levels, have a great deal of influence on the future directions of curricular development in the schools. If these leaders are not well-informed about the need for the inclusion of technology as a content area, students may not be adequately exposed to this material. Stated differently, it may be necessary to provide educational leaders with information regarding the importance of technology in education; this might be considered a crucial situation that should be dealt with immediately.

Statement of the Problem

The primary intent of this investigation was to ascertain the extent to which technological subject matter has been incorporated into the courses offered in Northern California high schools. Personal opinions as well as factual information regarding this issue were elicited from representative samples of high school administrators and recent high school graduates. The comprehensive nature of this assessment necessitated an examination of several interrelated areas of concern.

Focal Research Questions

During the course of this field study, the researcher attempted to develop succinct responses for each of the following inquiries:

Question 1: Do contemporary educational leaders acknowledge the importance of technological literacy in preparing students for survival in a somewhat tenuous future?

Question 2: Where do administrators believe the concept of technology belongs in high school curricula?

Question 3: Do California high schools offer a "general" course in present-day technology? For those that indicated an affirmative response to this inquiry, it was essential to denote the status of the course (e.g., elective or required); level of students who are eligible to enroll; instructional strategies and materials utilized to present course content; and basic components of the course outline.

Question 4: Are administrators verbally supportive of curricular programs designed to ameliorate technological illiteracy?

Question 5: Are any attempts being made to implement curricular strategies that stress a "futures" orientation and life skills related to technological literacy?

Question 6: Do recent California high school graduates feel that technological literacy is an important issue to be considered in present curricula?

Question 7: Do students believe that their high school education prepared them to enter an occupation that is related to a technology of some sort?

Question 8: Are there specific reasons for the absence of technological subject matter in high school curricula (e.g., interest, funding, personnel, facilities, awareness of a need)?

Definition of Terms

Educational Leader. This title was used generically to refer to those individuals who are directly involved with policy-making procedures related to high school curricula. Depending on the size of the school, these persons may be referred to as Principal or Assistant/Vice-Principal in Charge of Instruction.

Technological Literacy. This term is relatively new to the vernacular of technology education but has been recently linked with several definitions in the professional literature. According to Lauda (1979), "A philosophy of technology (call it technological literacy if you like) provides the student with an analysis of the concepts underlying the results of continued invention and innovation" (p. 30). Lux (1978) suggested that industrial technological literacy is "the ability to understand, appreciate and efficiently make use of the man-made world" (p. 190). Finally, Wright (1980) concluded that "it is the decision-making process about technological development that makes technological literacy paramount to basic education" (p. 37).

Since a definition of technological literacy should be understood holistically, each of the above explanations cited is limited in one way or another. For this research project, individuals who are technologically literate were those persons who believed that they possessed the following traits: confidence and skill in the use of technical tools and equipment; a satisfaction with their level of understanding of technical/scientific constructs and terminology; an awareness of the impact (both positive and negative) that technology can have on society; and an ability to project alternative futures wherein technology has an influence.

Technology. In recent years, numerous explanations have been cited to define technology as a concept (DeVore, 1980; Pytlik, Lauda & Johnson, 1978). Technology may be as simple as a paper clip or as complex as a computer; as helpful as a vacuum cleaner or as harmful as radioactive waste; a contributor to life's pleasures or a detriment to a worker's health. As a discipline, DeVore (1980) defined technology as

> the study of the creation and utilization of adaptive systems including tools, machines, materials, techniques and technical means and the relation of the behavior of these elements and systems to human beings, society and the civilization process (p. 4).

For their purposes, Pytlik, et al. (1978) defined technology as

> a process undertaken in all cultures (a universal), which involves the systematic application of organized knowledge (synthesis) and tangibles (tools and material) for the extension of human faculties that are restricted as a result of the evolutionary process (p. 6).

For the present research, two different explanations for technology were employed. The American Heritage dictionary suggests that technology is the application of science, especially to industrial or commercial objectives. This reference was provided for administrators who did _not_ have a personal definition for this term (see Appendix D). In the writer's mind, "technology" and "applied science" are _not_ synonomous terms. For this reason, the following description was developed:

> Technology represents the totality of the man-made means (e.g., tools, machines, information) employed to provide the objects and services that are necessary for human sustenance and comfort.

This definition is not more "correct" than any other, but it is germane in the sense that it depicts an aspect of human involvement with regard to technological issues that are pertinent to daily existence. It may be similar to other explanations (DeVore, 1980; Pytlik, et al., 1978), but the terminology is somewhat simpler.

Significance of the Study

The need to examine the salient past, present and future dimensions of technology and the extent to which these may dictate the competencies of both tomorrow's educational leaders and their students is manifest. For example, Olivero (1978) commented on the fact that society is firmly attached to technology on an ineffable scale and further urged his readers to begin a systematic study of the future in order that they may take action to control their destinies. In a similar fashion, Dowling (1980) concluded that "if we want technology to liberate rather than destroy us, then we have to assume responsibility for it" (p. 5). Although the profile of this study is broad in scope, its primary purpose involved an attempt to collect research data in support of these recommendations as they relate, in the writer's opinion, to the roles and responsibilities of educational leaders.

Social and technological change has accelerated to the point where the traditional habits of "waiting to see what happens" are no longer appropriate. Due to this accelerated pace of change, a point in time has arrived wherein the future is colliding rampantly with today, and students attending schools face even more uncertainties than did their parents. Concurrently, those persons who hold leadership positions in the field of education must, to a much greater extent than did their cousins of yesteryear, accept the challenge of preparing students to cope with rapid change and exist in a world whose future cannot be succinctly predicted.

This research project provides data that reveals the degree to which contemporary leaders in education are both ready and competent to meet these challenges. This information may be useful to assess the probable success or failure of tomorrow's educational institutions. In the writer's opinion, students who are technologically illiterate are somewhat deprived. The results of this study address this concern and may eventually have a positive impact on the future of high school curricular directions.

Organization of the Study

Chapter 1 has given the reader an introduction to the importance of technology education. Focal research questions were identified and essential terms were defined.

Chapter 2 reviews the professional literature that is related to this research project.

Chapter 3 describes the research design and methods employed to test several hypotheses.

Chapter 4 presents the statistical results of the investigation.

Chapter 5 delineates the researcher's conclusions and recommendations derived from the results.

Chapter 2

A REVIEW OF THE RELATED LITERATURE

The present study examined curricular issues as well as administrative and student opinions. Technology education and technological literacy were introduced as research variables in the focal research questions. An attempt to link pertinent issues in technology education with the field of educational administration resulted in an atypical literature review. Conversations with two university librarians revealed that a computer-assisted literature search would not be cost effective. It therefore became necessary to initiate a thorough hands-on investigation of various literature abstracts published since 1975 (e.g., CJIE -- ERIC; RIE -- ERIC; Applied Science and Technology Abstracts) and relevant current periodicals. Three university libraries were used to conduct this search which took approximately eleven months to complete.

During this investigation, it became evident to the writer that there were several disciplines that could contribute information related to this project's central inquiries; each of these deserved discussion in order to prepare a comprehensive review of the professional literature (e.g., industrial education, educational administration, technological literacy, technology education, present-day technological issues and concerns, futurology, curricular trends, etc.). The relevance of each of these topics was assessed, and they were ultimately incorporated into this chapter under the following subheadings: Impact of Technology on Society; Future Dimensions of Technology; Educating Students to be Technologically Literate; Trends Underway in the Educational Milieu; Roles and Competencies of Educational Leaders; and Previous Investigations Concerning Technology Education.

Impact of Technology on Society

Technology is a primary determinant of social change and its effects are interwoven through all aspects of society. The writer's definition of technology in Chapter 1 suggested that people should have some control over the directions technological advancement can take. Too often people experience the negative impact of technology and feel as though they had little, if any, voice in the decisions antecedent to the current conditions. The crux of this dilemma is related to the fact that technological change can be either positive or negative depending on society's reactions to it; technology itself is neutral.

The literature and media appear to the writer to be inundated with warnings of the dangers surrounding technology. Among these one might find environmental destruction, depletion of natural resources, demise of the family unit, nuclear war, alienation of the industrial worker, mental illness, inflation, decreased quality of life, etc. Although an improvement in the quality of life in centuries past is often attributed to the contributions of science and technology, it is generally believed today that the quality of life is declining; interestingly, science and technology are receiving a major portion of the blame. Sizer (1980) listed several factors from which one could readily compile anecdotal evidence for this trend. A few of these included air contamination, water/noise pollution, food additives, dependence on drugs/medication, crime, escalating costs of living/taxation, less money left over for luxuries and "fun," etc. Sizer (1980) immediately refuted the fact that science and/or technology were responsible for these issues. He concluded that the educational sector has made a minimal contribution to the public's understanding of science and technology as they relate to the well-being of society and quality of life.

Thompson (1978) was not as forgiving when he described technology to be a "craft of deceit" (p. 1). He prepared a detailed essay to speak vehemently against technology and cited it as the underlying factor which led to the Vietnam War, Watergate, the Central Intelligence Agency, subliminal seduction, and nuclear weaponry. He selected these examples from contemporary events to support the assertion that the "manipulation of people through technology now takes place on a grand scale with devastating results" (Thompson, 1978, p. 8). Thompson (1978) developed a strong case to denigrate technological advancement and managed to project a dismal scenario for world civilizations. On the other hand, his summative analyses were weak in that they lacked recommendations for improvement.

In an attempt to further illustrate possible public skepticism toward technological progress, Marshall (1979) discussed the failure of three feats of engineering design, including the nuclear reactor (at Three Mile Island), a sophisticated satellite (Skylab), and a new model passenger airplane (the DC-10). Sensationalism in the news media stimulated an uneasy suspicion in the scientific establishment "that the public just does not understand science and distrusts its practicioners" (Marshall, 1979, p. 281). This perception prompted the director of the Center for Science and International Affairs at Harvard to coordinate a meeting to review the public relations problem and recommend strategies to restore public confidence in scientific/technological enterprises. Twenty-four professors from Harvard and the Massachusetts Institute of Technology represented the quorum for this discussion. According to Marshall (1979), they agreed on very little, but several participants recommended a troubleshooting institution of some sort that could provide the general public with unbiased information concerning the reasons for and ramifications of technological failures. The extent to which this suggestion was credible may very well remain in the minds of its proponents. Although an organization of this nature has not been formed, there appear to be other agencies that concur with the underlying facts which led up to that particular recommendation.

Walton (1980) synopsized a lengthy report from the National Science Foundation and the Department of Education. From this material, she deduced that "the USA, as a people, is woefully lacking in scientific and technical knowledge and understanding" (Walton, 1980, p. 860). This state of affairs is a direct result of a deemphasis on technology education for all citizens. Subsequently, Walton (1980) postulated that the United States would quickly lose its competitive edge in science and technology, and future technological decisions will be based on ignorance.

Through all of this, informed readers may be seriously tempted to question whether or not technology has anything positive to contribute to their future destinies. Marshall (1979) did make an attempt to refute this perception through a discussion of the results of a recent survey which revealed the fact that many people tend to agree with this statement: "Science and advanced technology have brought us more benefits through better products and an easier, healthier life than the problems they have created" (p. 284). The fact that people can seemingly lack basic scientific and technical knowledge and concurrently possess this type of attitude summarized by Marshall (1979), presents a most interesting challenge to education.

Modern technology has become a membership card into the twentieth century for numerous world nations. Although many people may fear technology's ability to simultaneously create and destroy values, the researcher must agree with Goulet (1979), who concluded:

> The essential problem is not technology *itself* but the successful *management* of it, which requires wisdom and clarity as to the kind of society desired and the ways in which technology can help construct it (italics in original; p. 430).

Educational leaders have a role to play with reference to Goulet's (1979) assertions. Specifically, they should not allow students to become overwhelmed by present-day technology, but should introduce educational activities that will help their students understand successful, as well as unsuccessful, technological innovations.

Future Dimensions of Technology

Contrary to the beliefs of many present-day fortune tellers, Tarot Card readers, and persons who profess to be clairvoyant, the future cannot be predicted. On the other hand, fairly accurate projections based on current conditions can be made in an attempt to elucidate a number of alternative futures (Shane, 1973).

Several years ago, Herman Kahn (1967) listed one hundred areas wherein he perceived the probability of technological innovation occurring before the year 2000. A few of his more provacative projections included human "hibernation" for medical purposes, capability to choose the sex of unborn children, extensive use of robots and machines "slaved" to humans, widespread use of cryogenics, space defense systems, conversion of mammals to fluid breathers, automated highways, and lifetime immunization against practically all diseases. Even the most superficial perusal of current weekly magazines and newspapers will alert the general public that scientific and technological research is already making many of these projections appear realistic rather than fictional.

Once again, the exact nature of the future may be unknown, but researchers (Lemons, 1981; Toffler, 1980) remain willing to conjecture about future technological trends. Toffler (1980) suggested that we are in an irreversible move out of the industrial era into a technological wave wherein all institutions founded in the industrial concept (i.e., Second Wave civilization) will be overrun and destroyed. He described a new way of life that will be based on "diversified, renewable energy sources; methods of production that make most factory assembly lines obsolete; new, nonnuclear families; a novel institution that might be called the 'electronic cottage'; and radically changed schools and corporations of the future" (Toffler, 1980, p. 10). This new civilization, as it challenges the old, will necessitate, and perhaps demand, a myriad of curricular changes in the public schools.

Regardless of how incredible or unbelievable some of these "possibilities" may seem, it is imperative for people in today's society to confront them analytically in order to be prepared for life in tomorrow's world. With reference to education, Toffler (1974), in an earlier work, commented that

> The ultimate purpose of futurism in education . . . is to strengthen the individual's practical ability to anticipate and adapt to change, whether through invention, informed acquiescence, or through intelligent resistance (p. 13).

Educating Students to be Technologically Literate

Many teachers and educational administrators are currently facing a professional dilemma with regard to the appropriate strategies that might be required to prepare students to deal with the problems of drastic change related to technology. Hartman (1977) addressed this uncertainty and concluded that today's educators must strive to nurture the following competencies in their students: well-developed focusing ability, decision-making ability, and coping ability. She further stated that teachers must "work harder than ever to assure an atmosphere in which children learn independently, calling on their inner resources and increased direct experiences" (Hartman, 1977, p. 36).

Another educator noted that "although technological literacy has yet to be widely recognized as a significant goal of general education, its day is coming" (Dyrenfurth, 1981, p. 49). A major portion of his paper focused on the need for industrial arts "cluster" programs (e.g., Communications, Energy and Power, Materials and Processing, Manufacturing) to serve postsecondary and adult vocational students. His curricular recommendations involved a coupling of laboratory experiences and instruction that could ultimately enable students to develop a comprehensive view of technology as it affects them today and as it will be likely to affect them in the future. Dyrenfurth (1981) seemed to imply that industrial/vocational educators would continue to be the persons responsible for teaching about technology until it becomes an acceptable topic for discussion in other disciplines (e.g., English, History, Mathematics, Science, etc.).

Seif (1979), in his assessment of the role of the schools in preparing its students for the future, noted the importance of <u>knowledge</u> (e.g., citizenship, everyday living, personal growth); <u>skills</u> (e.g., thinking, problem-solving, decision-making, research, communication, personal reflection and assessment, technical); and <u>attitudes</u> (e.g., scientific, self-acceptance, future orientation, caring). He presented four interesting recommendations which should be considered by educational leaders in the process of developing curricula focused on future living. Those guidelines include the following:

> <u>First</u>, certain types of knowledge should be emphasized, and schools should determine if their programs are geared to future living knowledge.
>
> <u>Second</u>, a school district should determine whether there is a strong enough emphasis on skills and attitudes for future living.
>
> <u>Third</u>, schools can organize their programs to be consistent with their students' stages of development.
>
> <u>Fourth</u>, schools should emphasize active, experiential real world learning (Italics added) (Seif, 1979, pp. 101-102).

The author of a recent editorial entitled "The high-tech challenge: Schools, industry can meet it" (1981) appeared to agree with Seif's (1979) recommendations but added more "specificity" to the above guidelines. Among other things, the public schools should require more than one year of science and math for graduation; gear more science courses toward modern, high technology education; integrate scientific and technical subjects into other more general courses; install more computers and "high-tech" equipment into the classroom.

Industrial firms can also play an active role in educating students to become more technologically literate. For example, high-technology corporations could offer summer jobs and internship training to science and vocational teachers; provide scholarship incentives for students who plan to teach in these fields; and coordinate regular, comprehensive plant visitation programs and guest instruction for the public schools. It appears that industry should have a clear self-interest in joining with the schools "to ensure that they have the tools and the people to produce the next generation of engineers, technicians and computer programmers" (The high-tech challenge, 1981, p. 6C).

Still another avenue for educators to consider was introduced by Kitch (1980) who referred to computer literacy as the "fourth basic intellectual skill" (p. 22). He seemed thoroughly convinced that unless students are well-informed with regard to the tools and techniques germane to a vast computerized information network, the next great crisis in American education will be the computer literacy crisis. This inference was drawn from this statement:

> With the advent of home-computers and the widespread development of computer-controlled devices for the home and place of work, effort must be directed toward computer literacy for the entire population. Otherwise, these devices may become tools in the hands of the powerful and affluent to emphasize and exploit the disadvantages of the "computer illiterates." (Kitch, 1980, p. 22)

Speaking in more general terms about curricular concerns, Boyer and Kaplan (1977) discussed the need for a "core curriculum" which would, among other things, encourage students to investigate the ways in which they are intractable as well as malleable and discover the interrelationships between what they do today and the lives they will live tomorrow. Furthermore, according to Doll (1978), educators must give more attention to the development of analytical skills in the public schools. In his words, "learning how to learn, or learning how to think, will become a major thrust of the schools" (Doll, 1978, p. 348). Finally, Laudicina and Laudicina (1977) iterated that educational institutions must take more responsibility for formulating the mechanism which can bridge the gap between individual growth and social change. They surmised that today's education "must enable the individual to develop a new focus, the capacity to discern complex relationships between and among social and environmental conditions" (p. 26).

A majority of the writers whose work was examined during this literature search seem to stress the importance of adaptive skills for the learner who will live in the society of tomorrow. Although one cannot deny the importance of these proficiencies, in the writer's opinion, too few researchers have investigated the necessity for developing the "life skills" related to technological literacy in today's students. Toffler (1974) discussed the issue briefly and stressed the need to combine action learning with academic work having a future orientation. He used the term "action learning" to describe activities such as constructing buildings on campus, helping to police a high crime area, doing research for a trade union, etc.

Along a similar line of thinking, Phillips and McElhinney (1979) introduced the term "life-role competencies" and accentuated the need for increased efforts which strive to relate classroom instruction to real life situations. Suggesting that becoming a wise consumer was one essential life role competency, they delineated a general list of classroom activities that might lead to this objective.

Starkweather (1979) and Daiber (1979) contributed their suggestions with regard to the relationships between general education and technology. Specifically, "education which is technology based can provide members of society a common knowledge to develop the necessary skills for survival in a technological culture" (Daiber, 1979, p. 42).

If educational leaders have an honest commitment to meet the challenge of educating students for survival in the future, they should heed each and every one of these recommendations by implementing both "future-orientation skills" and "life skills" into their present curricula. Furthermore, they should strive to ameliorate technological illiteracy among all students through the inclusion of technology-based material in all high school subjects.

Trends Underway in the Educational Milieu

Before reviewing the roles and competencies of educational leaders, several trends in the field of education deserve mention. Perhaps the most obvious trend involves the declining enrollments in the schools. Olivero (1978) noted this phenomenon and discussed teacher/administrator layoffs and transfers and the fact that teacher supply is exceeding demand. In surveying a variety of general trends, he stated that

> The educational system may find itself seriously overburdened by assuming the expanding range of social commitments previously handled by the family . . . education will begin earlier and continue longer, with less sharply defined termination . . . work itself will be organized for its value as education rather than education being organized for its value to work. (Olivero, 1978, pp. 4, 16-17)

Mundy (1978) explicated the importance of technology as a school subject and noted the trend toward an interdisciplinary approach in presenting this material in university curricula. Teachers from a variety of subject disciplines seem to be interested in learning more about present-day science and technology in order to become more involved with this aspect of university subject matter. The writer's recent experiences with a course entitled "Technology and Civilization" at San Jose State University in California provides further support for Mundy's (1978) conclusions. Due to declining enrollments in the "softer" disciplines, several faculty members (e.g., History, Social Science, and Philosophy) have openly admitted to their interest in "team-teaching" a course of this genre.

Hummel (1978) depicted positive trends toward the concept of lifelong learning, mid-life career changes as the norm, and new forms of nonformal education. With reference to guidance and counseling trends, Gordon (1979) suggested that counselors concerned with career development would soon begin to focus on helping young people learn how to live a life.

However, the trend which may be most threatening to educational administrators was explained by Chapple (1978) who concluded that the school is no longer the principal educator. He further stated that the school "provides only the ingredients, the substructures on which education in the corporate and technological world can build" (Chapple, 1978, p. 734). With these present and/or probable educational directions in mind, together with the challenge of educating students for the future and the need for technological literacy, how will today's educational leaders fare in tomorrow's nebulous educational milieu?

Roles and Competencies of Educational Leaders

Surprisingly enough, many of the strategies previously illustrated with reference to educating students are analogous to the competencies that educational leaders will need for success and survival in the future. Skills which are first and foremost seem to entail the ability to be flexible, adaptive, and make decisions to promote change only when necessary.

Educational leaders of the future will need to maintain a holistic perspective and be characteristically proactive, not reactive. Case and Larson (1973) stressed the need for "training in and experience with value clarification, normative forecasting, consensual validation processes, Delphi trend analysis and design" (p. 244).

From Tye's (1977) vantage point, the school principal should be identified as the critical person in the educational process. Through his delineation of the dimensions of leadership which merit consideration in these complex times, the writer perceived the need for a contingency plan with regard to leadership strategies. Stated more simply, an administrator's actions and/or competencies will be dictated by a variety of situations; there may not exist "one correct" course of action for all settings.

Several additional researchers have contributed their opinions with reference to the future of educational leadership. Hutton (1976) defined the role of educational administrators as that of the primary change agent in the schools. To satisfy the overwhelming demands of this role, the person must act as coordinator, educational engineer, research virtuoso, intellectual leader, instigator, etc. Koehler (1978) reexamined the concept of administration as a social process and revealed the need for people in leadership roles to establish purposeful relationships with their subordinates.

Finally, highlighting the educational training of administrators, Glines (1978) examined the major shortcomings of Competency Based Education (CBE) in 26 states and revealed the recurrent failure to create competencies with a futures focus. He continued this train of thought and stated that CBE programs "have not been tested against the emerging possible/probable/preferable alternative futures facing society" (Glines, 1978, p. 24). The preparation and/or retraining of administrators, therefore, should be directly relevant to the complex, technological world of the future that lies "outside" the confines of the educational environment. Glines' (1978) assertions almost begin to lend credence to the writer's premise concerning the need for an acute awareness of the importance of technological education among educational leaders, but the need for an empirical investigation of this hypothesis remains apparent.

The preceding paragraphs raise many inquiries with regard to the extent to which current educational leaders and those individuals preparing to enter the field of administration possess a keen futuristic orientation and an understanding of technology. The facts that technological information will continue to accumulate, rapid industrialization and modernization will continue to accelerate, and technology, itself, will do much to increase educational availability should not be alarming. On the other hand, these issues should undoubtedly stimilate the need for critical reform in the public schools.

Previous Investigations Concerning Technology Education

The findings of a recent National Public Affairs Study conducted by Miller, Suchner and Voelker (1980) under a grant from the National Science Foundation are germane to the present investigation. These researchers measured high school student attentiveness to four different issue domains: (1) science and technology; (2) foreign policy; (3) economic policy; and (4) civil rights. With specific reference to science and technology, they defined attentiveness as having three dimensions: interest, knowledge, and acquisition of information. The results of this portion of their study are illustrated in Table 1.

These statistics speak for themselves and connote a dismal state of affairs for the existence of technology education in the high schools. The reader should be inclined to wonder why the high school experience is ostensibly contributing so little to enlarging the level of public awareness of the importance of science and technology in today's world.

It was just this type of concern which prompted a

Table 1

Attentiveness to Science and Technology by Year in School and Educational Plan

Group	N	Percent Attentive To: Both Science & Technology	Science Only	Technology Only	Neither	Total
High School, No College						
Year 10	466	0	0	3	97	100
Year 11	392	1	0	3	96	100
Year 12	359	1	0	6	93	100
High School College Bound						
Year 10	342	6	2	10	81	99
Year 11	361	9	1	8	83	101
Year 12	395	8	1	6	85	100
College						
Year 13	254	16	2	5	77	100
Year 14	319	18	5	5	72	100
Year 15	386	19	4	8	69	100
Year 16	462	18	6	8	67	99
Total	4029	9	2	6	84	101

Note: From "Evaluating Student Attentiveness to Science and Technology" by Mary Budd Rowe, The Science Teacher, 1980, 47(9), pp. 26-28.

recent study by Useem (1981) in the Santa Clara Valley of Northern California. In an endeavor to determine the extent to which educators are presently responsive to high technology industrial employment demands, she conducted over one hundred interviews with officials from education, industry, and government between January and July 1981. Through these conversations, she concluded:

> 1. Public schools have been the least responsive and elite institutions of higher learning, especially Stanford, have been the most responsive to the demands of the high technology economy in Santa Clara Valley.
>
> 2. The public schools, starved for funds and beset by conflicting demands of many constituent groups, are moving in a direction opposite to the economic trends in the area.
>
> 3. Executives were far more willing to donate funds, personnel, and equipment to community colleges and universities because students were closer in age to the point of employment . . . Business people want a quick return on their investment, something public schools can rarely deliver.
>
> 4. There are a few signs that high technology companies are beginning to think more about "what to do" as they come to recognize that public schools are the core of the nation's educational system and that the system is in decline relative to that of their foreign competitors. (Useem, 1981, pp. 25-26).

Useem's (1981) findings are timely since it was during her data collection period that the hypotheses for the present investigation were formulated. Perhaps this writer's findings combined with Useem's (1981) report will create the necessary impetus for the inclusion of technology education in the high schools.

A thorough review of the related research has not located previous studies designed to measure perceived technological literacy among high school administrators. Blackenbaker (1980) recently documented evidence of general technology courses in university industrial education departments, and Peterson (1980) chronicled one approach to developing a technology-based curriculum for the elementary school level. However, the writer has been unable to find research data of this nature pertinent to high school programs. Furthermore, attendance at the 1981 American Industrial Arts Association Conference suggested that there have not been any empirical attempts to measure technological literacy among either of the groups studied in the present research project (Daiber & Wright, 1981).

In summation, the writer can only reiterate her perception of the distinct importance of the need to implement technology, life skills related to technological literacy, and a futures orientation in all areas of general education curricula. The present research project has attempted to measure current administrators' perceptions of the importance of these three content areas and the degree to which same are existent in the schools' curricula. The self-reports provided by these individuals were statistically compared to the opinions of a representative sample of recent California high school graduates.

Information gleaned from both of these groups should provide the reader with a more comprehensive assessment of the current state-of-the-art with reference to technology education in Northern California high schools.

The subject matter included in current curricula stems from an awareness of possible/probable future world profiles. As these images/projections begin to approximate accuracy, the "future shock malaise" will become extinct. Subsequently, those of us who refer to ourselves as educators and educational leaders should accept the responsibility for preparing our students for high quality future living.

Summary

This Chapter was introduced with a discussion of the impact of technology on society indicating that technological change can be either positive or negative depending on society's reactions to it. In other words, technology itself is neutral. Several projections regarding future dimensions of technology were briefly discussed to convey the purpose of futurism in secondary education. These projections were followed by an examination of various strategies educators might consider to possibly improve their students' levels of technological literacy. A discussion of current educational and curricular trends revealed the fact that enrollments in the "softer" disciplines were declining and that public schools could no longer be considered the principal educators. They should, however, continue to provide a solid substructure on which education in the corporate and technological world can build. Professional literature in the field of educational administration was examined through a depiction of the roles and responsibilities of educational leaders of the future. It was noted that individuals who were preparing to pursue an administrative career should possess a keen futuristic orientation and a basic understanding of present-day technology. Finally, two investigations concerning technology education were highlighted. Research data collected in both cases concluded that students were not adequately exposed to scientific and technological topics during their secondary educational experiences. The design and methodology of the present research project are described in Chapter 3.

Chapter 3

DESIGN AND METHODOLOGY OF THE STUDY

To reiterate briefly, the primary intent of this research involved an attempt to ascertain the extent to which technological subject matter has been incorporated into the courses offered in Northern California high schools. Personal opinions as well as factual information regarding this issue were elicited from representative samples of high school administrators and recent high school graduates.

In an effort to contribute relevant information to educational administrators, teachers, and curricular specialists, the present investigation sought to examine the state-of-the-art with reference to the role of technology education in the secondary programs. Subsequent measures were taken to determine the amount of emphasis placed upon and interest ascribed to technological issues as an integral component of this area's public school curricular offerings.

The comprehensive nature of these issues prompted an interest in several related areas of concern; these areas were presented in the form of focal research questions in the first chapter. The research data compiled to address these inquiries were also used to test several hypotheses. Since there has been a minimal amount of empirical research conducted with regard to either the concept of perceived technological literacy or the inclusion of technological subject matter in public school curricula, all hypotheses were stated in the null.

Delimitations and Scope

This study examined the issue of technological literacy among educational leaders and recent high school graduates. Random samples were selected from three target populations, including (1) high school administrators who are specifically responsible for curricular revision and development; (2) community college freshmen who have graduated from a California high school within the past two years; and (3) university freshmen who have graduated from a California high school within the same time period. It was necessary to draw representative samples of college freshmen from each type of postsecondary institution due to possible differences in their career aspirations, high school curricular orientations, and levels of technological awareness in home communities. Since all eligible student participants had attained a high school diploma within a fixed time period (i.e., 1979 or later), age and educacational level factors were held constant.

All participants who were surveyed during this research project were randomly selected from educational institutions located in thirty-two Northern California counties (see Appendix A). This geographic region included all high schools, community colleges, and universities that are currently in operation within an approximate one hundred fifty mile radius of the City of San Jose.

It was assumed that the level of technological advancement in a given area may be related to the number of residents in that immediate locale. For this reason, population size was measured on the administrative questionnaire (see Appendix E), but the level of technological advancement was considered to be the independent variable (see Table 2). The terms low (limited technological research and development), middle (technology applied in industrial firms), and high (extensive technological research and development) were used to describe the level of development in the areas surveyed.

Information regarding the extent to which technological material exists in present high schools was attained from a representative sample of administrators who were considered proficient in curricular policy-making strategies and projections. Survey responses from recent high school graduates yielded comparative data concerning

Table 2

Area Population and Levels of Technological Advancement

Category Label	Absolute Frequency	Relative Frequency (%)	Adjusted Frequency (%)	Cumulative Frequency (%)
Administrative Sample, Population				
Less than 10,000	20	16.9	16.9	16.9
10,000 to 50,000	50	42.4	42.4	59.3
More than 50,000	48	40.7	40.7	100.0
Total	118	100.0	100.0	
Valid cases = 118; missing cases = 0				
Administrative Sample, Level of Technological Advancement				
Low	45	38.1	39.1	39.1
Middle	39	33.1	33.9	73.0
High	31	26.3	27.0	100.0
Missing	3	2.5	missing	
Total	118	100.0	100.0	
Valid cases = 115; missing cases = 3				
Student Sample, Level of Technological Advancement				
Low	59	31.1	32.1	32.1
Middle	69	36.3	37.5	69.6
High	56	29.5	30.4	100.0
Missing	6	3.2	missing	
Total	190	100.0	100.0	
Valid cases = 184; missing cases = 6				

this area of inquiry. The researcher found that some high schools employ a person who is specifically in charge of curriculum and instruction (e.g., Vice-Principal, Assistant Principal, Curriculum Specialist). In other settings, however, the principal him/herself seemed to assume this responsibility. These data are pertinent to the central focus of this study and are identified as a dependent variable.

Sampling Procedures

The present research was conducted as a survey. Although the primary intent of the investigation was descriptive in nature, research hypotheses were statistically tested to draw conclusions based on comparisons and evaluations of the present situations.

Administrative Sample

To obtain a sample (n_1) that is truly representative of the educational leaders employed by the high schools in the aforementioned geographic area, it was necessary to follow several steps to insure random selection of participants. Each of the thirty-two Northern California counties that are coterminous with a one hundred fifty mile radius surrounding San Jose (see Appendix A) were assigned a number. Using a table of random numbers, sixteen (50 percent) counties were selected for inclusion in the field study.

Once these areas had been identified, the researcher obtained a list of the high schools located within county boundaries. Similar procedures were used to attain samples of community college freshmen. Information regarding the names and addresses of high schools and community colleges were collected from the 1980 California Public Schools Directory. This reference identified 201 high schools and 26 community colleges that were eligible for participation with regard to geographic locale. Since the researcher is presently employed at San Jose State University, this facility was identified as the source from which university students were selected.

To determine those educational leaders who were to be invited to participate in the survey study, each of the high schools named in the list was once again assigned a number. Projecting a 60 percent response rate, a table of random numbers was employed to select 162 high schools (i.e., 81 percent of the total listed in the Directory) to yield a representative administrative sample ($n_1 = 100$). The final step was to record the names and titles of the administrative personnel who were contacted to respond to the researcher's inquiries.

Student Samples

To allow for discovery of possible differences in perceptions regarding technological literacy, two samples (n_2, community colleges; n_3, university) of recent California high school graduates were assembled. To insure the availability of two samples of 100 students, in addition to San Jose State University, four community colleges were randomly selected from the list described above.

It was impossible to select student samples wherein all participants would have had equivalent measures of experiences with technology-based curricula. On the other hand, it was essential to survey a group of students that is most representative of the target population of high school graduates. To accomplish this objective, the researcher selected the samples from community college/ university freshmen English classes (i.e., English 1A). Courses of this nature are generally required for all students, regardless of their declared majors. Subsequently, disparities in the students' previous experiences and future career aspirations should characterize representative samples.

The researcher obtained lists of those professors, instructors, and lecturers who were assigned to teach freshmen English during the Fall 1981 semester. Projecting an average class enrollment of thirty persons, one educator from each community college was randomly identified for inclusion in the study. Likewise, five educators were randomly chosen from the Fall 1981 San Jose State University Schedule of Classes. The design of the project precluded the use of data attained from students who did not attend a California high school within the past two years. It was therefore necessary to survey larger groups in order to attain the desired sample sizes ($n_2 = n_3 = 100$).

Subjects

Administrators

Survey questionnaire packets were disseminated to a total of 162 high school administrators throughout the sixteen counties selected. Each packet contained a letter of transmittal (see Appendix B) which explained the scope and purpose of the project, a copy of the survey instrument (see Appendix E), and a postage-paid, self-addressed envelope. A total of 82 usable instruments were returned, yielding a 50.6 percent response rate.

Since this initial percentage fell below the projected rate of 60 percent, a second mailing was essential. The researcher sent a follow-up letter (see Appendix C) and a second copy of the instrument to each of the 80 high schools from which a response had not yet been received. As a result of this correspondence, an additional 29 instruments were procured, increasing the response rate to 68.5 percent.

One of the primary concerns with reference to survey research projects involves the percentage of nonresponding subjects. Researchers are generally inclined to wonder how the results of their studies would have been changed if all subjects had returned the inventory. In an attempt to reveal the existence of common trends or opinions regarding the present study, the writer opted to telephone 50 percent of the nonrespondents (n = 25). This randomly selected sample was stratified by county. As expected, these personal conversations provided a measure of insight with reference to the reasons these individuals decided not to return the survey instrument. For the most part, they stated that they simply did not have enough time in a day to deal with these types of projects. Further anecdotal comments derived from these discussions appear in Appendix G.

On a more positive note, this strategy motivated seven administrators to immediately locate their copies of the inventory and return them to the researcher within several days. The number of usable instruments increased to 118, yielding an overall response rate of 72.8 percent. However, if one considers the verbal opinions recorded during the telephone conversations, 83.9 percent of the total sample has been accounted for.

Each of these measures was taken in order to reduce the possibility of a sampling bias. Frequency statistics and response rate percentages by county are tabulated in Table 3.

Table 3

Frequencies/Response Rates by County

County	Total No. of High Schools in County	Total No. of Instruments Mailed	Total No. of Instruments Returned	Response Rate (%)	Proportion of the Total Sample (%)
Alameda	42	35	27	77.1	22.9
Alpine	--	--	--	--	--
Colusa	4	4	4	100.0	3.4
Contra Costa	30	24	18	75.0	15.3
El Dorado	6	6	4	66.7	3.4
Kings	8	7	5	71.4	4.3
Marin	12	10	7	70.0	5.9
Merced	11	8	5	62.5	4.3
Nevada	2	1	--	--	--
San Benito	1	1	1	100.0	.8
San Luis Obispo	9	9	7	77.8	5.9
Santa Clara	50	39	25	64.1	21.2
Santa Cruz	8	6	6	100.0	5.1
Solano	12	10	7	70.0	5.9
Tuolumne	2	1	1	100.0	.8
Yuba	4	1	1	100.0	.8
Total	201	162	118	--	100.0

Students

Survey questionnaire packets were mailed to five randomly selected professors at San Jose State University. One English professor from each of four randomly selected community colleges was contacted in the same manner. Each packet contained a letter of transmittal (see Appendix D) that explained his/her role in the project and a copy of the survey instrument to which his/her students would be asked to respond (see Appendix F). A return postcard was enclosed to allow these individuals to either accept or deny the request for participation and to provide the researcher with information concerning his/her English class, office hours, and telephone extension.

Only one individual returned the postcard with an affirmative response prior to the deadline identified in the cover letter. Subsequently, the researcher chose to make all further arrangements by telephone. In each case, the instructor who was contacted apologized for not responding earlier and agreed to participate in the study. Appointments were made in order to allow the researcher to make personal visitaitons to each classroom selected for inclusion.

All classes were visited during the second and third weeks of October 1981. In each instance, the researcher was consistent in the instructions to the students and explanations regarding the ultimate use of their responses in this study. Although 100 percent of the surveys were usable, inaccurate enrollment projections, combined with poor attendance, yielded sample sizes that were slightly smaller than the researcher had expected (i.e., community college, $n_2 = 93$; university, $n_3 = 97$). These samples were, however, considered to be adequate in size for the purposes of this investigation.

Survey Instruments

The Technology Education Inventories that were used in this project were designed and developed by the researcher (see Appendices E and F). One of these was completed by high school administrators and the other by students enrolled in postsecondary level English classes.

To establish content validity for these instruments, the researcher interviewed approximately thirty-five individuals who possessed a wide range of skills and backgrounds (e.g., doctoral students, industrial technology educators, computer programmers and consultants, university administrators, industrial representatives, statistical consultants, and authors who had published articles dealing with the focal construct labeled technological literacy). Each person, in one way or another, was of assistance in the validation process. Four complete drafts of the instruments were necessary before these reviewers were satisfied with the content. During each transition, questionnaire items were added, revised, or deleted entirely; scales were proposed by combining various items; terminology was refined and clarified; and appropriate response formats were discussed. Once these steps had been taken, the researcher was confident that the instruments would indeed measure the variables delineated in the research hypotheses. Subsequently, the administrative instrument (see Appendix E) was copyrighted by the writer in October 1981.

To ascertain the degree to which students could be expected to be consistent in their responses to the items on the inventory (see Appendix F), students were randomly selected from the researcher's graphic design class to complete the instrument (n = 20). Two weeks later, these same twenty individuals were asked to complete the same form a second time. The presence of missing data caused shrinkage in the sample size during statistical analysis. Using only these data ($df = 12$), a test/retest reliability coefficient of stability of .75 ($p < .01$) was attained, a Spearman-Brown internal consistency reliability of .86 was found, and a Guttman Split-half reliability estimate of equivalence of .85 was computed.

Administrative responses to three items on the inventory provided descriptive information with regard to the following variables: high school enrollment, sex, and age. These statistics are presented in Table 4.

Table 4

Demographic Information, Administrative Sample

Variable	Category Label	Frequency	Proportion of Sample (%)
Enrollment	(1) Less than 200	18	15.3
	(2) 201 to 400	12	10.2
	(3) 401 to 800	7	5.9
	(4) More than 800	81	68.6
$\overline{X} = 3.3$			
Sex	Male	100	84.7
	Female	13	11.1
	Missing	5	4.2
Age	(1) 25 to 30	--	--
	(2) 31 to 35	9	7.6
	(3) 36 to 40	10	8.5
	(4) 41 to 45	19	16.1
	(5) 46 to 50	30	25.4
	(6) 51 to 55	28	23.7
	(7) 56 to 60	17	14.4
	(8) 61 to 65	4	3.4
	(9) Missing	1	.8
$\overline{X} = 5.1$			

Similarly, descriptive information regarding the students' responses were tabulated from three introductory items on the questionnaire. These data are relevant to the profile of the entire sample of students ($n_2 + n_3 = 190$) and are summarized in Table 5.

Table 5

Demographic Information, Student Samples

Variable	Category Label	Frequency	Proportion of Sample (%)
California High School Graduate?	Yes	163	85.8
	No	22	11.6
	Missing	5	2.6
Year of Graduation	Before 1979	44	23.2
	1979	14	7.4
	1980	40	21.1
	1981	89	46.8
	Missing	3	1.6
Sex	Male	100	52.6
	Female	90	47.4

Before attempting to test the aforementioned research hypotheses, it was necessary to identify the inventory items which would be used to measure the variables addressed. Rather than continually refer the reader to a specific appendix, several tables have been prepared to illustrate the derivation of each research variable. When appropriate, the items have been "keyed" (i.e., response circled) to reveal the type of response which resulted in a higher score on the scale during the analysis of the results.

Hypothesis 1: There is no relationship between the perceptions of educational leaders regarding the importance of technological literacy and the degree to which technological subject matter is included in their high school curricula.

For this analysis, perceived importance of technological literacy among administrators was treated as the independent variable, and the degree to which technological subject matter is included in their high school curricula was the dependent variable (see Table 6). A Pearson correlation statistic was used to determine the extent to which these variables are related for this sample.

Hypothesis 2: There is no relationship between the level of technological advancement in the high school's immediate vicinity and the amount of technology education taught in that school.

For this analysis, the level of technological advancement in the high schools' surrounding areas (see Table 2) was defined as the independent variable and the

Table 6

Derivation of Variables Labeled: Perceived Importance of Technological Literacy and Amount of Technology Education in the High Schools

Independent Variable = Perceived Importance of Technological Literacy

Items Selected ($\sum = 0 - 11$)

1.	Are you a member of any "technical" organizations or associations?	Yes	No
2.	Do you subscribe to any "technical" journals, newsletters, or publications?	Yes	No
3.	Do you feel that an understanding of technology is an important life skill for survival in the future?	Yes	No
4.	In your mind, does the concept of technology belong in your		
	a. English program	Yes	No
	b. Math program	Yes	No
	c. Industrial Arts program	Yes	No
	d. Social Studies program	Yes	No
	e. Science program	Yes	No
	f. History program	Yes	No
	g. Elective program	Yes	No
5.	Do you think that technology education is less important today than it will be in the year 2015?	Yes	No

Dependent Variable = Amount of Technology Education

Items Selected ($\sum = 0 - 12$)

1.	Does your school offer a "general" course in present-day technology?	Yes	No
2.	To the best of your knowledge, do any of the faculty members on your staff have an interest in future studies?	Yes	No
3.	Do any courses in your curriculum possess a "futures" orientation?	Yes	No

Table 6 (Continued)

Dependent Variable = Amount of Technology Education		
4. Does your high school library subscribe to any "technical" journals, newsletters, or publications?	Yes	No
5. To the best of your knowledge, is the concept of technology taught in your		
a. English program	Yes	No
b. Math program	Yes	No
c. Industrial Arts program	Yes	No
d. Social Studies program	Yes	No
e. Science program	Yes	No
f. History program	Yes	No
g. Elective program	Yes	No
6. To the best of your knowledge, do any of your faculty members discuss the technology of the future that your students will be exposed to?	Yes	No

amount of technology education taught in those schools was treated as the dependent variable. Since the items selected from the student instrument to measure this variable are nearly identical to those taken from the administrative form, the reader is referred to Table 6. A one-way analysis of variance statistic was employed to determine the strength of this relationship.

Hypothesis 3: There are no differences between the responses provided by educational leaders and those given by recent high school graduates with regard to the amount of technology education extant in the high school curricula.

For this analysis, the reports given by administrators were compared to those given by students with regard to the existence of technology education in present high school curricula. In this instance, equivalent scales to measure the dependent variable (i.e., amount of technology education) were constructed (see Table 6). Type of report (i.e., administrative or student) was defined as the independent variable. An independent means *t*-test was used to determine the degree of agreement between these samples with reference to the dependent variable.

Hypothesis 4: There are no differences between the perceptions of community college freshmen and university freshmen with reference to the importance of technological subject matter in high school curricula.

This analysis sought to reveal possible differences in perceptions between university students and community college students with respect to the importance of technological subject matter in high school programs. Type of student represented the independent variable, and the degree of importance was treated as the dependent variable (see Table 7). An independent means *t*-test was used to assess possible differences in opinions between these subsamples.

Table 7

Derivation of the Variable Labeled: Importance of Technological Subject Matter

Dependent Variable = Importance of Technological Subject Matter

Items Selected ($\sum = 0 - 8$)

1.	Do you know what is meant by the term "technology"?	Yes	No
2.	Is technology always associated with some sort of hardware?	Yes	No
3.	Do you read any "technical" magazines on a regular basis?	Yes	No
4.	Do you feel that your understanding of technology is a necessary survival skill?	Yes	No
5.	Do you feel that technology is more important today than it was ten years ago?	Yes	No
6.	Generally speaking, do you feel that you will have some control over the future directions that technology in general will take?	Yes	No
7.	If your high school did offer a "general" course in technology, did you take it?	Yes	No
8.	If your school did not have a "general" course in technology, would you have liked to see one of this nature offered?	Yes	No

Hypothesis 5: There is no relationship between the degree to which individuals perceive themselves to be technologically literate and their verbal support of technology-based subject matter in the high schools.

The final analysis treated the degree to which administrators perceived themselves to be technologically literate as the dependent variable. Three categories of their verbal support regarding technological subject matter were designated as the independent variable. For the derivation of these variables, the reader should consult Table 8. A one-way analysis of variance statistic revealed the degree to which these variables are related.

Table 8

Derivation of the Variables Labeled: Perceived Level of Technological Literacy and Verbal Support of Technology Education

Independent Variable = Verbal Support

Items Selected ($\sum = 0 - 2$)

1.	Do you believe that an understanding of technology is a life skill for your students?	Yes	No
2.	Would you be supportive of the implementation of a general course in technology if the curriculum was available to you?	Yes	No

Dependent Variable = Perceived Technological Literacy

Items Selected ($\sum = 0 - 27$)

1.	Do you feel that you have a personal definition for the term "technology"?	Yes	No
2.	Do you feel that "technology" and "applied science" are synonomous terms?	Yes	No
3.	Do you feel "technology" has negative implications for your life?	Yes	No
4.	Do you feel that "technology" has positive implications for your life?	Yes	No

Table 8 (Continued)

Dependent Variable = Perceived Technological Literacy

5.	Do you feel that "technology" is neutral?	Yes	No
6.	Do you feel that you will have some control over the future directions technology in general will take?	Yes	No
7.	Do you feel personally responsible for the advancement of technology in general?	Yes	No
8.	Are you able to operate the following equipment?		
	a. pocket calcualtor	Yes	No
	b. memory function on a pocket calculator	Yes	No
	c. automated bank teller machine	Yes	No
	d. electronic games	Yes	No
	e. microwave oven	Yes	No
	f. word processor	Yes	No
	g. digital clock	Yes	No
	h. home computer	Yes	No
	i. selectric typewriter	Yes	No
	j. video tape recorder	Yes	No
9.	In your mind, does technology necessarily involve some sort of hardware?	Yes	No
10.	Can you explain what is meant by the following terms?		
	a. laser	Yes	No
	b. microprocessor	Yes	No
	c. silicon chip	Yes	No
	d. recombinant DNA	Yes	No
	e. fusion power	Yes	No
	f. fiber optics	Yes	No
	g. robotics	Yes	No
	h. Z-gravity	Yes	No
	i. MX missile system	Yes	No
	j. artificial intelligence	Yes	No
11.	Drawing only from the formal education and experiences that you have had to date, do you feel you would be competent to administer a high school built in the year 2015?	Yes	No

Two-tailed tests of significance with an alpha level of .05 were used to analyze each of these nulls. A rejection of H_o1 and H_o5 was projected. The retention of H_o2, H_o3, and H_o4 was perceived to be consistent with the researcher's premise concerning the importance of a technological orientation in general education. The above alpha level (i.e., .05, as opposed to a smaller alpha number) was used to reduce the probability of a Type II error (i.e., the retention of a false null hypothesis).

Each of these variables derived above is germane to the findings of this investigation. A more elaborate discussion of the statistical analyses is provided in Chapter 4, which describes the results of this research endeavor.

Chapter 4

ANALYSIS AND INTERPRETATION OF DATA

An analysis of the survey results revealed an association between the perceived importance of technological literacy and the reported amount of technology education available for the administrative sample. The level of technological advancement in a school's immediate vicinity was not shown to be related to the reported amount of technology-based subject matter as perceived by both the students and the administrators. Community college and university students appeared to be in agreement with regard to the importance of technological curricula, but they disagreed with administrators about the extent to which courses of this description were available to them during their high school education. A majority of the high school principals seemed to be supportive of the implementation of technology education programs regardless of their personal levels of technological literacy.

The major criterion variables in this research project were the following: amount of technology education taught in the high schools, importance of technological subject matter in high school programs, and the degree to which administrators perceived themselves to be technologically literate. The central classificatory variables included perceived importance of technological literacy, level of technological advancement in the high schools' surrounding areas, administrative versus student report regarding the amount of technology education in the secondary schools, type of student (i.e., university or community college), and level of administrative verbal support of technological subject matter. Appropriate statistical analyses were identified to examine relationships and/or differences between these variables.

These statistics were computed separately for the administrative sample (n = 118) and for the entire student sample (n = 190). One of the analyses regarding student reports required the use of subsamples (i.e., community college, n_2 = 93; university, n_3 = 97). Before reviewing the inferential statistical results, a brief synopsis of the descriptive data germane to the focal research questions presented in Chapter 1 is provided.

Descriptive Data Related to Focal Research Questions

One of the central purposes of this research project was to examine the state-of-the-art with reference to technology education in Northern California secondary schools. Administrators were asked, "Does your school offer a 'general' course in present-day technology?" Ninety-three (78.8 percent) of these persons reported that they did <u>not</u> have a course of this nature, while only twenty-five (21.2 percent) responded affirmatively. Their responses to additional questions on the survey provided information concerning either the reasons such a course was not offered or a description of the course that was available (see Table 9).

Table 9

General Secondary Courses in Present-day Technology

Questions	Yes		No		Missing	
	n	%	n	%	n	%
If your school <u>does</u> offer a general course in present-day technology (n = 25),						
1. Is the course required?	0	--	25	100.0	0	--
2. Is a current (post-1978 text-book used in this course?	21	84.0	4	16.0	0	--
3. Does the course outline include an emphasis on the history of technology?	8	32.0	17	68.0	0	--
4. Does the course outline include an emphasis on the future directions technology may take?	19	76.0	6	24.0	0	--
5. Does the course outline reveal an orientation toward technical skills?	24	96.0	1	4.0	0	--

Table 9 (Continued)

Questions	Yes n	Yes %	No n	No %	Missing n	Missing %
6. Are freshmen and sophomores allowed to take this course?	16	64.0	9	36.0	0	--
7. Are juniors and seniors allowed to take this course?	25	100.0	0	--	0	--
If your school <u>does not</u> offer a general course in present-day technology (n = 93),						
1. Do you have an interest in such a course?	67	72.0	16	17.2	10	10.8
2. Is there any funding available for a course of this nature?	8	8.6	76	81.7	9	9.7
3. Do you have any personnel who are qualified to teach a course like this?	42	45.2	39	41.9	12	12.9
4. Do you perceive a need for your school to offer a general course in technology?	66	71.0	15	16.1	12	12.9
5. Do you feel that a special facility is necessary to offer a course like this?	26	28.0	55	59.1	12	12.9

It appears that a majority of the schools canvassed reported that they did not offer a specific course which deals with present-day technology (n = 93; 78.8 percent), but most of the administrators (n = 108; 91.5 percent) seemed to recognize the importance of technological literacy for today's students and also supported curricula designed to ameliorate technological illiteracy (n = 99; 83.9 percent). In the event that a high school did not offer a course of this nature, the researcher asked whether or not the concept of technology had been incorporated into other disciplinary areas (see Table 10). Furthermore, administrators were asked to comment on those curricular areas wherein they felt that present-day technological issues could or should be discussed (see Table 10).

Table 10

The Concept of Technology in General Education

Questions	Yes		No		Missing	
	n	%	n	%	n	%
To the best of your knowledge, is the concept of technology taught in your (n = 118)						
1. English program	20	16.9	87	73.7	11	9.3
2. Math program	94	79.7	19	16.1	5	4.2
3. Industrial Arts program	96	81.3	16	13.6	6	5.1
4. Social Studies program	51	43.2	61	51.7	6	5.1
5. Science program	106	89.8	8	6.8	4	3.4
6. History program	29	24.6	78	66.1	11	9.3
7. Elective program	59	50.0	48	40.7	11	9.3

Table 10 (Continued)

Questions	Yes n	Yes %	No n	No %	Missing n	Missing %
In your mind, does the concept of technology belong in your (n = 118)						
1. English program	69	58.5	42	35.6	7	5.9
2. Math program	111	94.1	3	2.5	4	3.4
3. Industrial Arts program	111	94.1	5	4.2	2	1.7
4. Social Studies program	99	83.9	15	12.7	4	3.4
5. Science program	112	95.0	3	2.5	3	2.5
6. History program	81	68.6	32	27.1	5	4.2
7. Elective program	98	83.1	16	13.6	4	3.4

Two administrative survey questions were related to those attempts that were being made to implement curricular strategies that stress a "futures" orientation. One hundred two persons (86.4 percent) responded that there were faculty members who discussed the technology of the future, but only seventy (59.3 percent) said that there were courses in their curriculum that possessed a "futures" orientation. When students were asked a similar question, one hundred twenty-seven (66.8 percent) replied that their high school teachers had seemed interested in discussing the technology of the future. Table 11 presents additional student opinions regarding technology education and technological literacy.

Table 11

Student Opinions

Questions	Yes		No		Missing	
	n	%	n	%	n	%
Do you feel that your understanding of technology is a necessary survival skill? (n = 190)	118	62.1	70	36.8	2	1.1
Do you think that your high school education prepared you to enter an occupation that is related to a technology of some sort? (n = 190)	43	22.6	144	75.8	3	1.6

Relationship Between Perceived Importance of Technological Literacy and Amount of Technology Education

The first hypothesis negated the possibility that administrative perceptions regarding the importance of technological literacy were related to the amount of technology education extant in their high schools. A significant, albeit small, Pearson correlation (r = .24, $p < .05$) indicated the degree to which these two variables were related for this sample. Additional computations revealed the extent to which this independent variable was related to an administrator's age, sex, and high school enrollment (see Table 12).

Table 12

Importance of Technological Literacy Relationships

Amount of Technology Education (N = 50)	Age (N = 64)	Sex (N = 61)	Enrollment (N = 65)
r = .24[a]	r = .30[b]	r = .16	r = .02

a = $p < .05$
b = $p < .01$

These coefficients are sufficient to reject the null hypothesis with reference to the independent variable labeled amount of technology education. Furthermore, the small negative relationship computed for the age variable suggests that younger administrators tend only slightly to believe that technological literacy is more important than do the older respondents.

Relationship Between Level of Technological Advancement and Amount of Technology Education

The second research hypothesis suggested that the amount of technology education taught in a given high school was unrelated to the level of technological advancement in that school's immediate vicinity. A separate one-way analysis of variance was performed for each sample.

The responses provided by administrators were tabulated and resulted in an insignificant *F*-ratio ($F = .34$, $p > .05$). In other words, the level of technological advancement in the high schools' surrounding areas was not shown to be related to the extent to which technological subject matter was included in their curricula. The null hypothesis was therefore retained for this sample of administrators. These data are summarized in Table 13.

Data attained from the student sample were analyzed and revealed a significant *F*-ratio ($F = 3.2$, $p < .05$) with regard to a relationship between these same variables. Stated differently, their reports indicated that the amount of technology education in their high schools was in some way related to the level of technological advancement in the surrounding region. A multiple range test disclosed the fact that there was a significant difference ($p < .05$) between the amount of technology

Table 13

Amount of Technology Education as Classified By
Level of Technological Advancement
For Administrative Sample

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F-ratio	Probability
Between groups	2	85.011	42.506	.338	.714
Within groups	112	14085.337	125.762	--	--
Total	114	14170.348	--	--	--

Mean Difference Matrix*

	Low	Middle	High
Low	--	.78	1.42
Middle	--	--	2.20
High	--	--	--

*Means must differ by 3.44 to be significant at the .05 level (modified LSD procedure).

education reported by the high and low groups and between the high and middle groups; however, the difference in means between the middle and low groups was not significant at this alpha level. For this reason, it is not possible to reject the null for the entire student sample (see Table 14).

Table 14

Amount of Technology Education as Classified
By Level of Technological Advancement
For Student Sample

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F-ratio	Probability
Between groups	2	1312.734	656.367	3.212	.045
Within groups	181	36982.744	204.325	--	--
Total	183	38295.478	--	--	--

Mean Difference Matrix*

	Low	Middle	High
Low	--	1.31	4.98*
Middle	--	--	6.29*
High	--	--	--

* Means must differ by 3.42 to be significant at the .05 level (modified LSD procedure).

Administrative Versus Student Reports Regarding Technology Education Curricula

The third hypothesis was proposed in order to determine the extent to which administrators and students were in agreement with regard to extant technology education curricula. It was postulated that the opinions provided by these two groups would not differ significantly. An independent means $\underline{t}$-test discovered significant disparities between the responses collected from these administrators and students ($\underline{t}$ = 3.3, $\underline{p} < .01$). On the average, the students were not as positive about the degree to which they were exposed to technology education during their high school education as were the administrators with regard to present curricula (see Table 15). These data are sufficient to reject the null for these samples.

Table 15

Administrators Versus Students Perceptions of the Amount of Technology Education Taught

	Administrators	Students	$\underline{t}$
Mean	5.406	4.575	3.27*
Standard Deviation	1.696	2.115	--
Valid Cases	n = 96	n = 134	--

* $._{95}\underline{t}_{200} = 1.97$; $._{99}\underline{t}_{200} = 2.60$

Community College Versus University Student Opinions Regarding the Importance of Technology Education

The fourth research hypothesis was devised to investigate the extent to which students attending community colleges were in agreement with students attending San Jose State University as to the importance of technological subject matter during their high school educational experiences. Several independent means t-tests were once again computed to determine if there were any differences of opinions between these subsamples.

The first computation included the responses procured from all students (n = 190) and an insignificant t-value was found ($t = .50$, $p > .05$). Subsequently, the researcher eliminated the responses provided by students who either (1) had not graduated from a California high school or (2) had graduated before 1979. This strategy created a new sample for consideration (n = 137). A second calculation revealed a larger but still insignificant t-value ($t = 1.56$, $p > .05$). These data indicated that student opinions regarding the importance of technology education do not differ significantly with reference to the type of postsecondary program they selected (see Table 16). The null hypothesis was retained, as projected, for these subsamples.

Table 16

Opinions Regarding the Importance of Technology Education: Community College Versus University Students

	Community College	University	$\underline{t}$
Results for Entire Sample (n = 190)			
Mean	14.043	14.289	.50
Standard Deviation	3.750	3.048	--
Valid Cases	n = 93	n - 97	
Results for Selected Samples (n = 137)			
Mean	13.350	14.039	1.56
Standard Deviation	2.276	2.765	--
Valid Cases	n = 60	n = 77	--

* $.95^{\underline{t}}100 = 1.98$

Having discovered no differences in opinions regarding the importance of technology education between the two student samples, the researcher opted to further investigate the data. A one-way analysis of variance was applied which treated the year that the students graduated from high school as the independent variable. An insignificant $\underline{F}$-ratio ($\underline{F}$ = .688, $\underline{p} > .05$) did not indicate that the importance of technology education was related to the length of time students had been out of a secondary institution (see Table 17).

Table 17

Importance of Technology Education as Classified By Year of High School Graduation

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F-ratio	Probability
Between groups	2	9.389	4.695	.688	.504
Within groups	140	955.450	6.825	--	--
Total	142	964.839	--	--	--

Mean Difference Matrix*

	1979	1980	1981
1979	--	.26	.70
1980	--	--	.54
1981	--	--	--

*Means must differ by 3.43 to be significant at the .05 level (modified LSD procedure).

Relationship Between Administrators' Perceived Levels of Technological Literacy and Their Verbal Support of Technology Education

The final research hypothesis made inquiry regarding the degree to which an administrator's perceptions with reference to his/her own level of technological literacy was related to his/her verbal support of technology-based subject matter. Their responses were tabulated and analyzed via a one-way analysis of variance procedure. An insignificant F-ratio (F = .52, $p > .05$) resulted in the retention of the null for this sample. Stated differently, administrators who perceived themselves to be less technologically literate were not shown to be less supportive of technology education than those who scored higher on the scale (see Table 18).

The variable referred to as verbal support was also investigated with reference to the extent to which it was related to the age of the administrative subjects. Since this inquiry was peripheral to the design of the study, an alpha of .10 was selected to compute a one-way analysis of variance statistic. In this instance, a significant F-ratio (F = 2.968, $p < .10$) was found. However, a multiple range test revealed the fact that differences in verbal support were only significant

Table 18

Perceived Levels of Technological Literacy as Classified by Administrative Verbal Support of Technology Education

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F-ratio	Probability
Between groups	2	16.330	8.165	.520	.597
Within groups	78	1225.547	15.712	--	--
Total	80	1241.877	--	--	--

Mean Difference Matrix*

	Low	Medium	High
Low	--	1.79	.70
Medium	--	--	1.08
High	--	--	--

* Means must differ by 3.46 to be significant at the .05 level (modified LSD procedure).

between the medium and low groups (i.e., younger administrators were more supportive than older ones). For this reason, tenuous support is given to the negative relationship between age and level of verbal support regarding technological subject matter (see Table 19).

Table 19

Age of Administrators as Classified by Their Verbal Support of Technology Education

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F-Ratio	Probability
Between groups	2	13.780	6.890	2.968	.056
Within groups	110	255.336	2.321	--	--
Total	112	269.116	--	--	--

Mean Difference Matrix*

	Low	Medium	High
Low	--	3.31*	2.95
Medium	--	--	1.56
High	--	--	--

* Means must differ by 3.05 to be significant at the .10 level (modified LSD procedure).

Summary

The statistical results of this survey research investigation are briefly summarized in the following statements:

1. A positive relationship was found between perceived importance of technological literacy and the

reported amount of technology education offered in the high schools ($p < .05$).

2. A review of the administrative reports revealed no relationship between the level of technological advancement in the high schools' surrounding areas and the amount of technology education taught in those schools ($p > .05$). Student opinions suggested that these two variables were related ($p < .05$).

3. On the average, administrators were more positive about the amount of technology education extant in the high schools than were the students surveyed ($p < .01$).

4. There were no significant differences in opinions between community college and university students regarding the importance of technology-based subject matter in high school curricula ($p > .05$).

5. An administrator's perceived level of technological literacy was not found to be related to his/her verbal support of technology education ($p > .05$).

Further discussion and various conclusions based on these findings are presented in Chapter 5.

Chapter 5

SUMMARY AND RECOMMENDATIONS

Discussion and General Conclusions

This technology education survey investigation was designed and executed for several reasons. First, it represented an attempt to make a scholarly contribution to extant literature regarding technology education in the public schools (e.g., Mundy, 1978; Olivero, 1978). Second, it was, in a sense, conducted as a needs assessment report examining technology education curricula in Northern California high schools. Third, it elicited both administrative and student opinions pertinent to the relative importance of technology-based subject matter and classroom activities in secondary programs. Finally, it was not a replication of a previous research project, but did illustrate a measure of concordance with the findings of recent technology education investigations (e.g., Miller, et al., 1980; Useem, 1981).

The present sampling of high school principals was assumed to be representative of those employed in the Northern California public school system. Likewise, the students who were randomly selected for participation in this project were assumed to be representative of persons who had recently graduated from a Northern California high school. Although there is no certainty that these samples are not representative of a wider distribution of subjects, generalizations beyond the target populations should remain tentative.

General conclusions derived from the administrative inventories address one of the focal issues labeled technological literacy. Statistical support for a significant positive relationship between the perceived importance of this construct and the reported amount of technology education offered was discovered. In other words, high school principals who ascribed higher levels of importance to technological literacy for their students were more positive about the availability of technology-oriented programs in their schools. These results may be considered logical but are not as meaningful as originally anticipated. It stands to reason that proponents of technological literacy would be inclined to report that their schools are making a concerted effort to prepare their students to be "technology conscious" citizens. Associative conclusions based on inclinations of this nature would be misleading and unstable from an empirical perspective. Furthermore, the size of this statistical relationship was too small to allow the researcher to deduce further useful inferences (i.e., $\underline{r} = .24$, $\underline{p} < .05$).

A significant negative relationship was found between the age of the administrative subjects and the degree to which they perceived technological literacy to be important. A variety of conclusions based on this finding are possible. For example, the younger administrators may have had a more extensive exposure to technological subject matter during the course of their educational programs than did their older colleagues. It is also possible that these younger incumbents are more responsive to technology-oriented media. Perhaps these persons are simply more interested in "technical" journals and periodicals. In any event, the small size of this negative relationship makes each of these conjectures trivial (i.e., $\underline{r} = .30$, $\underline{p} < .01$).

The fact that an administrator's perceived level of personal technological literacy was not found to be related to his/her verbal support of technology education seems meaningful. From this finding, it may be concluded that administrators remain willing to recognize the importance of technology education even though they may consider themselves to be "techno-peasants." Stated differently, some of these high school principals reported lower levels of personal understanding and competency with regard to technical terminology and equipment but still indicated a desire to support technology education programs in their schools. Since it is often difficult for people to support projects and/or ideas wherein they feel uneasy or deficient, the researcher did not expect these results. On the other hand, they connote several curricular implications for the students attending Northern California high schools. Further attention is given to this topic in the following section.

Another inference can be drawn from the fact that no relationship was found between the level of technological advancement in the high schools' surrounding areas and the reported amount of technology education taught in these schools. The writer queried as to whether or not students who lived in the less technologically developed areas of Northern California were less likely to be exposed to technology-based subject matter than their peers residing in the "high technology" counties (e.g., Alameda, Contra Costa, Santa Clara). Insignificant statistical data posited a negative response to this inquiry. It therefore seemed logical to assume that technology educational opportunity is not contingent upon the proximity of "high technology" industrial firms (c.f., "The high-tech challenge," 1981).

Significant differences were found between the opinions of principals and those of students regarding the amount of technology education available in the schools ($p < .01$). On the average, the administrators appeared to be more affirmative than the students with reference to the scope of technology-based subject matter available in the schools. Since these data are based on a self-report survey, no conclusions concerning which groups' perceptions are most accurate can be made. A logical deduction might be relevant to the recency of attendance, interest, knowledge of the full range of courses taught in the schools, enthusiasm, greater insight into faculty competencies, etc. It stands to reason that students might not have been aware of the curricular content of every course offered in their high school, or they may have simply forgotten about or repressed some of the material they were taught. In a similar fashion, it should not be assumed that all principals are privy to the actual content of each and every course available in their schools. For this reason, generalities based on these findings must remain tentative.

Random samples of college freshmen were selected from two types of postsecondary institutions due to possible disparities in their career aspirations, high school curricular orientations, and levels of technological awareness in home communities (i.e., community college and university). Furthermore, the researcher hypothesized as to whether or not these groups would agree on the importance of technology-based subject matter during their high school experiences. Subsequent statistical analyses revealed no significant differences in the opinions provided by these two student groups. A possible reason for the degree of similarity between these samples might stem from the fact that the four community colleges selected are located within a fifty-mile radius of San Jose State University. Further conclusions involving the students' career aspirations or curricular interests cannot be derived from these data. It is sufficient to note that these groups of students reported similar perceptions about the importance of technology education in the secondary school system.

In summation, most of the inferences drawn from the data collected during this investigation are speculative. From the administrator's perspective, there seemed to be some association between the importance of technological literacy and affirmative responses regarding the amount of technology-oriented subject matter available. On the other hand, the degree to which they believed themselves to be technologically literate did not appear to be related to their willingness to support technology education programs. Students tended to be in agreement about the importance of secondary level technology-based programs, regardless of the type of postsecondary institution they attended, but they did not concur with the principals with respect to the availability of courses related to technology during their high school careers. The administrative inventories revealed that the amount of technology education taught in the schools was not related to the proximal level of technological advancement; however, the student opinions implied that these two variables might be in some way related.

Implications for High School Curricula

A cursory review of the opinions of the authors cited in Chapter 2 suggested the following:

1. The educational sector has made a minimal contribution to the public's understanding of science and technology as they relate to the well-being of society and quality of life (Sizer, 1980; Walton, 1980).

2. Educational leaders should begin to devise curricular avenues through which students will become familiar with present-day technological issues (Goulet, 1979).

3. Technological literacy should be recognized as a significant goal of general education (Dyrenfurth, 1981).

4. Technology-based education might provide citizens with a common knowledge to develop the skills

necessary for survival in a technological culture (Daiber, 1979).

5. It appears that the high school experience has been unsuccessful at increasing the level of public awareness of the importance of science and technology in today's world (Miller, et al., 1980; Useem, 1981).

The opinions set forth by the high school principals surveyed imply that they would most likely agree with these conclusions. For example, a majority of the administrative respondents reported that an understanding of technology is an important life skill for survival in the future (n = 108; 91.5 percent); it was also designated as an important life skill for their students (n = 104; 88.1 percent). Likewise, most of them did not indicate that technology education was less important today than it will be in twenty-five years (n = 87; 73.7 percent). There is some question about the extent to which technology education programs have been adopted in the schools. However, administrators reported an awareness of their significance in today's society.

Technology in General Education

It was found that most principals would be supportive of the implementation of a general course in technology (n = 99; 83.9 percent), but the utility of this support remains dubious. The availability of funds in public education is currently difficult, which has a tendency to discourage the initiation of new programs. In the event that an innovative program is initiated, its longevity may depend upon its record of accountability. The present research findings, coupled with the lack of financial support, seem to imply the need for a common emphasis on technology throughout the entire curricular spectrum.

A portion of the administrative inventory was designed to examine the plausibility of an implication of this nature. First, they were asked if the concept of technology was taught in each of the following programs: English, Math, Industrial Arts, Social Studies, Science, History, and Elective (see Table 10). A second question allowed them to designate those particular programs wherein they felt that the concept of technology should be taught (see Table 10). In each instance, affirmative responses regarding the programs listed in the latter inquiry exceeded those tabulated in the first question. These data provide the foundation for an argument in favor of a "technology-emphasis" program.

It seems reasonable to assume that discussions revolving around contemporary technological issues could take place in any classroom, regardless of the specific discipline. In the researcher's experience, parochial school instructors were able to incorporate the topic of Catholicism into each lesson presented during the course of each day. Conversations with persons who attended high school during the second World War suggested the presence of a "patriotic emphasis" during that period. A "technology-emphasis" program seems feasible during a time when technological issues have become pervasive in society. Specific suggestions regarding curricular strategies aligned with a program of this genre appear in the following section.

Recommendations

Continuing research among national samples with regard to public school "technology-emphasis" programs and student/administrative technological literacy is recommended. Further research in this area should not be totally reliant upon survey data but should include empirical reviews of high school curricular offerings through personal visitations. The Technology Education Inventory copyrighted for use in the present research project needs modification before it is used again. Specific attention should be given to the response format and the length of the instrument. An exact replication of the present investigation is not recommended for the following reasons:

1. It is difficult to analyze survey data via parametric statistical techniques.

2. Conclusive inferences were, for the most part, tentative.

3. Responses elicited from the student samples were costly to collect and were not as useful as the opinions from high school instructors might have been.

4. The utility of the student inventory is questionable since the "technology-emphasis" approach was not clearly examined.

An operational definition for the construct referred to as technological literacy was cited in Chapter 1. Further analysis of that definition prompted the researcher's attempt to identify high school disciplines wherein the competencies related to technological literacy could be developed. A synopsis of possible interdisciplinary avenues is presented in the outline as follows on page 88.

Although this study dealt specifically with high school programs, it is the researcher's opinion that a student's orientation to present-day technological issues and concerns could feasibly begin much earlier. Whenever deemed appropriate, educational leaders could encourage their instructors to introduce classroom activities and

Technological Literacy Redefined

People who are technologically literate should possess these traits:

Trait → Developed In	→ Curricular Area
1. Confidence and skill in the use of technical tools and equipment.	a. Industrial Ed. b. Vocational Ed. c. Science d. Computer Science e. Mathematics
2. Understanding of technical/ scientific constructs and terminology.	a. Industrial Ed. b. Science c. Mathematics d. History e. English
3. An awareness of the impact (both positive and negative) that technology can have on society.	a. Social Studies b. Science c. History
4. An ability to project alternative futures wherein technology has an influence.	a. Mathematics b. Science c. History d. Social Studies e. Industrial Ed. f. English

assignments designed to heighten their student's awareness of the impact of technological advancement on their daily lives. For example,

1. English teachers could assign essays that pertain to contemporary technological issues and focus on technical writing format and style.

2. Social Studies teachers might allow their

students to become involved with local police force operations for a short time. They could also have the students write a letter to either their Congressman or State Assemblyman to depict personal concerns about the impact of technology on the environment.

3. History instructors could introduce the concept of appropriate or intermediate technology as it relates to critical events in the history of technology. Students might be instructed to eliminate one aspect of modern technology from their daily lives for a short period and chronicle the impact of this modification.

4. Science educators should assume a finer focus on present-day scientific issues and controversies (e.g., silicon chip fabrication, recombinant DNA, fusion power, artificial intelligence, etc.). They might also review RFPs generated by the National Science Foundation to enlighten students about current federal concerns.

5. Mathematics teachers could discuss topics related to computerized checking accounts and information systems, inflationary trend analysis and projection, statistical analyses, computer logic and programming, and the development of personal budgets.

6. Industrial educators should provide a liaison between the educational environment and the area's industrial/technological structure. They might establish

an in-classroom manufacturing enterprise to expose students to many aspects of the contemporary and future world of business.

A list of possible classroom activities akin to a "technology-emphasis" program is limitless; these suggestions are merely a beginning. An interdisciplinary effort is essential if public school officials are desirous of change. The Northern California administrators surveyed appear to be ready to support future endeavors outlined to enable students to cope with the rampant pace of technological change.

To conclude, the data suggest that students, regardless of career orientations, sex, age, socioeconomic status, or curricular interests should have the opportunity to become technologically literate individuals.

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Appendix A

NORTHERN CALIFORNIA COUNTIES

NORTHERN CALIFORNIA COUNTIES

Counties from which random samples of educational institutions were drawn:

1.	Alameda*	17.	Placer
2.	Alpine	18.	Sacramento
3.	Amador	19.	San Benito*
4.	Calaveras	20.	San Francisco
5.	Colusa*	21.	San Joaquin
6.	Contra Costa*	22.	San Luis Obispo*
7.	El Dorado*	23.	San Mateo
8.	Fresno	24.	Santa Clara*
9.	Kings*	25.	Santa Cruz*
10.	Madera	26.	Solano*
11.	Marin*	27.	Sonoma
12.	Mariposa	28.	Stanislaus
13.	Merced*	29.	Sutter
14.	Mono	30.	Tuolomne*
15.	Monterey	31.	Yolo
16.	Nevada*	32.	Yuba*

*Counties that were randomly selected for inclusion in this study.

Appendix B

LETTER OF TRANSMITTAL TO ADMINISTRATIVE SAMPLE

San José State University
WASHINGTON SQUARE
SAN JOSE, CALIFORNIA 95192

SCHOOL OF APPLIED ARTS AND SCIENCES
Division of Technology (408) 277-3446

This correspondence is to inform you about a Technology Education research project that is being conducted among northern California high school principals and recent high school graduates. It is being carried on cooperatively by the Division of Technology at San Jose State University and the Educational Administration Department at the University of the Pacific. Concurrent interest in industrial education curricula and possible training programs for educational administrators has stimulated this research.

We are interested in examining the state-of-the-art with reference to high school curricula developed to study technology. While it has become apparent that some universities are addressing this concern, your responses will help us to determine the degree to which our high schools are encouraging students to learn about present-day technology.

Please complete and return the enclosed survey information form prior to October 15, 1981. A self-addressed, postage-paid envelope is enclosed for this purpose. The data sheet has been developed specifically for use in this project and, on the average, requires less than 10 minutes of your time. If your high school employs an individual who is responsible for Curriculum and Instruction issues, please pass these materials along to that person.

The survey sheets have been coded in order that all information can be entered into a computer program; however, your responses will remain anonymous. We are willing to forward a summary of the research results if you so request. We genuinely appreciate your cooperation and interest in this vital topic in education.

Have a pleasant day!

Sincerely

Linda Rae Markert
Project Director
Division of Technology

Enclosures

Appendix C

FOLLOW-UP LETTER TO ADMINISTRATIVE SAMPLE

San José State University

WASHINGTON SQUARE
SAN JOSE, CALIFORNIA 95192

SCHOOL OF APPLIED ARTS AND SCIENCES

Division of Technology (408) 277-3446

October 26, 1981

Dear Colleague:

As you may recall, we recently sent you some information regarding a "Technology Education" research project that is being conducted among northern California high school principals and recent high school graduates. It is being carried on cooperatively by the Division of Technology at San Jose State University and the Educational Administration Department at the University of the Pacific.

Realizing that your daily schedule is extremely busy, we assumed that you may not have had time to respond to our initial request, or simply did not receive the correspondence. Since your participation is crucial to the success of our investigation, could you perhaps take a moment to complete and return the enclosed survey information form at your earliest convenience (prior to November 6, 1981, if possible). The estimated time of completion is 7 minutes. A self-addressed, postage-paid envelope is enclosed for your use.

Once again, we assure you that your responses will remain anonymous, but we are willing to forward a summary of the research results if you so request. We genuinely appreciate your cooperation and interest in this vital topic in education.

Please disregard this request if you have already returned a copy of the survey form to us. Have a fine day!

Sincerely,

Linda Rae Markert
Project Director
Division of Technology

Enclosures

Appendix D

LETTER OF TRANSMITTAL TO EDUCATIONAL SAMPLE

San José State University

WASHINGTON SQUARE
SAN JOSE, CALIFORNIA 95192

SCHOOL OF APPLIED ARTS AND SCIENCES

Division of Technology (408) 277-3446

Dear Fellow Colleague:

This correspondence is to inform you about a Technology Education research project that is being conducted among northern California high school principals and recent high school graduates. It is being carried on cooperatively by the Division of Technology at San Jose State University and the Educational Administration Department at the University of the Pacific. We would like to solicit feedback from one class of your Freshman English students during the fourth week of October (i.e., the week of the 19th).

We are primarily interested in examinining the state-of-the-art with reference to high school curricula developed to study technology. Your students who, for the most part, will have recently graduated from high school, are the persons most qualified to provide an accurate portrayal of their experiences.

Please complete and return the enclosed postcard prior to October 9, 1981. If possible, please list your office hours and extension in order that I may telephone you and make arrangements to conduct the survey during one of your classes.

The questionnaire developed for this project has been pilot tested among university students and revisions have been made. On the average, they were able to complete it in 7 minutes or less. We genuinely appreciate your cooperation and interest in this vital topic in education.

Have a pleasant day!

Sincerely,

Linda Rae Markert
Assistant Professor
Divison of Technology

Enclosures

Appendix E

SURVEY QUESTIONNAIRE--ADMINISTRATORS

TECHNOLOGY EDUCATION INVENTORY*

*If you do not have a personal definition for this term, you may refer to the American Heritage explanation which suggests that Technology is the application of science, especially to industrial or commercial objectives.

TECHNOLOGY EDUCATION INVENTORY*

ADMINISTRATORS

A. DEMOGRAPHIC INFORMATION

1. What is the approximate population where your high school is located? Circle one.

Less than 10,000	(1)
Between 10,000 and 50,000	(2)
More than 50,000	(3)

2. What is the approximate number of students currently attending your high school? Circle one.

Less than 200	(1)
201 to 400	(2)
401 to 800	(3)
More than 800	(4)

3. In your mind, what is the level of technological advancement in the community where your high school is located? Circle one.

Low--limited technological research and development	(1)
Middle--technology applied in industrial firms	(2)
High--extensive technological research and development	(3)

4. Circle one.

Male	(1)
Female	(2)

5. What is your age category? Circle one.

(1) 25-30	(5) 46-50
(2) 31-35	(6) 51-55
(3) 36-40	(7) 56-60
(4) 41-45	(8) 61-65

*Estimated time of completion: 7 minutes.

B. TECHNOLOGICAL LITERACY

Circle one response for each of the following items:

1. Do you feel that you have a personal definition for the term "technology"?

   Yes No

2. Do you feel that "technology" and "applied science" are synonymous terms?

   Yes No

3. Do you feel that "technology" has <u>negative</u> implications for your life?

   Yes No

4. Do you feel that "technology" has <u>positive</u> implications for your life?

   Yes No

5. Do you feel that "technology" is neutral?

   Yes No

6. Do you feel that you have some control over the future directions technology in general will take?

   Yes No

7. Do you feel personally responsible for the advancement of technology in general?

   Yes No

8. Do you subscribe to any "technical" journals, newsletters, or publications?

   Yes No

   If YES, please give an example of such a publication.

   ____

9. Are you a member of any "technical" organizations or associations?

   Yes No

10. Are you able to operate the following equipment?

    a. pocket calculator Yes No
    b. memory function on a pocket calculator Yes No

c. automated bank teller machine Yes No
d. microwave oven Yes No
e. electronic games Yes No

11. Can you explain what is meant by the following terms?

a. laser Yes No
b. microprocessor Yes No
c. silicon chip Yes No
d. recombinant DNA Yes No
e. fusion power Yes No

12. In your mind, does technology necessarily involve some sort of hardware?

Yes No

13. Do you feel that an understanding of technology is an important life skill for survival in the future?

Yes No

14. Are you able to explain what is meant by the following terms?

a. fiber optics Yes No
b. robotics Yes No
c. Z-gravity Yes No
d. MX missile system Yes No
e. artificial intelligence Yes No

15. Drawing <u>only</u> from the formal education and experience that you have had to date, do you feel you would be competent to administer a high school built in the year 2015?

Yes No

16. Can you operate the following equipment?

a. word processor Yes No
b. digital clock Yes No
c. home computer Yes No
d. selectric typewriter Yes No
e. video tape recorder Yes No

C. TECHNOLOGY EDUCATION

Circle one response for each of the following items:

1. Does your school offer a "general" course in present-day technology?

   Yes No

   Answer a if YES; answer b if NO

   a. If the answer to question 1 is YES, please respond to the following:

      (1) Is the course required? Yes No
      (2) Is a current textbook (post-1978) used in this course? Yes No
      (3) Does the course outline include an emphasis on the history of technology? Yes No
      (4) Does the course outline include an emphasis on the future directions technology may take? Yes No
      (5) Does the course outline reveal an orientation toward technical skills? Yes No
      (6) Are freshmen and sophomores allowed to take this class? Yes No
      (7) Are juniors and seniors allowed to take this class? Yes No

   b. If the answer to question 1 is NO, please respond to the following:

      (1) Do you have an interest in such a course? Yes No
      (2) Is there any funding available for a course of this nature? Yes No
      (3) Do you have any personnel who are qualified to teach such a course? Yes No
      (4) Do you perceive a need for your school to offer a general course in technology? Yes No
      (5) Do you feel that a special facility is necessary to offer a course like this? Yes No

2. To the best of your knowledge, do any of the faculty members on your staff have an interest in "future studies"?

   Yes No

3. Do any courses in your curriculum possess a "futures" orientation?

Yes No

4. Do you believe that an understanding of technology is a life skill for your students?

Yes No

5. Would you be supportive of the implementation of a general course in technology if the curriculum was available to you?

Yes No

6. Does your high school library subscribe to any "technical" journals, newsletters, or publications?

Yes No

7. To the best of your knowledge, is the concept of technology taught in your: (respond to each item separately)

a. English program	Yes	No
b. Math program	Yes	No
c. Industrial Arts program	Yes	No
d. Social Studies program	Yes	No
e. Science program	Yes	No
f. History program	Yes	No
g. Elective program (a category by itself)	Yes	No

8. To the best of your knowledge, do any of your faculty members discuss the technology of the future that your students will be exposed to?

Yes No

9. In your mind, does the concept of technology belong in your: (respond to each item separately)

a. English program	Yes	No
b. Math program	Yes	No
c. Industrial Arts program	Yes	No
d. Social Studies program	Yes	No
e. Science program	Yes	No
f. History program	Yes	No
g. Elective program (a category by itself)	Yes	No

10. Do you think that technology education is less important today than it will be in the year 2015?

Yes No

Appendix F

SURVEY QUESTIONNAIRE--STUDENTS

TECHNOLOGY EDUCATION INVENTORY

STUDENTS

Directions: The following questions are being answered by many students who are currently enrolled in post-secondary English classes. Please take a few minutes to respond to each item by circling the answer that best expresses your opinion. There are no incorrect answers. Please respond honestly. Do not write your name on this form. When you are finished, return the questionnaire to your instructor or to the individual identified to collect them. Thank you!

1. Did you graduate from a California high school?

   Yes No

2. When did you graduate?

   Before 1979 (0)
   1979 (1)
   1980 (2)
   1981 (3)

3. Circle one:

   Male (1)
   Female (2)

4. In your mind, what is the level of technological advancement in the community where your high school is located? Circle one.

   Low--limited technological research and development (1)
   Middle--technology applied in industrial firms (2)
   High--extensive technological research and development (3)

5. Do you know what is meant by the word technology?

   Yes No

6. Is technology always associated with some sort of hardware?

   Yes No

7. Do you read any "technical" magazines on a regular basis?

Yes No

If YES, please give an example of a magazine you read:

____

8. Do you feel that your understanding of technology is a necessary survival skill?

Yes No

9. Do you feel that technology is more important today than it was 10 years ago?

Yes No

10. Generally speaking, do you feel that you will have some control over the future directions that technology will take?

Yes No

11. To the best of your knowledge, did your high school offer a general course about technology?

Yes No

a. If YES, did you take that class? Yes No
b. If NO, would you have liked to see such a course taught in your high school? Yes No

12. Did your high school library have any technical magazines or newspapers available for your use?

Yes No

13. Did you learn about technology in your: (please respond to each item separately)

a. English class Yes No
b. Math class Yes No
c. Industrial Arts class Yes No
d. Social Studies class Yes No
e. Science class Yes No
f. History class Yes No

14. Did any of your high school teachers seem to be interested in discussing the technology of the future that you will be exposed to?

Yes No

15. Do you think that your high school education prepared you to enter an occupation that is related to a technology of some sort?

Yes No

If YES, please identify that occupational area of technology:

____

Appendix G

ADMINISTRATIVE COMMENTS DERIVED FROM TELEPHONE FOLLOW-UP CONVERSATIONS

ANECDOTAL COMMENTS DERIVED FROM FOLLOW-UP

TELEPHONE CONVERSATIONS WITH

NONRESPONDENTS

1. " My secretary may have thrown it out thinking that it wasn't a big priority. Send me another copy please and mark it important!"

2. "I've probably filed it with my C-mail. I simply do not have the time but will try to find it within the next few days."

3. "I gave it to a counselor and asked him to respond. I see a need for the project and it sounds interesting; however, my office is inundated with surveys."

4. "It seems like a worthwhile project, but I do not intend to fill it out until Thanksgiving break. I have too many questionnaires to fill out as it is; in fact, I have a questionnaire file which I get to when I have time. We do teach Computer Education at this school, and I believe that the schools should begin to move in the direction of offering more technology education."

5. "We get bombarded with surveys and they are a low priority with administrators. There is no immediate return on the time invested in answering requests for participation. Our school is not getting involved with technology education at present--we are having a hard enough time catching up with the 20th century!"

6. "The form was too long and you were asking too much. I started to fill it out but got ticked off and threw it in the garbage. I felt like I was being set up--it was not the world's swiftest instrument. I am very interested in technology education programs and have allocated $7,000 of SIP funds for this aspect of curricular improvement."

7. "We have been trying to locate the survey since you called the first time. Perhaps you could send us another copy."

8. "Please send us another copy. I'll be happy to fill it out if it is only two pages."

9. "It was rather time consuming, and the form seemed a bit too complicated. I wasn't certain of the purpose or how our school could benefit from the results."

10. "We just don't have the time. There are no counselors, only four administrators and 2,000 students. Therefore, I just don't do any surveys, and that makes it easier. I'm here until 11:00 or 12:00 many evenings--something had to go."

11. "I get two or three of these things from San Jose State each week. Truthfully, between SJSU, the University of Santa Clara, and Stanford, I find it impossible to deal with all of them. We may miss on some of these, but I've been a principal for 18 years, and this is called survival!"

12. "I think I deep-sixed it since I generally get rid of all surveys as a matter of routine. They are burdensome to staff and teachers."

13. "This is a continuation high school, and we don't have the type of student who could handle technology education of any kind. This is the reason I did not send it back."