Contents

From The Editor

Welcome to the JTE!

Dear JTE Readers,

Welcome, indeed! We hope this inaugural issue of the JTE begins an ongoing discourse on issues and concerns of importance in the field of technology education. The JTE goes out to all of you who believe that technology education should be a part of every young person's schooling experience. It's a chance for us all to explore and document ideas that will move us forward as a profession.

In this and subsequent issues of the JTE, you will find articles, guest articles, book reviews, editorials, and reactions to previously published manuscripts. We hope the variety of sections will encourage a wide range of contributions.

The *Articles* section focuses on technology education research, philosophy, theory, and practice. All manuscripts appearing in this section undergo a rigorous review by the editorial board. In this issue, Clark writes about the emergence of the new technology education paradigm, de Klerk Wolters describes research on student attitudes toward technology in the Netherlands, and Zuga addresses curriculum issues.

The *Editorials* section, on the other hand, is a place where you can tell it as you see it. We will consider any professionally written piece that relates to our field for this section. However, it need not be documented or tediously researched (as do those intended for the *Articles* section). Moreover, editorials should be short - perhaps three to five pages long. Here, you'll find Smalley lamenting our troubled schools, and Zuga and Bjorkquist examining the pursuit of excellence.

Book Reviews focuses on recently published books that relate to the field, but probably cannot be found on the ITEA convention floor. Limited space simply does not allow us to publish reviews of the many textbooks in our field. In this issue, Markert and de Vries put us in touch with two worthwhile selections.

In addition to those sections noted above, you may also look for *Guest Articles* and *Reactions*. Guest articles will be solicited from time to time from prominent individuals. In our next issue, for example, Dr. Rustom Roy, a noted leader in the STS movement, will discuss the relationship of science to technology education in a *Guest Article*. The *Reactions* section is intended to encourage you to provide written responses to ideas published in the JTE.

It's a cliche to suggest that the JTE relies upon your written contributions. But, it's true nonetheless. If you've got an *Editorial* in you, send it in. If you have a bone to pick with one of this issue's authors, put your *Reaction* in writing and fire it our way. If you are engrossed in a research effort that's of interest to our field, this is the place to report your findings.

A final note.... I've used the collective “we” throughout this greeting to represent all of those who have worked so hard to make this journal happen. The ITEA and CTTE Boards have been there with their support from the beginning. Associate Editor Jim LaPorte, whose office is 15 feet from mine, has been a constant help with the tough decisions, as well as the nitty gritty of getting this issue to press. Brenda French has worked diligently with me in getting the manuscript into camera-ready format, and on a myriad of other tasks associated with the *Journal*. The editorial board members have given generously of their time in reviewing manuscripts, a thankless task for which I'd like to thank them. And, of course, my sincere thanks go out to professionals like yourself who care enough about your work to read and (I hope) contribute to your new *Journal*.

Mark Sanders, Editor

The Board of Directors and members of the International Technology Education Association (ITEA) welcome you to this, the first issue of the *Journal of Technology Education* (JTE). We hope that the JTE will join *The Technology Teacher* in providing additional thought and perspectives for those involved in the study of technology and technology education. The JTE shall serve professionals in higher education and scholars working to advance theory and practice in philosophical thought, teaching methodologies, learning styles, and exemplary practices in technology education.

We initiate this publication at a time when the state of teacher preparation institutions in the field is at one of its weakest points in history. The need for additional thought-provoking articles and issues could not be greater. Also, the expansion of one's thoughts beyond current boundaries into the sciences, engineering, liberal arts, and more are needed to communicate and promote the study of technology far beyond the narrow perspective envisioned by educators and the general public. The need for the JTE becomes more pronounced when one realizes that, in our societal institutions today, there is no organization other than our own with the sole purpose of developing, advancing, and promoting the importance of understanding our technological society. In an increasingly more sophisticated technological society, the need for advocates of education about technology becomes more imperative.

The study of technology and technological literacy needs to be addressed as the continual change and advancement in our society requires that we further our work. A technologically literate person is one who has at least an elementary understanding of scientific concepts, knows the needs of society and moral constructs, is cognizant of applications through problem solving and has the ability to use tools, materials, and systems. Issues such as these will be further identified and expanded through this publication. The need for research on these issues will not go away, just as technology will never disappear. As technology continues to make remarkable strides, ITEA must keep pace through its publications and work.

Technology education is in its infancy as a discipline within the field of education. Much work lies ahead to further the history of the discipline, to enhance and expand upon its body of knowledge, and to continue to derive intellectual processes and procedures. This knowledge and understanding are essential elements in the preparation of liberally educated citizens for a democratic society. The JTE will help to support this discipline by providing for the expression of new thoughts and ideas.

Finally, we hope that this publication will be a vehicle for promoting individuals, through their work, to advance the study of technology. One of the main objectives of a strong association is the promotion of its members. This personal promotion will occur with each issue as new ideas are shared with the reader. We recognize that the individual is the chief focus of all of the activities of ITEA and the ultimate strength of the entire association. These individual efforts improve technology education and education in general. And through individual efforts, the *Journal of Technology Education* will become a strong contributor to the education process. We invite anyone interested in technology and technology education to contribute to this important publication.

ITEA Board of Directors

The Council on Technology Teacher Education is proud to join the International Technology Education Association in sponsoring a new journal for technology education. The *Journal of Technology Education* (JTE) promises to fill a distinct void in our literature.

Every educational field grows in a number of ways. However, rational growth comes from developing strong philosophical bases and research supported practices. Technology education lacks a publication that focuses on these two issues. We have *The Technology Teacher* which provides association news and features and presents a wide variety of articles for technology educators from the elementary school through university levels. The *TIES* (Technology Innovation and Entrepreneurship for Students) magazine presents information and problem solving activities for teaching about various technologies.

Neither of these publications provide an avenue for exchanging philosophical views or results from research projects. The *JTE* should not be seen as an “ivory tower” publication, but rather as a primary source of stimulating, thought provoking articles that will help each professional plot a course for program improvement. And this should be the goal of each of us. No program is beyond improvement and many are facing unique challenges as they make the transition from industrial arts to technology education.

Public school technology education programs must come to grips with their general education role at a time when other programs, such as math and science, seek to embrace technology content for their courses. Teacher education programs must make significant curriculum changes during a period when enrollments are generally declining and their sister engineering technology programs are becoming more narrowly focused. The challenges are upon us and the ways we address or fail to address them will determine the future of the field.

The readers of the *Journal of Technology Education* can make a difference. They can contribute to the publication and apply the information contained in each issue to better meet the educational needs of their students.

Thomas Wright, President
Council on Technology Teacher Education °

Articles

The Industrial Arts Paradigm: Adjustment, Replacement, or Extinction?

Steven C. Clark[1]

Introduction

Industrial arts/technology education (IA/TE) is in a crisis - a crisis caused largely by the increasing changes that are occurring within society and technology. In the past five years, national, state, and local commissions, organizations, and educators have developed countless documents, curricula, and workshops on the subject of technology education (International Technology Education Association, 1985; Ferns, 1983, 1984, 1985, 1986, 1987, 1988; Hoopfer, Jost & Nelson, 1987; Hales & Snyder, 1981; Hull & Smink, 1988; Kadamus & Daggett, 1986; Maley, 1988; Michigan Department of Education, Vocational-Technical Education Service (MDE/V-TES), 1988, 1989; Savage, 1989; Virginia Vocational Curriculum Resource Center, 1988). Through various means, thousands of administrators, educators, and ancillary staff members have been exposed to technology education. IA/TE educators in Michigan strongly agree that technology should be a part of their programming, and, in some cases, identify technology education as what they currently teach (Smith, 1989). Still, the unit shop remains the primary delivery method in the field (Ellis, 1989; Smith, 1989). This serves to accentuate the scope of the crisis, and the professional reaction (or lack thereof) to it. It appears that many efforts in the movement toward technology education have failed because changes have been made in name only, rather than in instructors' understanding of the underlying philosophical differences between industrial arts and technology education. Because of the recurrence of name-change-only programs, and the fact that industrial arts teachers often do not perceive differences between industrial arts and technology education, it may be beneficial to the profession to view industrial arts as a paradigm.

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In a 1985 position paper, Pratzner viewed vocational education as a paradigm while providing insightful views into the paradigm's configuration and possible metamorphosis to a new emerging paradigm of vocational education. Citing “significant technological changes, quality of work life developments, lagging productivity, quality and international competitiveness” (p. 6) as reasons for a possible paradigm shift, Pratzner presented a persuasive case for change. Key to Pratzner's paradigm development was an abstracted version of the six components Mohrman and Lawler (1981) believed to be essential to any paradigm: image of subject matter, beliefs in particular theories and models, values, methods and instruments, exemplars, and social matrices. Copa (1985) supported Pratzner's position that, in order to survive, vocational education must change to meet the needs of society and technology, and also used industrial arts as an example of an “old paradigm” (p. 28). Using Pratzner's conceptional framework and Copa's observation that industrial arts is surely an “old paradigm,” the possibility of an “emerging paradigm” - technology education - is investigated in this paper.

An analogy may be drawn between Pratzner's view of the position of vocational education nationally and the state of IA/TE in Michigan schools. Ironically, Pratzner's perception of what vocational education should be (“developing, applying, and practicing basic skills and higher-order, transferable skills, judgements, and initiative [e.g., problem solving, decision making, planning] required of all learners”) constitutes the philosophical base for what industrial arts education was designed to be (p. 9). It is also ironic that many IA/TE teachers see their programs as prevocational, if not vocational, in scope. This view impedes their coexistence with vocational educators and widens the already existing gap between general education courses and IA/TE laboratories and classrooms. The situation is unfortunate, because IA/TE belongs, both philosophically and historically, within the cluster of courses deemed necessary for the general education of all children.

Paradigms in Crisis

Thomas Kuhn (1962) coined the term “paradigm” to denote a universally accepted set of models and beliefs held by a “community of practitioners” (p. x). These models and beliefs govern and define the scope and mission of a paradigm. According to Kuhn, paradigm shifts occur when a paradigm enters a crisis-like state: “All crises begin with the blurring of a paradigm and the consequent loosening of the rules. . . and close with the emergence of a new candidate for paradigm and with the subsequent battle over its acceptance” (p. 84). Transition from one paradigm to a new one requires more than simply “an articulation or extension of the old paradigm” (p. 84). A reconstruction of the most elementary models and beliefs that guide members' behavior must occur; there will be translucent periods, during which problems can be solved by either set of beliefs, but “never complete overlap” (p. 84).

Industrial arts/technology education is a true paradigm in crisis, according to Kuhn's (1962) definition. Industrial arts teachers adhere to beliefs and traditions that are firmly established in successful pedagogical methodologies, which have served them well. That tradition may well be what has slowed the progress to a 21st-century, technology-based paradigm. This new paradigm may be technology education for all students in public schools - a shift, in essence, from one set of beliefs to another.

According to Kuhn (1962), there should be a shift in methods and applications from the traditional to the new. If such a shift is achieved, “the profession will have changed its view of the field, its methods, and its goals” (Kuhn, 1962, p. 85). Thus, “the new paradigm is no longer seen as a radical approach, but as the only way to operate” (Mohrman & Lawler, 1981, p. 21). The legitimacy of the traditional industrial arts paradigm is locked in the early 1900's. IA/TE teachers and students alike are prisoners in a content world that is so far removed from modern technology that many professionals in the field have difficulty simply justifying their existence to their general education colleagues.

In Pratzner's (1985) view, “A paradigm is a framework used by a community of adherents to explain and make sense of their world and to guide their efforts to further understand and improve it.” (p. 7) IA/TE educators have rarely strayed beyond their conceptual framework, because as a group they understand it; improvements generally concern new ways to test old “technology.” In the following sections, the six components abstracted by Pratzner (subject matter, beliefs, values, methods, exemplars, and social matrices) are used to distinguish between the paradigm of industrial arts and the hypothesized new technology education paradigm. A summary of these distinctions for each of the component areas is shown in Table 1.

Subject Matter

The industrial arts curriculum is industry based. However, the current curriculum reflects the technology of years past. In 1876, American educators marveled at the Russian system of manual training presented at the Philadelphia Centennial Exposition. The exhibit showed exercise pieces of both wood and metal; students learned segments of a process through exercise and practice (Bennett, 1937). However, the working blueprints for student projects shown in Bennett's *History of Manual and Industrial Education, 1870 to 1917*, could have come from almost any modern industrial arts program.

The curriculum of the industrial arts paradigm is based on definitions that depict the subject matter. Bonser and Mossman (1924) defined industrial arts as a study of the changes people make in the forms of materials to increase their value and of the problems of life related to those changes. Bennett (1937) stated that industrial arts is essentially the same as manual arts (forerunner of industrial arts), although its connotations are different. In industrial arts, the “industrial” is emphasized, whereas in manual training (forerunner to manual arts), “manual” is stressed.

Table 1
Current and Emerging Paradigms of Industrial Arts

Components of a Paradigm	Industrial Arts	Technology Education
Subject Matter	Material shops Avocational skill Serves the interests of local instructors	Human-adaptive systems: manufacturing, transportation, communication, construction Developmental skills for all students Experimental approach to concepts/content Integrated knowledge
Theories and Models	Late 19th century/early 20th century industry Teachers impart knowledge Product emphasized Step-by-step methods Drill and practice	Problem solving Critical thinking Process emphasized Supports total curriculum Trial and error
Values	Individualized instruction Survival skills Leisure-time skills Hands-on Alternate track for academically less able, less willing	Individualized instruction and performance Cooperative learning Action based/hands-on Applications of technology
Methods and Instruments	Domain-referenced testing Psychomotor skill development Individual predesigned projects	Group problem solving Individual problem solving Generalizable skills Total domain learning: cognitive, affective, psychomotor Scientific inquiry
Exemplars	Unit shops Locally developed programs Vocational or prevocational education Survival skills	Today's technology Transferable knowledge Unified mission
Social Matrices	AIAA, state and local divisions Armchair curriculum development *School Shop* Project fairs	ITEA, state and local divisions *The Technology Teacher* ITEA: Stanley/Proto mass-production competition Advisory committees Technology-based student organizations Science/technology fairs ITEA: technology fairs

NOTE: The designation of the six components of a paradigm was abstracted from Lawler (1981). Some signifiers were developed by Pratzner (1985).

Bonser (1930) thought the term “field” was more fitting than the word “subject” because industrial arts represented a number of subjects. This was one of the first references to "subjects" in the literature on industrial arts; the move was being made from the general shop to the "unit shop."

During the next 40 years, people like Warner (1947), Olson (1955, 1963, 1972), Hales & Snyder, (1981), and Maley (1975, 1978), returned to the broad study of the materials, organizations, tools, processes, products, jobs, and human problems of industry as their content statement for the profession. Four years ago, Bensen (1985), Ferns & Clark (1985), and Rudnick (1985) urged industrial arts teachers to re-evaluate their course content because of what they saw as an outdated curriculum based on "industry."

Over the past 70 years, the subject matter in industrial arts classrooms and laboratories has undergone little change. The philosophy of teaching the tools, processes, and materials of industry has served the existing paradigm well. However, if the emerging paradigm is to become dominant in the area of subject matter, the content of technology education courses will have to evolve rapidly.

Many IA/TE programs in Michigan exist today because of a strong traditional commitment to an instructor or a special population within the school district served by those programs (Rudnick, 1985). The emerging paradigm of technology education, which is the alternative to industrial arts education, eliminates the dedication to special-interest groups and moves back into the general education curriculum with a program designed to serve the needs of all students - a general education course dealing with an understanding of today's technological society.

The new paradigm of technology education is based in the 21st century and beyond. Four human-adaptive systems of subject matter embody four major areas of contemporary society. Communication technology involves efficiently using resources to transfer information to extend human potential. Construction technology involves efficiently using resources to build structures or constructed works on a site. Manufacturing technology involves efficiently using resources to extract and convert raw/recycled materials into industrial and consumer goods at a central plant location. Transportation technology involves efficiently using resources to obtain time-and-place utility and to attain and maintain direct physical contact and exchange among individuals and societal units through the movement of materials/goods and people (ITEA, 1985).

Savage (1989) took the evolution of technology education one step further to expand the subject matter base. State departments of education in Michigan, New York, and Ohio are currently considering this "systems" approach (Smith, 1989), which consists of bio-related, physical, and communication technologies. Bio-related technology subject matter ranges from societal concerns regarding waste treatment to technological issues related to agriculture. Physical technology subject matter ranges from societal concerns for alternate energy sources to the technological problems confronting manufacturing engineers. Communication technology subject matter ranges from computer-aided drafting (CAD) to laser communication systems (Savage, 1989).

The content areas of the new paradigm can be based in society as well as industry and will not create specialists in any field within either realm. Understanding the social implications of work and change and developing problem-solving and critical-thinking skills are but a few of the major goals of the technology education paradigm. Justifying one's existence within general education through the integration of all subject areas becomes a matter of one's technological focus.

Theories and Models

Paradigms encompass a number of characteristic theories and models that explain and relate the variables defining subject matter (Mohrman & Lawler, 1981). The paradigm of industrial arts is based on the labor-intensive model of industry that existed at the time of the industrial revolution in America. Content is determined from a trade and job analysis of selected occupations such as cabinetmaking, drafting, printing, welding, and so on.

Even though early federal funding of vocational education programs (Smith-Hughes Act of 1917) removed trade-specific training from the general education mainstream, a need remained to develop a philosophical base on which the two disciplines could grow. Technology analysis (Warner, 1947), human needs analysis (Maley, 1976), the Industrial Arts Curriculum Project (Lux & Ray, 1971), and social-cultural analysis (DeVore, 1965), were all attempts to establish a philosophical base for industrial arts education. However, the difference between industrial arts and vocational education was never clearly defined and implemented as a universal practice. The unit shops of the existing paradigm survived as generic reflections of industry; most of them still model specific job training.

Dewey's “project method” (1933, 1942) of scientific problem solving was well suited for industrial arts, with its emphasis on tools and equipment. Industrial arts teachers could pose hypothetical problems, and students could work until they found acceptable solutions. In theory, this approach was to be the embodiment of all educational efforts toward problem solving. For many years industrial arts prided itself as one of the prime forces in the development of problem-solving techniques (Ferns, 1962; Lux & Ray, 1971; Maley, 1985; Olson, 1972). However, (in most industrial arts shops) the movement from student irritation with a problem that needed a solution to an examination of actual conditions never crystallized. The problems posed by industrial arts teachers primarily involved machine operation and tool manipulation. The industrial arts paradigm seldom articulated the full intent of Dewey's concern to break down the dichotomy between means and ends (Archambault, 1964). The tools and machinery served as the means to produce a functional product (project) that was an end in itself.

The mechanistic content of the industrial arts paradigm is arousing divergent thinking among practitioners. The models and theoretical genesis of the technology education paradigm are derived from the ways human beings adapt to contemporary technological society (Savage, 1989). The technology education curriculum is in a constant state of flux. The major concerns lie with problem-solving and critical-thinking skills, futuristic thinking, adaptability, and application of general skills for a productive life (ITEA, 1985). These broad areas can be covered in the total school curriculum because technology is the thread that runs through all subjects and affects all people. The "key to success" is to apply technology to develop an understanding of the processes American society must encounter and overcome while staying competitive in a world economy (Naisbitt, 1984). The global concept, applied as an integrated curriculum within the school building, will guide educators in the 21st century. That integration of curriculum stands at the core of technology education for all students (Maley, 1985).

Values

A democratic society provides equal educational opportunity of the same quantity and quality (Dewey, 1942). Many of the values currently held by industrial arts supporters run contrary to this expectation. Instructors in the industrial arts paradigm link directly with the values of industry: drill and practice, assembly lines, scientific management, and no-work-equals-no-pay evaluation models. Many educators describe industrial arts courses in general as "good for those kids." This shields them from critics who seek to evaluate their program content in the light of current educational reforms and technological advances. The valued curriculum becomes a continuum from developmental shop work to advanced shop work. The only curriculum that can exist in this environment depends on the two major factors that have always driven vocational education: (a) task analysis based on terminal objectives (Finch & Crunkilton, 1979) and (b) the material (wood/metal, etc.) primary to the course (Rudnick, 1985). Placement of students in jobs related to their course work becomes a strong program goal. This progression from basic shop work to vocational work was criticized as early as 1923 (Bonser et al., 1923) and has continued to reduced the general education value of the IA/TE curriculum.

The curriculum in the emerging technology education paradigm bases its values on solid educational goals. "Successful education," as seen by Goodlad (1978), Dewey (1942), and others, focuses on problem solving, sensitive human relations, self-understanding, and the intergration of one's total experience into an educational system that aims toward self-renewal and lifelong learning. Just as the word "technology" conjures images of change and the future, the emerging technology education paradigm seeks to advance beyond the philosophy of industry as content. With technology as the charge, class content will change as industry and society change.

Using the total school curriculum as a resource base, the new technology education paradigm lends credence to its philosophical position within general education. The role of technology in the 21st century has as many social implications (Adler, 1982) as it does industrial ones. Change is the key. All educational curriculum springs from some image of the future. If the image of the future held by a society is grossly inaccurate, its education curriculum will betray its youth (Toffler, 1974). Technology education will instill in students the developmental skills they will need, regardless of their vocational aspirations.

Methods and Instruments

The unit shop within junior and senior high schools is the most unifying feature of the industrial arts paradigm. The tools and equipment common to hand and machine working of a specific material can be found in these unit shops. Wood shops, metal shops, and drafting rooms all represent common unit shops that have existed since the late 1800's. In 1876, Runkle (cited in Barlow, 1967) expressed the need to (a) separate instruction shops from construction shops, (b) provide only one kind of work in each shop, (c) provide as many work stations and tools per student as can be handled in one instructional period, and (d) graduate the instruction in each shop according to the difficulty of the operation. This moved general shop instruction into the specialization that the United States needed as it progressed from an agrarian society through the first industrial revolution. Many industrial arts educators thus adopted Runkle's and others' concept of the unit shop. Today, approximately 95% of the IA/TE programs in Michigan still deliver programs by means of the unit shop (Ellis, 1989; Smith, 1989).

The methods of instruction and evaluation in the old industrial arts paradigm tend to be psychomotor skill development and domain-referenced testing. The skills inherent in the material with which students work dictate the range in the domain for which testing is done. The hands-on techniques for developing psychomotor skills are generic to both the existing and the emerging paradigms. The philosophy and mission behind the processes in the alternate paradigm of technology education make it vastly different from the existing paradigm.

Major program goals involve generalization of problem-solving and critical-thinking skills. The models developed by students in the emerging paradigm involve skill development in all domains of learning: cognitive, affective, and psychomotor. These skills are fostered through both group and individual-learning activities in the technology education classroom and laboratory.

Characteristics of the emerging paradigm of technology education are consistent with the “effective schools” research (Brookover & Lezotte, 1979; Edmonds, 1978), in that high expectations exist for all students. Because technology education is based on society in the 21st century, with communication, construction, manufacturing, and transportation systems forming the core curriculum, each student has the opportunity to excel in many areas. The rationale for including technology education in the general education curriculum need not be the largely unproven hypothesis that the existing paradigm retains potential high school dropouts or that “those kids” cannot succeed anywhere else. Technology education is relevant for all students, regardless of their academic goals.

Exemplars

When Kuhn (1962) defined the term “paradigm” in the late 1950's, he identified it as a group of “universally recognized scientific achievements” (p. x). These “achievements” make up the rules-and-regulations to which paradigm practitioners adhere. Mohrman and Lawler (1981) exchanged the concept of “scientific achievements” for “exemplars.” They stated that exemplars are absolute necessities in the existence of a paradigm because its very existence depends on specific identifiable traits common to the paradigm. The exemplars of industrial arts are the existence and perpetuation of the unit shop and inconsistency in the curriculum (Rudnick, 1987). Locally developed courses such as “crafts,” “home maintenance,” and others too numerous to list , all of which are delivered under the name of industrial arts, display a decisive lack of mission. The only common exemplars seem to be survival skills for the handyman and introductory-level courses that advance shop-work skills generic to a specific vocational course. Pratzner (1985) claimed that the industrial arts paradigm is an alternative to the existing paradigm of vocational education. This observation is true of the emerging technology education paradigm; however, the exemplars that describe the current industrial arts paradigm are inconsistent and have difficulty linking to any curriculum.

Exemplars of the alternative paradigm can be found in the engineering departments of business or industry, with people working together on a collective charge in which each participant is responsible for his or her own area of expertise, while understanding conceptually the contribution each member is making. Manufacturing Engineering recently published its “Ten Top Places to Work” (Hayner, Redebaugh, Stauffer, Bergstrom, & Owen, 1989); the exemplar common to these companies was “teamwork” or “team.” The alternate paradigm of technology education encourages teamwork while using knowledge and processes that are common to today's society and technology. Students individually develop strategies to accept the inevitable changes taking place outside the classroom. This teaching attitude gives students responsibility for their own education.

Social Matrices

Paradigms cannot exist without the support of a group of adherents (Kuhn, 1962) or a social network that adopts the ideas and practices of the profession (Mohrman & Lawler, 1981). Articulation of ideas through both social and professional networks strengthens and supports the exemplars of a paradigm, both internally (among the members) and externally (outside the present membership). Since the late 1800's, the existing paradigm of industrial arts has gained numerous supporters from both industry and education. The American Industrial Arts Association was the professional organization that represented the paradigm of industrial arts. The AIAA held national and regional conferences, seeking to solidify and support teachers of the many industrial arts content areas. The other national network for the industrial arts profession was the Industrial Arts Division of the American Vocational Association. Many states have within their departments of education a similarly named unit with responsibility for industrial arts. State organizations also provide leadership with conferences and student project fairs. The Technology Student Association (formerly the American Industrial Arts Student Association) has student members from every state and gives students opportunities to expand their horizons within the existing curriculum.

The social matrices that support the new technology education paradigm are emerging and becoming more predominant. The AIAA renamed itself the International Technology Education Association (ITEA) in February 1985. In 1988, the Industrial Arts Division of the AVA proposed changing their name to the Technology Education Division. Many state organizations have changed to a technology-based paradigm, some by slim margins during member voting. Kuhn (1962) wrote that the "emergence of a new candidate for paradigm" is followed by "the subsequent battle over its acceptance" (p. 84). The ITEA changed its "official" magazine title to *The Technology Teacher*, in affirmation of the emerging paradigm, whereas others like *School Shop* resist changing their names, in order to serve both paradigms.

The social and political pressure to produce technologically literate youth has seldom been more publicized than in the past five years. The discussion of the Technology Education Act in 1985 by Congress and House of Representatives began the trend of national support for the new paradigm. Today, there are strong indications that future amendment(s) of the Perkins Act will favor technology education (Smith, 1989). This progression portends strong social promise for the technology education paradigm. Adler's (1982) Paideia Proposal called for the type of holistic education embodying the emerging paradigm of technology education.

The strength of the social matrices and methods used to support and deliver the new paradigm shows that professional attitudes are changing. There is little question as to the existence of the old industrial arts paradigm based on the aforementioned components. However, the social matrices are in place for a shift, if the methodology is developed, articulated, and followed up. This transition requires a solid philosophical understanding. The new paradigm must, at some point, make sense to industrial arts proponents.

Anomalies and Crises

Major anomalies within the existing paradigm of industrial arts have caused crises that have translated into noted reductions in the professional staff serving the paradigm (Ellis, 1989; Rudnick, 1985; Smith, 1989). This reduction raises concern among adherents of both the dominant and emerging paradigms, for one must have something from which to "emerge." The anomalies and crises necessary to provoke a paradigm shift must be great enough to disturb the adherents (Kuhn, 1962). Almost 60 percent of Michigan's IA/TE teachers believe their programs need to change, which appears to indicate crisis for the existing paradigm. Fewer and fewer school districts are finding the values and philosophy of the industrial arts paradigm result in viable programming. Many IA/TE teachers have been relegated to part-time status; while the tools and equipment used in their programs are being sold, and the numbers of courses offered are dropping at an alarming rate. In Michigan, the average IA/TE instructor is 44 years old and has 17 years of experience, with more than 10 years of service remaining (Smith, 1989). If the emerging paradigm of technology education is to be delivered by the present instructors, change must occur rapidly. The existing trend points to the extinction of industrial arts and the elimination of a universally accepted technology education paradigm.

Conclusions

A paradigm shift depends on many variables. The theories of Kuhn (1962), with abstractions by Mohrman and Lawler (1981), and Pratzner (1985), provide an excellent framework for understanding the components of a paradigm. The examples referred to in this paper revealed that a shift in the industrial arts paradigm is feasible. The strength of traditional industrial arts ideologies accounts for its longevity. However, the tools and machinery of the field disguise these ideologies, and a majority of students do not elect to become involved in the existing programs.

The emerging paradigm seeks to develop the three noted domains of learning: affective, cognitive, and psychomotor. This gives technology education a distinct advantage over the present paradigm, which in many cases has never lived up to its purported problem-solving capabilities (Ferns, 1962). A curriculum that addresses the needs of a technological society has never been in more demand. A recent survey indicated that less than half (43.7%) of the IA/TE teachers in Michigan considered themselves knowledgeable on the subject of technology education (Smith, 1989). Technology education must evolve rapidly, if adherents of the current paradigm are expected to be a part of the new paradigm.

It would be presumptuous to assume that the alternate paradigm of technology education is a “fad” rather than a trend in educational reform. The framework for a paradigm shift has been established in New York, Wisconsin, Illinois, Ohio, Virginia, Michigan, and California, and other states are developing support for such a shift. The Industrial Arts Curriculum Project (IACP) at The Ohio State University (Lux and Ray, 1971) fell short of national acceptance, largely due to timing. Lux & Ray's work in manufacturing and construction has become an integral component of the core curriculum of the emerging paradigm. The career education movement of the mid-1970's lost momentum and all but died because of infighting about who could deliver the service within existing curricula. The movement failed because of an internal articulation problem (Pratzner, 1985), not because the crisis career education set out to alleviate was not real.

The alternate paradigm of technology education has developed strong support at most levels of American society. That support has come through a strong push by technology education supporters to change the "attitude" of many toward technological instruction in the public schools (Bensen, 1985). The price of teaching technology within the new paradigm is a bargain when compared to that of instructing students within the existing paradigm. Ignoring the potential of the alternate paradigm and failing to articulate a well-defined model may endanger both the existing and the alternate paradigms.

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A PATT Study Among 10 to 12-Year-Old Students in The Netherlands

Falco de Klerk Wolters[2]

Introduction

Education in technology is behind the fast technological changes of the last decade. In the Netherlands, as in many other countries, technology is being introduced as a separate subject to overcome this back-log. The subject is required for all 12 to 15-year-olds. Also, in primary education (age 4 to 12) there is a growing interest in teaching about technology.

It is important to take into account pupils' interests, opinions and needs when developing technology curricula. It is also important not to rely only on the subject-centered approach derived from technology experts. Boys' and girls' differences in attitudes towards technology, for example, can put girls at a disadvantage when they choose a career. (Rennie 1988).

This "student-centered approach" is characteristic of the international Pupils' Attitudes Towards Technology (PATT) project. (Mottier, 1986; Todd, 1986). Compared with studies about pupils' attitudes towards "science" or "science and technology," not much literature is devoted to attitudes towards technology as a general concept. Raat and de Vries started PATT in 1986 with the purpose of developing an instrument that could be used internationally to measure pupils' attitudes towards technology. Researchers in 11 countries conducted pilot studies with translated questionnaires. From these results, an instrument was developed that was proved to be reliable and valid in the Western countries (Raat, de Klerk Wolters, de Vries 1989). The instrument has now been used in many countries all over the world, including Australia, Belgium, Canada, Denmark, France, Hungary, India, Italy, Kenya, Nigeria, Mexico, Poland, Great Britain, the United States, Surinam, Sweden and Zimbabwe.

This article describes a large scale measurement in the Netherlands among 10 to 12-year-old students in grades 7 and 8 of the primary school. The attitudes towards technology of two other age groups, 13 to 15-year-olds and 16 to 18-year-olds, have already been investigated and an integration of the results of the three cross-sectional studies is in preparation by the author.

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Literature Review

At the age of 10, pupils already have ideas about technology and it seems that they have already developed attitudes towards technology. Boys seem to have a more positive attitude towards technology than girls. However, there is little research available to support these assumptions.

Smail and Kelly (1984) did an extensive study among this age group. They used three instruments to measure attitudes towards science and technology: a Science Curiosity Test, a Science Activity Scale and an Image of Science Test. Their results show that at the age of 11, the attitude towards science and technology of boys and girls differs more greatly than the cognitive differences between boys and girls. Boys have a more positive attitude towards technology than girls. Also, boys are more interested in subjects related to physics and girls are more interested in biological subjects. Moore (1987a, 1987b) used drawings and developed a Technology Picture Questionnaire (TPQ) to investigate pupils' ideas about technology. He used drawing methods because young pupils may not have the writing and reading skills needed for written tests. From the drawing analyses, it appears that boys and girls associate technology with “making something.” The products they draw differ: boys mainly draw “transportation” and “computers” and girls draw “electrical equipment in general.” Pupils believe that a “technologist” is a “scientist,” doing “difficult things.” The TPQ, which is based on the results of the drawing analysis, consists of drawings of people who are working. A caption below each drawing explains what the person is doing. Pupils must indicate whether an activity is technical or not. The results of the TPQ show that young pupils associate technology with “inventing,” “making,” and “working with electricity.” Criteria they use to distinguish the “technical” from the “non-technical” are: “difficulty,” “high-tech” and “relevance.” For example, repairing a chairleg (not difficult) and developing a tomato sauce (not relevant) are considered to be non-technical. No significant differences between boys and girls were found in the use of these criteria.

From attitudes towards science studies, it might be possible to deduce some predictors for attitudes towards technology. Meta-analyses of research on attitudes towards science from Gardner (1975) and Schibeci (1984) show that “sex,” “personality” (self-concept) and “school” (class behavior) are important predictors for attitudes towards science. Educational variables like “achievement” and “intelligence” have a weak influence on attitudes towards science. The same applies to structural variables like “grade level” or “socio-economic background.” A possible predictor of attitudes towards technology is “familiarity with technology.” Knulst and Van Beek (1988) found that this variable is rather important in explaining the attitude towards technology among adults.

Methodology

Research Questions

The study focused on two questions:

1. What is the concept of and the affection towards technology of 10 to 12-year-old pupils?
2. Which variables affect attitudes towards technology?

Population and Sample

The total population of 10 to 12-year-olds consists of about 50,000 pupils belonging to 8,000 primary schools in the Netherlands. The sample consisted of 2,050 pupils belonging to 60 schools. This sample was representative of the whole population with respect to sex, geographical variations and schooltypes. To fulfill statistical requirements for an independent random sample, 900 pupils should have been required. But a larger sample was necessary because the sample consisted of whole school classes.

Instrumentation

The attitude towards technology is multi-dimensional. This is reflected in the instrument. It consists of 6 scales measuring the Affective and Behavioral components of the attitude towards technology (so called AB-scales) and 4 scales measuring the Cognitive component of the attitude toward technology (so called C-scales). The AB-scales are: a) Interest - the extent to which pupils engage in technological activities outside school; b) Role pattern - the extent to which technology as a career or study is equally suitable for boys and girls; c) Consequences - the extent to which pupils think that the effects of technology are negative; d) Difficulty - the perceived difficulty of technology as a school subject or a profession; e) School - the extent to which pupils like technology as a school subject; and f) Career - the extent to which pupils like technology as a profession.

The C-scales are: a) Society - technology is directed and controlled by human beings; b) Science - there exists a mutual influence between technology and science; c) Skills - technology has to do with skills; and d) Pillars - matter, energy and information are the pillars of technology.

The AB-scales are based on opinions and statements of pupils themselves about technology. The C-scales were designed *a priori* and operationalize a definition of technology in which technology is described by five features: a) technology is a feature of human activities; b) matter, energy and information are the "pillars" of technology; c) there is a mutual influence between technology and sciences; d) the three most important skills in technology are design skills, practical-technical skills (making, producing), and skills in handling (using) technical products; and e) there is a mutual influence between technology and society (Raat and de Vries, 1986).

The AB-scales are based on the Likert scale model. Pupils had to answer on a 5-point answering format: "totally agree," "agree," "not agree/not disagree," "disagree," "totally disagree." The C-scales are based on a probabilistic Guttman scale model (Mokken 1970). Pupils had to answer a 3-point answering format: "agree," "disagree," and "don't know."

Two different methods were used to answer the research questions: 1) written questionnaires, including the ABC-scales; and 2) drawings of technology and semi-structured interviews about technology.

Written questionnaires were supposed to measure the attitude towards technology. Two C-scales "Science" (relation technology science) and "Pillars" (matter, energy and information) were not used because they were not relevant and too difficult for 10 to 12-year-olds (see Table 1).

The alpha-values of the AB-scales were reasonable, but the H-values of the C-scales were too low. Therefore, the decision was made to also use alternative methods - drawing and interviews - to investigate pupils' concept of technology. Fifteen students from three teacher training colleges, doing their practical year, did this part of the research. These students were given extensive training for this purpose by the author in order to learn about the definition of technology and attitude measurement.

The student teachers had to categorize all the elements of drawings made by their class into the following groups: products, process, evaluation, place indication, and fantasy. For each group the inter-rater reliability or Kappa coefficient was calculated (Cohen 1980). One group had a low coefficient (R(it) evaluation=.51), others have coefficients > .65.

Interviews were held with 60 boys and 60 girls. The interviews were semi-structured, refering to the five features of technology (C-scales) and also to the AB-scales.

To investigate potential predictors of the attitudes towards technology, a series of questions (in the written questionnaire) had to be answered. These questions operationalized the following variables: Sex, School Choice (vocational or general school), School Experience (like school or not), Self-Concept (perceived knowledge of technology), Ambition (future technical or non-technical career), Home Environment (technical or non-technical profession of parents, technical or non-technical brothers and/or sisters, technical or non-technical friends, amount of technical tools, played with technical toys or not), and Teacher Attitude (attitude of the classroom teacher towards technology).

Data-collection and Analyses

Written questionnaires were filled in at schools during schooltime. The class teachers were given instructions, and had to fill in a questionnaire themselves to measure their own attitudes towards technology. The questionnaires were returned to Eindhoven University of Technology and an SPSS data matrix was developed from the results. The data were analyzed by means of SPSSx and SPSSpc+. Standard statistical programs were used: Reliability, Factor, Regression, Pearson Correlation, Partial Correlation, T-Test, Nonparametric Correlation, Oneway ANOVA. In addition, the student teachers recorded the interviews on tape and collected the elements of the drawings in data-matrices.

Table 1
Scale Names, Typical Items and Reliability Values

AB-Scales	Typical Item	Cronbach-Value
INTEREST 5 items	I like to read technological magazines	.78
ROLE PATTERN 4 items	Typical item: A girl can have a technical job	.70
CONSEQUENCES 5 items	Technology has brought more good than bad things	.59
DIFFICULTY 3 items	Technology is only for bright people	.60
SCHOOL 3 items	I would like to learn more about technology at school	.81
CAREER 5 items	I would like to have a job in technology some day	.80

C-Scales	Typical Item	H-Value
SOCIETY 8 items	Technology is as old as mankind	+.25
SKILLS 4 items	In technology you handle tools	+.33

Results/Findings

Affective and Behavioral Aspects

As was the case with older age-groups, 10 to 12-year-olds had positive attitudes towards technology. The scores on the AB-scales are positively skewed (see Figure 1).

Figure 1. Comparing Boys and Girls on AB-Scales

Boys scored significantly higher on the positive attitude scales than girls ($p < .001$). The largest differences were on the scales Interest, School, and Career. Boys liked technology more than girls did, boys wanted to hear about it at school more than girls, and more boys than girls wanted to have a technical profession in the future. These differences in interest were also found in the interviews. Boys were, in particular, focused on “equipment- technology.” The operating of and playing with computers and other electric equipment was more normal for boys than for girls. The differences between boys and girls on other attitudinal aspects of technology (Role Pattern, Consequences and Difficulty) were less extreme. Boys considered technology to be more important than girls. From the interviews, it became evident that this was not a consequence of girls thinking in a more differentiated way, as was suggested by Grant and Harding (1987). On the question “Is technology good or bad?” more boys than girls mentioned the bad sides of technology (35.0% of the boys versus 18.3% of the girls). In contrast with the scores on the Difficulty scale, 45% of the boys and 76.6% of the girls considered technology to be difficult. Only 5% of the boys and 1% of the girls believed that technology is easy.

Concept of Technology

Boys scored significantly higher on the two C-scales than girls (see Figure 2). The boys' and girls' concept of the relation “technology and skills” is reasonable, whereas the scores on the Society-scale sugggest that the concept of the relation “technology and society” was poor. It means that pupils are not aware of the daily influence of technology on their lives. This finding corresponds with the findings from the drawing analyses and the interviews.

Figure 2. Comparing Boys and Girls on C-Scales

In the drawings, a great many “daily products” can be found (see Table 2). But these drawing are usually without human beings. This may be because people are more difficult to draw than computers, but it is more likely that pupils do not think of human beings in relation to technology. According to the student teachers, their pupils liked talking about technology and they also had fun drawing about technology. This confirms the assumption that pupils at the age of 10 already have ideas and conceptions about technology. Their first association with technology is products - mainly electrical products like computers, radio, television and CD players. On the question of whether they think about equipment or human beings when thinking about technology, only 8.3% of the boys and 16.7% of the girls thought of human beings. Many boys (53.3%) and girls (78.3%) believed that they have nothing to do with technology. As a matter of fact, many boys (50.0%) and girls (71.7%) had the perception that a lot of people were not dealing with technology. The kind of people that they mentioned were babies, young children (like themselves), unemployed people, old people (senior citizens), people from the developing countries, mothers, and (unfortunately) also teachers. It is striking to note that 40.0% of the girls could not mention one technical profession, whereas this percentage is much lower for boys(3%).

Another misconception of 10 to 12-year-olds in the Netherlands is the association of technology with something modern (23.3% boys and 45.0% girls). A relatively high percentage (10.0% boys and 40.0% girls) were not able to mention school subjects that are related to technology. When they did, they mentioned arithmetic and math, but not “knowledge of nature” and “biology” (which are both taught at primary school).

Table 2
Results of Drawing Analyses

Category	Elements	Boys (N=139) N	Boys (N=139) %	Girls (N=124) N	Girls (N=124) %
Products	Radio, TV, video, CD player	41	29.5	46	40.7
	Domestic equipment	15	10.8	20	16.1
	Non-electrical equipment	15	10.8	9	7.2
	Computer	47	33.8	48	38.7
	Robot	6	4.3	6	4.8
	Cars	17	12.2	12	9.7
	Plane	32	23.0	7	5.6
	Boat	8	5.8	2	1.6
	Space travel	18	12.9	3	2.4
	Bike	3	2.1	5	4.0
	Tools	2	1.4	2	1.6
	Machines	8	5.8	9	7.2
	Building	14	10.1	2	1.6
	Rest	9	6.5	12	9.7
Process	A man is busy	20	14.4	12	9.7
	A woman is busy	1	0.7	11	8.9
	Something is being made	17	12.2	14	11.3
	Something is being invented	2	1.4	3	2.4
	Something is being repaired	2	1.4	2	1.6
Evaluation	Dangerous	17	12.2	5	4.0
	Not dangerous	20	14.3	30	24.2
	Difficult	19	13.7	13	24.2
	Easy	10	7.1	15	12.1
	Important	35	25.1	19	15.3
	Unimportant	5	3.6	4	3.2
	Nice/interesting	25	17.9	22	17.7
	Not nice/boring	--	--	6	4.8
Place	School	10	7.1	11	8.9
	Factory (workplace)	31	24.5	18	14.5
	Home	52	37.5	75	60.4
	Street	28	20.1	15	12.0
	Space	24	17.2	3	2.4
Fantasy	Future	19	13.7	6	4.8
	Daily life	69	49.6	81	65.3
	Old technology	4	2.9	3	2.4

Most boys (81.7%) and girls (74.1%) agreed that inventing, doing things with your hands and repairing are part of technology. However, they considered repairing a bike an inferior technological activity to working with a computer.

The conclusion is that boys, and to a lesser extent girls, have a positive feeling (affection) towards technology, but that their concept of technology is rather poor.

The Influence of Variables on the Attitude Towards Technology

Already at the age of 10, we can notice extreme differences between boys and girls in their attitudes towards technology. As pupils grow older, these differences do not seem to disappear (de Klerk Wolters, 1989). Probably the attitudes towards technology, which are formed at an age younger than 10, are very persistent and may be more resistant to change than we expect. Gender is an important predictor of attitudes towards technology, as it is in predicting attitudes towards science.

The influence of variables related to school was weak (see Table 3). The school choice did not predict the attitudes towards technology. There was no significant difference between pupils who say they want to go to a vocational school and those who say they will go to a general education school. There was also no significant difference between pupils with positive (like school) and negative (do not like school) school experiences. Finally, there was only a vague (insignificant) relationship between the teachers' attitudes towards technology (measured with a separate instrument) and the class' attitudes towards technology.

More important were individual variables. Pupils with a positive technical self-concept (pupils who think that they already know quite a lot about technology) had better attitudes than those who do not. And the same can be said for ambition; those with a technical ambition appeared to have a more positive attitudes towards technology.

The variable Home Environment had a moderately postive influence on the attitude towards technology. Having played with technical toys and having a variety of tools is more important (correlates higher with the scores on the scales) than having parents with technical professions.

The relative influence of separate variables was investigated by means of multiple regression. Forty percent of the score on the AB-scales was explained by the following predictors:

1.	Concept	20%
2.	Gender	9%
3.	Ambition	5%
4.	Self-Concept	2%
5.	Home Environment	2%
6.	Teacher Attitude	<1%
7.	School Choice	<1%
8.	School Experience	<1%

Table 3
Kruskal's Coefficient Gamma Between Scale Scores and Variables

	Int.	Rol.	Con.	Dif.	Sch.	Car.	Soc.	Skil.*
Gender	.52	-.34	.18	.08	.49	.47	-.32	-.21
Ambition	.88	-.24	.28	.16	.87	.98	-.43	-.28
Self-Concept	.84	-.11	.41	.14	.75	.73	-.67	-.44
Home Environment	.39	-.06	.24	.07	.39	.31	-.17	-.30
School Choice	.08	-.06	.07	.07	.09	.10	-.10	-.02
School Experienc	.05	-.03	.03	.02	.04	.03	-.02	-.02

* Int=Interest, Rol=Role Pattern, Con=Consequences, Dif=Difficulty, Sch=School, Car=Career, Soc=Society, Skil=Skills

From a path analysis with three variables, Gender, Affect (score on AB-scales), and Concept (score on C-scales), it appears that Concept influences Affect and not the other way around (see Figure 3). The total covariation between Concept and Affect (-.41) may be split up in a causal part (-.34) and a non-causal part (-.07). The model also shows that apart from Gender there are other major latent influences. This result means that a good concept of technology corresponds with a positive feeling about technology.

GENDER -.19 CONCEPT -.34 AFFECT

.39

Figure 3. Path-coefficients Gender, Concept and Affect

Implications for Teacher Education at the Primary Level (age 4 -12)

From the perspective of attitude-formation, it is important to start technology education at an early age. This means that it is appropriate to pay attention to technology in the initial training of primary school teachers and/or as part of an inservice training. Pupils' should be taught a “broad concept of technology,” because there is a positive relation between having a broad concept of technology and positive affection towards technology. A broad concept of technology means teaching different aspects of technology of which the relation between technology and society is important. It is necessary that pupils experience that technology is more than equipment and transportation. It is necessary for them to experience that technology is around them. Pupils must have a chance to deal with products of technology, and also to produce technology. If it is not possible to teach technology as a separate subject, it should be possible to develop “1001 examples” of practical applications that can be used or integrated in the existing curriculum.

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Relating Technology Education Goals to Curriculum Planning

Karen F. Zuga[3]

As representations of the aims, mission, and aspirations of industrial arts/technology educators, the written goals of the field have always prescribed a liberal educational role for industrial arts/technology education. Goal statements exceed the single goal of skill development and include such goals as helping students to become wise consumers and problem solvers and to understand industry and technology. Industrial arts/technology education goals have evolved over time. This evolution has reflected a drift towards more liberal education ideals with goals which specify the study of the relationships among industry, technology, and society, the interdisciplinary nature of the field, and general problem solving.

The practice of industrial arts/technology education, however, has not always demonstrated a clear relationship to those goal statements. Industrial arts/technology education laboratories and student activities often resemble vocational education laboratories and student activities. Moreover, much of the prescriptive theory of curriculum planning for industrial arts/technology education is technical in nature, relying upon curriculum planning techniques which are based upon behaviorism. A discontinuity exists in the descriptive theory (goal statements) and prescriptive theory (curriculum-planning practices) of industrial arts/technology education. This discontinuity is caused, in part, by the strategies used for planning curriculum and the limited prescriptive theory which exists in the field.

Identifying alternative curriculum-planning processes could have a sizeable influence on the future of technology education. If teachers were able to know and to use curriculum planning processes which are compatible with the

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goals they choose to implement, then the congruence between the goals and practices of technology education should improve. This is especially critical for a subject matter which is in a state of transition. Learning about a variety of curriculum designs and processes would result in a more informed technology education teacher, capable of making more accurate curriculum decisions. Accurate decisions about content and the presentation of that content should result in observable differences in the conduct of technology education.

The goals of industrial arts in the beginning of this century were more restricted and less varied than recent goal statements referring to technology education. Furthermore, as the goals of technology education have changed, the priorities of technology education have changed also. These changes reflect a mission of technology education which differs from the mission of industrial arts education at the beginning of the century. Written curriculum documents, compared over a period of years, reflect an addition of goals and a repositioning of goal statements which represents a theoretical shift. Tracking that shift is difficult because of the involvement of numerous people and agencies, such as specific authors, state departments of education, and school committees. Nonetheless, by looking at specific examples of the general trend, educators can see both the addition of new goals and a change in the priority of goals for technology education. Documents which synthesize goals from selected time periods of approximately 20 year increments can illustrate this shift.

Early industrial arts goals included statements about career exploration and vocation, consumerism, and skill development and heavily emphasized the purpose of the subject matter as prevocational study. Recent technology education goals reflect an increased emphasis on the study of industry and technology, critical consumerism, and the development of intellectual processes and interpersonal behavioral skills. Essentially, industrial arts and technology education goals can be grouped into the following seven categories: physical development, career exploration and vocation, intellectual processes, skill development, critical consumerism, industry and technology, and integration of the disciplines. *Physical development* refers to largely historical goals of the field which represent the effort to improve motor control and coordination through tool instruction, but not for the purpose of skill development in the use of tools. *Career exploration and vocational* goals are concerned with preparing students for either entry into an occupation or entry into vocational education programs by providing exploratory activities which can be developed for avocational purposes in many occupational areas. *Intellectual processes* refer to those goals which develop critical thinking and problem solving ability, in addition to other processes which emphasize working together, communicating effectively, and taking leadership roles. *Skill development* goals point to the specific instruction and perfection of the ability to use tools, machines, and processes. *Critical consumerism* goals address the relationship of industrial arts/technology education to society through a variety of efforts, including the ability to be a wise consumer and a technologically literate citizen. *Industry and technology* goals are those which specify the study of industry and technology as a subject. Finally, the *integration of the disciplines* are those goals which provide for the relationship of industrial arts/technology education to other disciplines, fields of study, and subject matter.

In 1928 Warner did an extensive study about the goals of industrial arts by looking at books, courses of study, periodicals, government bulletins, and the annual reports of the National Education Association. These goals reflect a traditional view of industrial arts highlighting career exploration and vocation, consumerism, and skill development. The vestiges of the influence of Woodward's (1898) version of manual training are evident in the goal of developing fine motor control. Some of the goals were as follows:

Career Exploration and Vocation: exploratory shop and drawing courses for the detection, discovery, or tryout of interests and aptitudes; avocational and prevocational purposes, preparing for a future industrial occupation;
Critical Consumerism: making more intelligent choosers and users of the products of industry;
Skill Development: develop household mechanics; develop mechanical intelligence through experience in hand work where fairly high levels of skill in the use of various tools and materials are the chief emphasis;
Physical Development: develop coordination of "hand and eye" by making things.

A 1948 text by Newkirk and Johnson listed goals for industrial arts. By this time, the concern for developing motor control was dropped as a goal, but the major goals of career exploration and vocation, consumerism, and skill development continued, in addition to new goals in the intellectual processes and the integration of disciplines. These goals were influenced by the philosophy of the time period and reflected the earlier influence of the "Cardinal Principles" of secondary education generated by the Commission on the Reorganization of Secondary Education (1918), and the more recent influence of the National Education Association's Educational Policies Commission report (1937). Industrial arts was also growing into a specifically secondary education subject and reflected the prevocational emphasis necessary in a society in which a high school diploma was the terminal educational program for a majority of its members. The following are some of Newkirk and Johnson's goals:

Intellectual Processes: develop social understanding and the ability to work in groups; develop the ability to plan and complete projects;
Integration of the Disciplines: provide a medium for expression in mathematics, science, language arts, and social science;
Career Exploration and Vocation: give experiences that will increase understanding of modern industry and that will lay the foundation for and help determine vocational interests; avocational purposes;
Critical Consumerism: develop the ability to recognize quality and design in the products of industry;

Skill Development: use a variety of tools and construction materials in a workmanlike manner; develop the ability to read and make working drawings, charts, and graphs; and develop the ability to maintain and service the common products of industry in a safe and efficient manner.

By the 1960's, industrial arts goals began to reflect a greater concern for the study of industry and technology in addition to maintaining many of the previous goals. Perhaps industrial arts educators began to be influenced by the study of the disciplines movement in curriculum. In a 1967 textbook, Wilber and Pendered summarized industrial arts goals in the following way:

Industry and Technology: explore industry and American industrial civilization;
Intellectual Processes: develop critical thinking related to industry and industrial materials; develop desirable social relationships;
Career Exploration and Vocation: provide information and experiences in order that students may choose a future vocation; develop recreational and avocational activities;
Critical Consumerism: increase appreciation for good craftsmanship and design; increase consumer knowledge for the purpose of selecting, buying, and using the products of industry;
Skill Development: develop safe working practices and develop a degree of skill.

Because of the lack of contemporary teacher education texts about technology education goals and studies which synthesize those goals, a recent effort to achieve consensus in the field through the Jackson's Mill project and the resulting implementation guide (American Technical Foundation, undated) will serve as the model for technology education goals. They include the following:

Industry and Technology: appreciate the evolution of industry and technology;
Critical Consumerism: establish values on the impact of industry and technology and how it alters our environment; develop human potentials for responsible work, leisure, and citizenship roles in a technological society.
Skill Development: develop knowledge and ability to properly use the tools, techniques, and resources of industrial and technological systems;
Intellectual Processes: develop creative solutions to present and future societal problems using technical means; and
Career Exploration and Pre-Vocation: develop human potentials for responsible work, leisure, and citizenship roles in a technological society (pp. 9-10).

Just as Warner's (1928) identified goals reflected the influence of manual training, current goals for technology education reflect the influence of industrial arts goals. Even with the influence of tradition, a shift in the emphasis of industrial arts/technology education goals may be observed. More emphasis is being put on the subjects of industry and technology, the teaching of cognitive and affective intellectual processes, and the role of consumerism, which is represented as a critical preparation for citizenship. Many of the goals listed in current technology education plans, including the goals from the American Technical Foundation, appear to include a greater emphasis on the relationship of industry, technology, and society. The interest in identifying the history of technology and creating not just good consumers of industrial products, but also responsible citizens with respect for the environment, signals a change in the direction of the goals of the subject matter. In addition, as time has passed, statements about the value of problem solving have changed from simple statements about the ability to plan and construct projects to more global statements about the role of problem solving in society. Table 1 illustrates this gradual shift in industrial arts/technology education goals.

These goals represent what selected industrial arts/technology educators believe to be important about the subject matter. They do not necessarily reflect the actual practice of industrial arts/technology educators. Just what is happening in the classrooms and laboratories of technology education is, perhaps, a very different picture. The most comprehensive and current information about this comes from a study (Bame and Miller, 1980) that identified and created standards for industrial arts in the early 1980's. Data from this study indicated that teachers at that time listed “skill in tools and machines” and “technical knowledge and skill” (p. 15) as the two most important goals of industrial arts education. Even though the name of the subject matter has been changed in most states since that time, one cannot count on the philosophy of teachers to have changed without evidence of it. The Bame and Miller study also identified more contemporary purposes. Purposes such as “develop an understanding of the nature and characteristics of technology” and “understand the application of science and mathematics” (p. 15) were ranked last in positions eleven and twelve respectively by industrial arts teachers.

This discrepancy in ranking goals reflects discontinuity between the practice and goals of technology education. This discrepancy is caused, in part, by the curriculum planning practices in technology education and vocational education. Vocational education has influenced and continues to influence technology education. There has been an historical relationship among technology educators and vocational educators in universities, state departments of education, and federal guidelines for vocational education. Prescriptive curriculum theory in vocational education and technology education relies upon a technical curriculum design.

Curriculum Designs and Prescriptive Theory

Curriculum design refers to the way the subject matter is conceptualized and its major components are arranged, in order to provide direction for curriculum development (Ornstein & Hunkins, 1988). When curriculum designs are categorized, the prescriptive literature of industrial arts/technology education can be fit into those categories for the purpose of analyzing trends in the-

Table 1
Evolution of Industrial Arts/Technology Education Goals

Categories of Goals	Twenty Year Time Periods			
	1928	1948	1967	1980's
Physical Development	X			
Integration of Disciplines		X		
Intellectual Processes		X	X	X
Career and Vocation	X	X	X	X
Critical Consumerism	X	X	X	X
Skills Development	X	X	X	X
Industry and Technology			X	X

ory. This categorization further emphasizes the discontinuity between the goals of technology education and the prescriptions for curriculum planning.

Curriculum Designs

A number of curriculum texts and papers focus on curriculum designs. In one of the early attempts to categorize curriculum designs, Eisner and Vallance (1974) identified five orientations toward curriculum: academic rationalism, the development of cognitive processes, curriculum as technology, self-actualization, and social reconstruction-relevance. McNeil (1977) introduced four curriculum designs: humanistic, social reconstructionist, technological, and academic subject curriculum. Later, Eisner (1979) described five basic orientations toward curriculum: academic rationalism, personal relevance, social adaption and social reconstruction, curriculum as technology, and development of cognitive processes. Joyce (1980) provided four models for curriculum design: social interaction, information/processing, personal, and behavior modification and cybernetic models. Saylor, Alexander, and Lewis (1981) appeared to have achieved a temporary synthesis with the five designs: subject matter/disciplines, specific competencies/technology, human traits/processes, social functions/activities, and individual needs and interests/activities. Six categories were created by Wiles and Bondi (1984): conservative liberal arts, educational technology, vocational, humanistic, social reconstruction, and deschooling. In 1986, Schubert expanded the list to eight categories of designs: content or subject matter, cultural reproduction, learning outcomes, discrete tasks, social reconstruction, activities, experience, and *currere*. Recently, Ornstein and Hunkins (1988) grouped a total of eleven designs into three categories. These categories and designs are 1) subject-oriented designs: subject, discipline, broad fields, and correlation; 2) learner-centered designs: experience-centered, romantic (radical), child-centered, and humanistic; and 3) problem-centered designs: life-situation, core (social functions) and social problems, and reconstructionist.

In order to understand curriculum designs it is helpful to group the varying conceptions into broad categories and discuss the different designs suggested by the above authors within these categories. Many of the various names and descriptions of curriculum designs appear to be similar. For the purposes of discussion, the chart in Table 2 helps to organize curriculum designs into five major categories. Although some authors have suggested more than five designs, most of the designs can be included in the following five major categories: academic, technical, intellectual processes, social, and personal.

Academic. Academic curriculum designs tend to focus on a body of knowledge which is grouped into disciplines, subject matter, or broad fields. It is a familiar pattern of organization that is evident in the way in which knowledge is organized for course work in most schools. Besides being a means of designing curriculum, the academic design carries with it the message that knowledge is organized into logical categories and that values can be attached to those categories. For example, the academic rationalism conception of curriculum created by Eisner and Vallance (1974) illustrates this design. Selected content, such as the basic subjects in the liberal arts, is held to be the central purpose of schooling and the curriculum. These subjects, through a disciplinary organization of content, focus the curriculum. Often, academic rationalism as an ideology influences issues in education such as the "back to the basics" movement. Those who promote these designs identify particular subject matter which is designed to transmit the heritage of a culture through literature, history, science, and other fundamental disciplines.

In technology education, current curriculum proposals which focus on technology as the basis of content and also focus on taxonomies of technological concepts reflect an academic curriculum design. One of the first and best examples of this design was created in 1964 by DeVore, with the construction of taxonomies similar to the taxonomies of plant and animal life forms. From this early work, DeVore and his followers have continued to pursue the design of an academic curriculum for technology education. The academic design refers to organizing the concepts of the discipline or subject matter in a way that is very different from the technical design of organizing performance or behavioral objectives. The concepts of a subject such as technology education are identified for the purpose of generating constructs which cut across traditional skills and processes.

Technical. This design of the curriculum is based upon an analysis of performance or processes. A job and task analysis or the identification and sequencing of behavioral outcomes becomes the means for creating curriculum. Efficiency is desired, requiring the curriculum to provide the most efficient means of delivering the identified performance objectives. Objectives, or outcomes based on task and process sequencing, become the organizing elements of the curriculum rather than the taxonomy of content one might find in the academic design. These designs are highly structured, and whether they are derived from task analyses or systems (inputs, processes, outputs) analysis, they

Table 2
Synthesis of Curriculum Designs

Eisner & Vallance (1974)	Academic Rationalism	Curriculum as Technology	Development of Cognitive Processes	Social Reconstruction/Relevance	Self-Actualization
McNeil (1977)	Academic Subject	Technological		Social Reconstructionist	Humanistic
Eisner (1979)	Academic Rationalism	Curriculum as Technology	Development of Cognitive Processes	Social Adaptation and Reconstruction	Personal Relevance
Joyce (1980)		Behavior Modification Cybernetic	Information Processing	Social Interaction	Personal
Saylor, Alexander & Lewis (1981)	Subject Matter/ Disciplines	Specific Competencies/ Technology	Human Traits Processes	Social Functions/Activities	Individual Needs & Interests/ Activities
Wiles & Bondi (1984)	Conservative Liberal Arts	Educational Technology & Vocational		Social Reconstruction	Deschooling & Humanistic
Schubert (1986)	Subject Matter	Learning Outcomes & Discrete Tasks		Social Reconstruction, Activities, & Cultural Reproduction	Experience & Currere
Ornstein & Hunkins (1988)	Subject Centered			Problem Centered	Learner Centered
Primary Focus	*Academic*	*Technical*	*Intellectual Processes*	*Social*	*Personal*

are behavior-focused curriculum plans. Tyler (1949) is often credited with initiating this curriculum design with the course syllabus, *Basic Principles of Curriculum and Instruction.* However, others such as Bloom, Mager, and Popham have added much to his original work.

The technical design was influenced by the popularity of behavioral psychology during the middle of this century. This influence has resulted in the incorporation of devices such as teaching machines and computers to deliver programmed lessons. Often, there is a high degree of structure involved in technical designs no matter what or who delivers the lesson. Technical designs have been extremely popular in vocational education where one of the major objectives of the curriculum is to prepare people to function in specific jobs.

The vocational methods of analysis and delivery lend themselves to detailing the tasks of a job and organizing curriculum and instruction with specific performance objectives in mind.

Traditional vocational education efforts in trade and industrial education best illustrate a technological design of curriculum. Vocational curricula are created with task analyses and are structured to provide the student with a sequenced series of learning steps. The curriculum planning recommendations of Allen, Selvidge, and Fryklund (Allen, 1919; Selvidge, 1923; Selvidge and Fryklund, 1946; & Fryklund, 1956 & 1970) are excellent examples of a technical approach to developing curriculum.

A second effort serves as an industrial technology education example of technical design. Using systems to analyze content in 1966, Towers, Lux, and Ray organized the processes of industrial technology in a conceptual document called *A Rationale and Structure for Industrial Arts Subject Matter*. In their subsequent textbooks, *The World of Construction* (1970) and *The World of Manufacturing* (1971), they further refined the technical design for curriculum in industrial technology education by focusing on the processes of manufacturing and construction and by structuring the teaching materials with student performance objectives. The processes served as tasks.

Intellectual Processes. The least frequently represented curriculum design deals with the development of cognitive processes. This design makes the development of either cognitive processes such as critical thinking and problem solving or human processes and traits such as creativity and self-confidence the focus of curriculum, rather than a structured discipline or a sequenced task. The goal of this design is to increase learning efficiency and the transfer of problem solving abilities to all areas of the curriculum and life. Emphasis on processes has recently been increased through current research on students' cognition and metacognition. The emphasis in this design is on such processes as problem solving, first, and then on the context and content of the learning situation. Current research about cognition reveals the importance of the context and content of the activity, in addition to factors associated with the student such as prior knowledge with respect to intellectual processes.

Clear-cut examples of process curricula are difficult to identify. Recent thinking skills curricula which have been developed as separate courses or as subject-matter-specific programs in the social studies and language arts are the best examples of curriculum which are designed with a clear focus on intellectual processes to the exclusion (or relegation to lesser consideration) of content. In technology education, examples of intellectual processes curriculum designs often appear in design courses. In these courses, the instructor identifies a problem solving model as the basis of subject matter and particular activities related to industry and technology for improving or teaching about critical thinking and problem solving. These activities, similar to the activities one would find in an Odyssey of the Mind competition, are examples of an emphasis of intellectual processes within a subject matter.

Social. This design focuses on the application of knowledge in realistic or real world situations. A variety of assumptions may contribute to this design with some mutual exclusivity to the assumptions. In brief, there are two distinct and opposite sides to this design. For example, one variation of the design could focus on social reconstruction with the assumption that the future of society can be changed as a result of the educational activities of the current generation. This assumption leads to a curriculum plan which would focus on providing students with opportunities to work on social projects for the purposes of changing their environment. On the other hand, the social design could also focus on social adaptation with the assumption that students are the raw material of society, and they need to be shaped to conform to existing social values. In this variation, a social design takes the opposite direction with respect to students, society, and the future by focusing on the information students need in order to fit into adult society.

Examples of social reconstruction (changing society) assumptions are in the work of Dewey, Counts, and others of the Reconstructionist Era during the beginning and middle of this century, and in the work of the contemporary reconceptualists such as Apple, Giroux, and Anyon. Social reconstruction is demonstrated in technology education curriculum when students take on such projects as auditing the energy use of their homes and school buildings and proceeding to improve the efficiency of energy use in those buildings. Reconstruction designs are often integrated with other curriculum designs.

Adaptation (conforming to society) assumptions are present in the early curriculum work of Bobbitt. These same assumptions are often a part of technical designs of vocational curriculum when the goal is to prepare students to fill selected roles in an occupation. Vocational education curricula often involve social adaptation by preparing students for occupations. Technology education fulfills this goal by creating manufacturing roles as workers on simulated assembly lines or by specifying the following of directions in project work.

Personal. Personal curriculum designs are learner-centered with a focus on the individual needs and interests of the student. Students help or totally create curriculum by expressing interests and investigating those interests. Teachers serve as diagnosticians and facilitators for this effort. It is the teacher's role to help students to identify interests and guide them to appropriate resources and connections to other knowledge. The autobiographical nature of curriculum as *currere*, a personal experience, and the desire to deschool society because of the rigidity of schools fit into personal curriculum designs. The curriculum writing of Friere illustrates the nature of personal involvement in curriculum. The goals of the personal design are to put the control and choice of the curriculum into the hands of the students instead of subject matter specialists and to allow students to personally integrate the information which they choose. This curriculum design is associated with the progressive education movement, and more recently, open schools.

The Maryland Plan (Maley, 1973) emphasizes a personal curriculum design. Within the context of a subject, industrial arts, this plan creates a way for students to regain control over the curriculum. Under the auspices of industrial arts education, the Maryland Plan focuses on allowing the students to choose topics of investigation within specified areas of study such as production and research and development. This particular curriculum plan is one of the few documents which illustrates a personal curriculum design in technology education. However, traditional industrial arts teachers in woodworking, drawing, and metalworking often integrated personal curriculum designs into their programs through the use of self- selected projects as a major vehicle of the curriculum.

Curriculum Designs and Technology Education Goals

Curriculum designs are not always mutually exclusive in practice. Often, several designs can influence the creation of specific curriculum. In addition, curriculum designs are directly related to the purposes, goals, and objectives of a specific curriculum. A knowledge of curriculum designs serves two purposes. It can be used as a framework for diagnosing the purpose of a curriculum or the ideology of a teacher, and it can help to create curriculum which operationalizes the desired goals.

Many of the goals of technology education point to varying designs of curriculum. This becomes clearer when the goals of technology education are equated with the five curriculum designs in an attempt to diagnose the orientation of the field (see Table 3).

When contemporary technology education goals are correlated with curriculum designs, the diversity of the goals becomes apparent. Technology education goals tend to incorporate all of the five curriculum designs. For example, all of the goals listed in the recent American Technical Foundation project (see Table 3) illustrate how they could fit into the curriculum designs. Goals such as "appreciate the evolution of industry and technology" may guide practitioners to design curriculum based upon a selection of content-an academic design. Skill development goals encourage the use of a technology design. The goal of developing "creative solutions to societal problems" indicates a relationship to the intellectual processes and social designs. Critical consumerism goals such as establishing "values on the impact of industry and technology on our environment" indicate a social design. Finally, the desire to "develop human potential for responsible work, leisure, and citizenship roles" relates to both the personal and social curriculum designs.

Contemporary technology education goals relate to all of the curriculum designs. It is particularly interesting to note that three of the goals relate either directly or indirectly to the social design, demonstrating an increased emphasis on the importance of this curriculum design to technology education. Moreover, the statements appear to reflect the social reconstruction viewpoint of the social design rather than the social adaptation viewpoint of that design. This appears to be a major shift in the orientation of technology education. The

Table 3
Relationship of Technology Education Goals to Curriculum Designs

Curriculum Designs	Technology Education Goals*
Academic	Industry and Technology: appreciate the evolution of industry and technology.
Technical	Skill Development: develop knowledge and ability to use tools, techniques, and resources of industrial and technical systems.
Intellectual Processes	Intellectual Processes: develop creative solutions to present and future societal problems using technical means.
Social	Critical Consumerism: establish values on the impact of industry and technology and how it alters our environment.
Personal	Career Exploration and Vocation: develop human potential for responsible work, leisure, and citizenship roles in a technological society.

* Goals are taken from Technical Foundation of America (undated) curriculum guide.

orientation of technology education goals could provide much direction for curriculum planning if teachers were given adequate information about how to distinguish and implement a variety of curriculum designs. If teachers receive little guidance and information or receive only information about a technical curriculum design, then curriculum plans will reflect a technical approach and will revert to skill development as the primary activity in the classroom.

The diversity of technology education goals and their relationship to the various curriculum designs leads to the conclusion that there are many ways to proceed with curriculum planning in technology education. Historically, variations of two major curriculum designs have been prescribed most often in the literature - the technical and the academic designs. Recent changes in technology education goals may require a reconceptualization of curriculum planning theory for technology educators.

Planning Curriculum in Industrial Arts and Technology Education

Curriculum designs can also be used to diagnose the advice that technology educators give about how to select content and plan curriculum for the field. As a review of historical and contemporary curriculum advice, authors' ideas are categorized and discussed according to the curriculum designs (see Table 4). Early textbooks were used for the historical review of curriculum planning prescriptions and, because of the lack of a current professional textbook about planning curriculum in technology education, journal articles and yearbook chapters from technology education sources are used for contemporary prescriptions.

Although representation of each design can be found in the literature, most curriculum planning prescriptions in industrial arts/technology education have been and still are technical curriculum designs. Dominance of the technical design results in the increased chance of skill development as the primary outcome of industrial arts/technology education curriculum. Unquestioned acceptance of a technical curriculum design leads to a lack of attention to creating alternatives and a decreasing chance of providing alternative prescriptions. Technology education then could suffer from the same theory/practice discontinuity that industrial arts has endured.

The Dominant Technical Design. Prescriptions for curriculum planning increased after the turn of the century. Industrial and vocational educators contributed to prescriptions for planning curriculum and created some of the first texts for the purposes of teaching curriculum planning. Bobbitt's early curriculum book (1918) cites the work of vocational educators:

> They talked with expert workmen; and observed the work-processes. In their report, for each occupation they present: (1) a list of tools and machines with which a workman must be skillful; (2) a list of the materials used in the work with which workers need to be familiar; (3) a list of the items of general knowledge concerning jobs and processes; (4) the kinds of mathematical operations actually employed in the work; (5) the items or portions of science needed for control of processes; (6) the elements of drawing and design actually used in the work; (7) the characteristics of the English needed where language is vitally involved in one's work, as in commercial occupations; (8) elements of hygiene needed for keeping one's self up to the physical standards demanded by the work; and (9) the needed facts of economics (p. 47).

The basic system of occupational analysis, task analysis, or job and trade analysis on which Bobbitt reported was developed through years of practice and recorded by Allen in 1919 in the text, *The Instructor, The Man, and The Job*. Bobbitt's book served as the first curriculum book for all educators, whereas Allen's became the first curriculum book for vocational educators, specifically industrial educators. Both books took a technical approach to curriculum design. By examining ends, the instructor was guided to codify and teach the means to achieve the desired end. Curriculum and instruction were to be sequenced logically and linearly and to be based upon observable ends such as job performance.

Because of the association of industrial educators, which includes vocational-industrial, industrial arts/technology, industrial and military training, and technical educators, particular subject areas such as industrial

Table 4
Curriculum Planning Recommendations Categorized by Curriculum Designs

Designs	Sub-designs	Authors and Dates of Recommendations
Academic		DeVore, 1964
		McCrory, 1980
		Maley, 1982
		Yost, 1988
		Zuga, 1988
Technical	Task Analysis	Allen, 1919
		Selvidge, 1923
		Bollinger and Weaver,1955
		Fryklund, 1956, 1970
	System Analysis	Towers, Lux, and Ray, 1966
		Witherspoon, 1976
		Ritz, 1980
		Schwerkolt and Spontelli, 1987
		Wescott, 1988
		Jones, 1988
		Bjorklund, 1988
	Performance Objectives	Wilber, 1948
		Almost all authors have focused on objectives
Intellectual Processes		Sarapin and Starkweather, 1981
		Maley, 1982
		Moss, 1987
		Hatch, 1988
Social		Pytlik, 1981
		Wright, 1988
Personal		Maley, 1973
		Mentioned by:
		Sarapin and Starkweather, 1981
		Maley, 1982
		Moss, 1987

arts/technology education have shared many ideas, organizations, and, often, classrooms with the vocational educators. This association is apparent in the sequence of curriculum books which prescribed task analysis and followed Allen's (1919) original book (Selvidge, 1923; Selvidge and Fryklund, 1946; Fryklund, 1956 and 1970). Today, current texts about task analysis have strong ties to the ideas which Bobbitt outlined in 1918. Moreover, many industrial arts, soon to be technology, educators were exposed to task analysis as the primary method of curriculum planning for the field. The books by Selvidge and Fryklund emphasized that the task analysis methods were to be used for industrial arts curriculum planning with only the admonition to add more projects of a general education nature.

Some industrial arts/technology educators have identified a difficulty with task analysis as an appropriate prescriptive theory for curriculum planning in industrial arts/technology education. Lux created a reaction to his pronouncements against trade and job analysis in a 1979 editorial, causing some industrial arts educators to line up on opposite sides of the fence. The most frequently suggested alternative to the technical task analysis curriculum design, however, is the technical systems analysis curriculum design. Fully introduced to the industrial arts/technology education community by Towers, Lux, and Ray (1966) in their curriculum plans for industrial technology education, this design remains as technical and linear as task analysis. Using systems theory, industrial arts/technology educators were to identify the system of analysis and break down the component parts of the inputs, processes, and outputs in order to identify content for the subject matter. This kind of curriculum design is frequently recommended (Witherspoon, 1976; Ritz, 1980; Schwerkolt and Spontelli, 1987; Wescott, 1988; Jones, 1988; and Bjorklund, 1988) as a generic curriculum planning process for all curriculum assumptions, orientations, or designs. Using this design produces a focus on processes which are not very different from tasks.

In addition to the two methods of content analysis which have been developed by industrial arts/technology educators, almost all of those in industrial arts/technology education who offer curriculum advice (see Table 4 for an early work on this topic) utilize another aspect of the technical curriculum design, the structuring of the curriculum by some form of a performance objective. This popular and often mandated procedure further serves to reduce the complexity of curriculum to an observable behavior, omitting, by default, the attempt to instill values and the complexity which would relate to the social or personal curriculum designs.

It is interesting that this technical design is not viewed as a potential barrier to planning academic, intellectual processes, social, and personal curriculum and that it is widely endorsed. It may be that the nature of technology education and the teachers and teacher educators within the field causes a subconscious gravitation to the technical curriculum design (Zuga, 1987). It may be that the reductionism of the technical design provides a straightforward set of rules and procedures which simplify the complexities of curriculum planning and, therefore, simplify the teaching about planning curriculum. It may be that teachers and teacher educators have used forms of curriculum planning which are recommended by state and local education agencies. It may also be that as specialists in technology education, teachers and teacher educators are not prepared as curriculum specialists and are not aware of alternatives.

The technical curriculum design is by far the dominant design in technology education today. Even those who attempt to suggest alternatives ultimately employ a technical design. Therefore, although alternative curriculum designs are suggested, few are fully described.

Attempts at the Intellectual Processes Design. The intellectual processes design appears to be a curriculum design which is capturing selected technology educators' imaginations. However, it is not one which they readily identify as an intellectual processes design. In fact, most of the authors refer to this design as student- or learner-centered (personal). After designating ideas as learner-centered, explanations of what they mean, in view of the categories of curriculum designs, are best described as intellectual processes designs. Sarapin and Starkweather (1981) and Moss (1987) clearly take the path of introducing a new direction for the field as learner-centered and continue by recommending that curriculum planners identify intellectual processes which should be taught, create activities which students would like with those processes, and plan curriculum and instruction. By identifying the processes first, the authors are creating a design which focuses on those processes. The learner-centeredness of the design appears only as a slight afterthought when the educator selects activities that students will like. Maley (1982) does not place the personal element of the design as an afterthought; instead, he indicates that it is a factor equal to the intellectual processes and content (academic).

Unfortunately, current curriculum textbooks for technology education are lacking. This has caused authors to attempt to get across all of their ideas in one short article. Moreover, few in technology education have tried to describe a curriculum design and to operationalize that design into a prescriptive set of directions which are intelligible and easy to follow. Another of the difficulties in categorizing curriculum recommendations has been the lack of clarity of the authors. This may very well be caused by the lack of a framework which is known to technology educators for designing curriculum. These may also be some of the reasons for the confusion of the intellectual processes design.

The most promising outline of an intellectual processes curriculum design comes in a recent yearbook of the Council on Technology Teacher Education (CTTE). Hatch (1988) has attempted to define a problem solving approach to technology education. In his chapter of the yearbook, he begins with a problem solving focus by outlining the steps of problem solving and by selecting technology education content to fit the desired ends of teaching problem solving.

The Elusive Personal Curriculum Design. Several technology educators recommend personal curriculum designs. Selected goals of technology education indicate a personal design as a viable choice. As we have already observed, however, authors specify a personal design but fail to follow through with an adequate description and operationalization of the design. Sarapin and Starkweather (1981), Maley (1982), and Moss (1987) all seemed to be indicating the need for a personal curriculum design. Unfortunately, their papers did not describe one. The literature reflects a desire of technology educators to develop a personal curriculum design, but there is a lack of information about implementing such a design.

The only contemporary example of a personal design was presented by Maley in 1973 as a part of *The Maryland Plan*. Within this program, students have the ability to select personally relevant activities in the context of industrial arts as well as their own approach to industrial arts; for example, the anthropological or the research and development approach. Essentially, traditional project work, a personal design element, was included in this program which sought to change the emphasis of traditional industrial arts.

It is interesting that a field which has staked its reputation on project work now has a lack of information for teachers about ways to implement such activity through technology education. Perhaps because of the history of the subject matter, industrial arts/technology educators are experts on this design and need very little help.

An Academic Design for Technology Education. Interest in technology as a discipline and the translation of that discipline in technology education classes has sparked an effort to identify and operationalize an academic curriculum design. An attempt to introduce an academic design appeared with the introduction of a taxonomy of technology by DeVore (1964). Early work in technology education by DeVore was focused on identifying appropriate curriculum, and his suggestions involved creating taxonomies which were similar to the taxonomies used in the sciences in order to categorize the species of life. His reporting on the idea of taxonomies has been discontinued in the literature but employed by others in a variety of forms. The results of the systems analysis pursued by Towers, Lux, and Ray (1966) were listed in the form of a taxonomy. They created a taxonomy of the processes which were identified through the analysis of inputs, processes, and outputs. A recent initial attempt at creating a conceptual taxonomy was shared by McCrory (1980) in a discussion about technology education as a discipline. His position clearly called for and applied an academic curriculum design. Maley (1982) has listed content as one of the three factors in his curriculum planning design. Unfortunately, Maley does not explain how to identify and organize content. Recently, two chapters of the 1988 Council on Technology Teacher Education (CTTE) yearbook used the basis of an academic design to discuss a conceptual and an interdisciplinary approach to teaching technology education. Yost (1988) discussed the identification of concepts, a very different approach than the technical design with task analysis, system analysis, and performance objectives at its base. Zuga (1988) introduced a popular curriculum process called webbing in order to identify the relationships between subjects. Webbing has been used for many years by elementary educators in order to identify subject content.

The recent emphasis on technology as a discipline, perhaps fueled by the contemporary emphasis on academic rationalism in education, has created an interest in the academic design among technology educators. This is a new and growing trend. Industrial arts/technology education is moving from hand tool instruction to an organized study of industry and technology. This change creates a need for members of the field to identify means of operationalizing an academic curriculum design.

The Ephemeral Social Design. There are few examples of social curriculum design for technology educators, despite the emphasis on the social goals of technology education. Many of the technical designs include categories which are referred to as social impacts, but they are ill-conceived and provide little direction to the teacher as to how to implement curriculum and instruction about social issues. One example by Pytlik (1981) attempted to focus on the social design and demonstrated, through example, how teachers might proceed to implement a social design in technology education. Pytlik recommended an interplay between a content structure of technology education and social issues. In his article, he recommended that curriculum planners use a structure of technology which has incorporated both technical concepts and an historical framework. Through this structure, topics were identified and operationalized so that the main emphasis in the classroom became a focus on social issues. Wright (1988) also attempted to focus on the social goals of technology education by identifying content and selecting appropriate social problems and activities to complement the content.

A Framework for Curriculum Planning in Technology Education

Traditional curriculum advice for industrial arts/technology education has been a variation of the technical curriculum design. Only recent literature has revealed an effort to introduce and operationalize curriculum designs which are inclusive of most of the five categories of curriculum. This effort is most likely the result of the change in the goals of technology education. The problems technology educators are facing in making this change are the preponderance of and reductionism in the technical design, the lack of preparation in curriculum studies, and the difficulty of operationalizing directions for implementing the other categories of curriculum design.

As technology education or any subject matter evolves, the goals of that subject matter begin to show a different emphasis. When an emphasis on content changes, educators must examine their practices with respect to curriculum and instruction and determine if their practices are compatible with the new goals of the subject matter. If curriculum and instruction practices are not compatible with the goals, then the implementation of intended goals may not take place.

How we determine the content of the curriculum in technology education will influence students' experiences in the classroom. If we select a series of social problems, a list of technical processes, a structure of critical thinking and problem solving skills, a taxonomy of concepts of technology, or allow students to selected technology-related problems which are significant to them, then the curriculum as a plan and as taught will appear to be different in each case. This difference will also appear in the way in which we analyze technology for the purpose of creating curriculum.

At present five categories of goals for technology education exist. Even with this variety of goals, we appear to be stressing one design of curriculum, a technical design, which has two primary methods of analyzing content, task analysis and systems analysis. Both of these methods tend to yield overt behaviors or processes which become the basis of the content for technology education curriculum. With current practices, it appears to be difficult for teachers to implement the variety of technology education goals which are prescribed for contemporary technology education.

In order to teach teachers about curriculum designs and processes, frameworks for analysis such as the one used in this paper could be employed. Ultimately, we would begin to address some of the complexities of curriculum planning instead of reducing it to a single process which may not be adequate for implementing all of the goals or intentions of technology education. The following is a framework which could serve to guide the creation of alternative curriculum planning models (see Table 5).

Teacher educators need to take the responsibility for initiating an examination and possible revision of what is taught to teachers with respect to curriculum. It is apparent that teachers employ a technical design for the purpose of creating curriculum documents for local, state, and national education agencies which require those designs and often employ quite different curriculum processes for their own purpose, teaching. Teacher educators are not addressing the most important part of a teacher's work, designing appropriate curriculum. Teacher educators need to continue to identify both teachers' curriculum planning practices and means of teaching curriculum planning for teachers which will improve teachers' abilities to implement the goals of technology education.

Table 5
Framework for Curriculum Planning Models

Design	Goals and Purposes	Content Source	Structuring Elements
Academic	Transmit cultural heritage	Constructs and concepts	Taxonomies
Technical	Develop occupational proficiency	Observable behaviors	Task analyses
Intellectual Processes	Improve thinking and problem solving abilities	Cognitive processes	Problem solving and trouble-shooting processes
Social	Reconstruct or adapt to society	Societal needs or successful work behaviors	Social problems or work adjustment skills
Personal	Motivate personal interest in learning	Student interests - within subject context	Student research and projects

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Book Reviews

Volti, Rudi (1988) *Society and technological change.* New York: St. Martins Press, Inc., $16.60, 279 pp. (ISBN 0-312-00311-0)

Reviewed by Linda Rae Markert[4]

At the periphery, and in some cases at the core of Technology Education curricula, is a well-established aggregate of courses that focus on "technology and society." Rudi Volti's recent contribution is one among an ever-expanding collection of textbooks designed for use in college and university level courses that fit this general subject heading. Technology educators, together with sociologists, political scientists, historians and engineers, are commonly called upon to teach these "general technology issues" courses. In that courses of this nature can rarely be presented through the use of a single reference, *Society and Technological Change* is a worthwhile text to complement others currently being used.

Volti's publishers have highlighted a number of features to market this publication. They tell us that Volti: (1) uses non-technical explanations that are backed by specific examples through the use of case studies and illustrations; (2) follows a thematic approach that concentrates on social, political and economic issues which influence and are influenced by technological change; (3) provides an international perspective that contrasts technological change in countries such as Indonesia, China, Japan, England and Africa to changes that are taking place in the United States; (4) devotes attention to contemporary issues like arms control, violence on television and workplace trends; and (5) includes several discussion questions at the end of each chapter as well as a bibliography of selected readings at the end of the textbook.

A cursory review of this material provides a measure of validity for each of these assertions. As one delves a bit deeper, other key points become evident. To his credit, Volti presents his philosophy regarding technological change early in the text and continues to support and expand on it throughout proceeding sections. Suggesting that technological change is rarely neutral, he recalls a number of historical examples that illustrate its capacity to affect groups and persons in diametrically opposite ways -- technological change essentially leaves some in a better position while others seem to lose ground as its occurs.

Volti's treatment of topics related to the often confusing relationships between science and technology and development is thorough and quite con-

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vincing. He shows us how dynamic inter-connections between science and technology have a direct impact on the diffusion of new inventions, ideas and theories. His recognition of the fact that scientific knowledge is not always the prime source of technological advancement makes his discourse all the more tangible.

The segment of the textbook that deals with "Technology and the Transformation of Work" spends a larger percentage of time than might be desired on historical facts and figures. Volti does, however, manage to address the concerns of our contemporary workforce through an analysis of the many ways a new technology can render certain skills obsolete and simultaneously create several different job opportunities. The history of life on the job is traced from the early days of managerial control in the factories through Taylor's Scientific Management era to the newly devised white collar work mode we label "telecommuting."

Perhaps one of the most interesting (and unique) aspects of the text is Volti's trio of chapters on military technology. Historical events are effectively interwoven with a presentation of today's issues regarding arms control, the ethics of a military policy known as Mutually Assured Destruction (MAD), and the need for measures to arrest the international arms race. The title of one chapter summarizes this dark side of technology development quite succinctly -- "How We Got So Good At Being Bad."

Concluding chapters focus on society's never-ending challenges to draw in the reins on the technologies it continues to create in order to bring them under some acceptable level of control. Volti's final theses are perhaps his best as he distributes the responsibility for this great task among several prevalent social constituents -- business, industry, entrepreneurs, engineers, and government. His perspective on the future for both technology and society is refreshing without being overly optimistic.

In sum, *Society and Technological Change* is a well-written textbook. It is sparsely illustrated but heavily footnoted. Section titles are creative as well as logical. The material is organized effectively and presented at an appropriate reading level. I recommend this book for use in community college and university general technology and society courses. °

Cross, A. and R. McCormick (Eds.). (1986). *Technology in schools*. Milton Keynes: Open University Press. 352 pp. (ISBN No. 0-7102-0732-8)

Reviewed by Marc de Vries[5]

For the development of technology education in many countries - the USA among them - the situation in the United Kingdom serves as an example of a fruitful approach to help students in understanding the nature of technology. Design is an essential part of technology and the United Kingdom pays a great deal of attention to it. Students in both primary and secondary schools learn to solve technological problems in a creative way. The teacher guides the students in their problem-solving activities and also serves as a resource of knowledge and experience. Students often deliver solutions to technological problems that are then considered for patenting by industries. For that reason, a book on technology education in the United Kingdom certainly deserves attention.

Technology in Schools, edited by Anita Cross and Bob McCormick and published by the Open University, is a collection of 36 previously published articles and (parts of) book chapters on various aspects of technology education. Although most articles are concerned with the subject of Craft, Design, and Technology (CDT) - the British version of Technology Education - the content of the book is relevant to similar subjects in other countries. It contains a number of articles on the following topics: "What is technology?," "Technology and human values," "Technology and society," "Technology in education," various "Issues," "Teaching and learning technology," and "Planning the technology curriculum." As can be seen from this abbreviated table of contents, there is great variety in the issues that are dealt with. This makes the publication interesting for people who are concerned with technology education in various ways including researchers, curriculum developers, teachers, and teacher educators.

For the development of technology education, the answer to the question "What is technology?" is essential. Naughton focuses on two ways in which technology can be defined - as a collection of products and as a process. Both aspects are relevant for education. Lewin distinguishes engineering from science. In science, reductionism and mechanism play an important role; in engineering these principles do not fit. Engineering is concerned with solving problems using a process of problem specification, synthesis, analysis, and implementation. Therefore, engineering and technology need a philosophy of

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their own. The differences between the scientific and design method are explored further in the next chapter by Cross, Naughton and Walker.

The second part of the book is about "Technology and human values." Fores and Rey discuss "Technik: the relevance of a missing concept." The authors feel a need to distinguish between "technology" and "technik," as can be done in a number of other European languages (e.g. Dutch, German, Swedish). These languages use the word "technik" for the practical hands-on activities and the word "technology" for the study of the theoretical background of these practical activities. Using only "technology" in the English language makes it hard to realize that there is both a science-based and more empirical form of "technology," called "technik" in other languages. This latter form of technology is not to be seen as less relevant than the first one. Other kinds of human knowledge and experience can be as valuable to technology as science. Archer makes a plea for distinguishing design as a "third culture" apart from science and the humanities. Weiner shows the position of this "third culture" in the whole of the English culture.

The third section of the book is concerned with the relationship between technology and society. Clarke provides a number of different responses to technological developments by different ideologies that can be found in our societies. For example, to the problem of pollution a "price response" ideology reacts by calling pollution "inevitable and worth the benefit it brings," while a "radical political response" ideology will say that "pollution is a symptom of capitalism." It is important that pupils get an impression of various ideologies in society and the ways in which these ideologies react to technological issues.

In the fourth part of the book, lines to education are drawn. After a short "Manifesto by the Royal Society of Arts," Gorb stresses the relevance of technology education for an "education for capability." McCulloch, Jenkins and Layton suggest that the introduction of a "technological revolution" in schools is not easily accomplished. The articulation of the intrinsic value of design as a part of general education is needed, according to Cross in the next chapter. Down, especially, refers to the "technological society" in which we live as an argument for technology education for all children. Black and Harrison mention "Task-Action-Capability" as a goal for technology education. The next chapters by Dodd, Down, Tipping, Woolnough and Eggleston deal with the various options for introducing technology in the curriculum: as a separate subject, as a cross-curricular activity, and as a part of science. All options have their pros and cons, and the choice will depend on the specific school situation.

A section on "Issues" includes discussions on the role of girls in technology education, technology education for special needs and the relationship between schools and industry. Bruce, Catton and Evans suggest ways to make technology education more attractive to girls-for example, by paying attention to women's criteria in the design of technological products. Lund does the same for students with special educational needs. Jamieson shows the relevance of a good connection between schools/teachers and industry. Both need each other. Schools need industry to help students understand what technology is about, and industry needs schools to spread a good, balanced image of what goes on there.

In part 6, "Teaching and learning technology," various activities in specific technology education projects are discussed. As could be expected from a British publication on technology education, problem solving and design are the most prominent activities that are described.

The concluding part, “Planning the curriculum,” deals with strategies for developing technology education in schools. Page elaborates on the various options for introducing technology education in the school curriculum that were mentioned by Dodd. A survey of the Department of Education and Science (DES) in the United Kingdom has shown what strategies have been put into practice. The book ends with an article by Grant who opens with three possible approaches for technology education projects - starting from either skills, knowledge of human values - and then explains that the last-mentioned approach is the girl-friendliest because of its emphasis on the human aspect of technology, in which girls seem to be especially interested.

From the enormous amount of books and articles on technology education that have been published in the United Kingdom, the editors have made a choice. Each choice has its strong and its weak points. In this case, the editors have chosen breadth rather than depth. Many chapters have a length of just a few pages. That means that only some points can be highlighted and no details are discussed. This makes the book interesting as a first introduction to ideas about technology education in the United Kingdom. Such an introduction is more useful to readers in other countries than a more detailed discussion. Therefore, this publication provides information on the situation in one particular country, as well as a rich resource of thoughts on technology education applicable to the reader's own situation. ˚

Editorials

Images of Schools: 2020
Possible, Probable or Preferable?

Lee Smalley[6]

There is no need to belabor the point that all aspects of our school system need to reexamine their role and operation. Hardly a week goes by where there is not further proof that we have a school system inconsistent with our aspirations for ourselves or our country. This school system includes teacher education, teachers, students, administrators, school boards, parents, research institutions, governmental bodies and any other group or institution that impacts on the operation of our schools.

What are we going to do about the school as a helping place?

What changes would come about if students, teachers, parents and administrators perceived schools as a helping place, not a sorting place? Studies continue to show that marking a misspelled word wrong and returning the paper days later, with no follow up or corrective action except for a lower grade, makes a mockery of instructional strategy. Thus, the emphasis is on punishment rather than instruction. "I told you once," replaces understanding and empathy.

The awarding of a grade of "F" should be discarded for anyone below the age of legal alcohol consumption or voting. We should consider young people incompletes, not failures, and adjust our policies and procedures accordingly. We need to keep performance constant and vary the time for students to achieve. We should perform as the doctor or lawyer and not give up on our clients until after they do, and even then, reluctantly and sadly.

What are we going to do about the school as a democratic place?

The vision of schools as a place to practice democratic skills and attitudes has either been dimmed or severely damaged by autocratic practices in the classroom and in the administrative offices. The traditional vertical hierarchy of line and staff, with the Board of Education on top and the teachers on the bottom (usually students are not shown), is based on the existence of an illiterate group who needs to be directed by the elite who are selected or born to

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rule. These conditions existed once in the army and the church, but they do not exist now in American schools.

The organizational chart should not reflect a ranking of salaries but should indicate responsibilities and competencies with horizontal networking necessary to encourage cooperation (like quality circles) rather than separation. This chart should graphically display the school system, emphasizing the importance of teachers, where they are not on the bottom. Students need to practice democratic skills and attitudes through decision making in classes as well as in schools. Let us mirror the representative republic we want our citizens to understand and participate in.

What are we going to do about the teacher as director?

Teachers generally teach as they were taught, as well as continuing those techniques that seem to be consistent with peer approval and support from administration and parents. Therefore, the teacher as teller continues far longer than is appropriate in this communication age. We have successfully rejected the radio, telephone and television as an instructional device and are doing the same thing with the computer. We are increasingly using computers to teach about themselves and not using them to teach history, geography, etc. Teachers still stand and talk while students sit and listen. Teachers work too hard during class time and students are too passive. Class time should be for students to test, reform and remodel information gained outside the classroom, increasingly through an expert system. These systems will be interactive, portable and accessible in shopping malls, homes, and schools.

Teachers should let the technical devices do the easy work- transferring information-and leave the more difficult task of developing generalizations and providing a social context to the information learned to the teacher-student.

What are we going to do about recognizing the importance of talent?

Most educators assign 100 percent of success or failure to environmental factors: college teachers blame high school, middle school, and elementary school teachers and parents. Nowhere does the role of inherited talent seem to play a part. If the only tool you have is a hammer, then all problems will look like nails! Yet in recent studies of identical twins raised apart conducted at the University of Minnesota researchers suggest that 60 percent of a person's personality characteristics such as learning style, risk taking, information-processing, extroversion or introversion and empathy are all extremely important in determining behavior. Yet, those traits are usually attributed only to learned behavior that can be changed or modified by teaching, whereas quite the contrary seems to be true.

Teachers should be helping students discover their talents and designing activities to encourage their strengths, rather than running an “animal” school where all the animals have to fly, climb, dig, run, jump and hide.

What are we going to do about teaching higher order thinking skills?

Bloom's taxonomy of the cognitive domain should have a large gap between the lowest three levels (knowledge, comprehension and application) and the highest three levels (analysis, synthesis and evaluation). The lowest three are product-oriented with one right answer - best taught by telling. The highest three are process-oriented, with no "right" answer - best taught through problem solving.

Each subject and grade level should have at least one activity that goes into the higher order thinking skills area. Most curricula are based upon breadth (material to be covered) and neglect the experience of studying, practicing, revising and refining a skill until a high order of competence is achieved. Usually, this is only experienced in extra-curricular activities such as sports, music, plays, etc., but shouldn't all students experience this part of the learning curve?

What are we going to do about including the future in schools?

We have neglected the integration of the three time frames for too long. History courses should emphasize the processes, attitudes and skills of historical research, as if this were the student's last history course and what they learned would have to serve them for the next 60-80 years. These research techniques would be used in all other subject areas to develop the student's historical perspective within a discipline's context (math, science, physical education, technology, etc.).

A course in future studies would emphasize the concepts, attitudes and projection techniques that can be used in other subject areas so as to enable students to better design and handle the future. One of the essential steps in the "futuring" process is to understand how present characteristics have developed from past events or trends, in order to project this into the future. Teachers will have to provide a better balance between "what" to learn and "how" to learn. Should we teach people to fish as well as give them a fish?

What are we going to do about other items on the agenda?

- How can we increase the amount and improve the quality of in-service time so that we can focus on improvements? Too many teachers "live in a cave," and need some fresh air.
- How can we get some of the university research to apply to problems in K-12 schools? (University researchers generally live in a "tower.")
- How can we get community involvement in career education? It is not working the way it is now.
- How can we get a greater focus on transferable skills? Rapid change demands this concern in schools.
- Why do we still require teachers to "carry bedpans" rather than utilizing more para-professionals?
- Why don't more subjects use "the game" as a motivator as sports, music and dramatics do?
- Why do we allow skilled professionals (teachers) to be unemployed for three months a year in their profession?
- Do we ever offer students an option to materialism?
- Why don't we provide more leadership in environmental solutions?
- Why are cooperative work groups more prevalent outside of schools than inside?

Things to think about while driving to work:

- How can educational leaders take the initiative from governmental officials for policy decisions?
- Is there any evidence to support the assertion that students interrupt their education when they attend school?
- What would happen if teachers were empowered with status, knowledge and access to decision making?
- How do we reduce the confrontation between the teacher who operates on an ad hoc basis and the administrator who is driven by policy?
- What happens to the joy of learning that is so evident in the early years of a child's life?
- Maybe Allison Davis (sociologist from University of Chicago) was correct when he said that schools teach the unimportant things so the informal educational system can teach the important aspects of living in a society.
- Francis Drake, 1578, when his fleet ran into some troubles part way around the world said, the rules of discipline which should govern any hazardous undertaking should be:

  Equal sharing of hardship and labor
  No privilege for rank
  Entire subordination to the commander
  Need to be a company, all together

  "Let us not give occasion to the enemy to rejoice in our decay." ˚

The Search for Excellence in Technology Education

Karen F. Zuga
David C. Bjorkquist[7]

There is an intense desire to create excellence in technology education, or, if preferred, industrial arts. This is not something that has been brought on by recent efforts to renew the field although the zeal of the quest has been heightened in recent years. In the process of trying to encourage advancements in programs, one of the thrusts has been to identify exemplary practices and hold them up as examples. In some cases these practices have been by real teachers and schools, while in others they have been projected and described by visionaries. In large part, the models are of the content to be taught and are set in opposition to existing subject matter organization. Less attention is given to methods of instruction.

The new favorites are those subjects that are representative of so called "high technology." These subjects are appealing to many who are fixated by the mechanization of modern life and they give the outward appearance of being advanced subject matter within the schools. Status symbols of success in the field are the artifacts of advanced technology in the laboratories where teaching occurs. Wide-belt sanders have been replaced by computers with more megabytes as rewards for doing what is right as a teacher. It is a rare person who has escaped this influence. Teachers, teacher educators, textbook publishers, equipment vendors, researchers, school administrators, school boards, and others associated with or supporting technology education have been lured by the appeal of newer, faster, higher capacity (but smaller) hardware. In many instances, there is software to go with it. It is argued that this is representative of the day. "Look at industry!" or "Look at technology!" is the petition of those who would teach technology education - a subject field conceived as general education and dedicated to liberating the minds of its learners. There is confusion about the interpretation of the purposes that we purport to fulfill and how to achieve them.

With the focus on the content of technology education, insufficient attention is given to the methodology of instruction. While learning objectives such as problem solving, innovation, and higher order thinking skills are considered to be important, too few learning experiences are designed to accomplish them. When the primary activities of learning are intended to place students in contact with the newest technological mechanisms available rather than to engage their minds in the identification and solution of problems, op-

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portunities are missed. The seductiveness of the machines lures students and teachers away from the things that could serve them best. There will be newer and smarter machines tomorrow, making the knowledge acquired about today's model very perishable. By contrast, the learned ability to develop ideas and create solutions will always serve the learner.

It is apparent that the newest technology available does not lead to the best instruction in technology education and it does not result in the achievement of the primary purpose of the field. In many instances, flashy equipment has been used to camouflage inferior teaching. Students learn to manipulate robots in exercises that are tightly described by the teacher within timelines controlled by the school schedule, or to find answers to problems that no one really cares about. At the same time, some teachers of woodworking, metalworking, crafts, or drafting are teaching students how to solve problems that they have identified, how to develop methods for study, and how to evaluate alternative outcomes in systematic fashion. These teachers are developing technologically literate people. Judgements about good and poor teaching in technology education are being made on the basis of the wrong criteria. Teaching woodworking is not all bad and teaching computers is not all good. There are opportunities in both subjects to prepare students for the future as well as to deny them learning experiences that will engage their powers to do such things as identify and solve problems.

Observations at a local school district over the past five years illustrate how traditional course work can provide problem-solving experiences and contemporary course work can negate critical thinking and problem solving.

Teachers of technology education have a major role in organizing curriculum and instruction. For example, two teachers - one teaching a traditional subject and one teaching a contemporary subject - could employ two different approaches to curriculum and instruction, thereby creating a traditional environment within a communication course and an innovative environment within a woodworking course. The communication teacher may be teaching students about computers, lasers, and robots, but doing this with specific activities such as digitizing a picture, programming a robot to talk, and transmitting sound via a laser beam. This teacher's course could require all students to perform the same activities such as reading the same selections of text, answering the same study questions, and performing the same activities. The students should then take the same test and move on to more of the exact duplicate activities as all the other students in the class. Students would plod through this “innovative” course much in the same way that students in previous years all learned the parts of the hand plane, how to square a board with hand tools and build a bookshelf using teacher-made templates. On the other hand, the woodworking teacher's students could be learning traditional content, but having a very different kind of experience. Within the context of woodworking, the students may be exposed to basic demonstrations of tools and equipment, but must design and create their own project, conduct a study on the use of wood in contemporary cabinet making or construction, and study the effects of deforestation upon the earth. This kind of “traditional” course provides many opportunities for students to be creative, improve their problem solving abilities, become critical consumers, and develop technological literacy.

Too often, a blanket critique of anything labeled with a traditional content descriptor is made. Given the choice of taking one of the two courses mentioned above, students probably have a better chance of becoming critical thinkers and problem solvers in the woodworking course. The way in which the course is organized and conducted demonstrates a type of educational activity that attempts to prepare students to be independent thinkers and problem solvers. The specific content of the course becomes a secondary issue; the activities provided for the students become the primary issue. This approach to teaching should not be criticized or abandoned in favor of instruction that is a system for putting students through inconsequential exercises with the latest mechanisms available to a particular school. If technology educators truly wish to achieve excellence, then the valuable traditional practices of teaching must be preserved and incorporated into the practice of technology education. °

Miscellany

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