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ABSTRACT

Historically, technology education evolved from several strands: Bacon's realism, Pestalozzi's belief in the practical application of knowledge, Rousseau's naturalism, Herbart's sense realism, Dewey's progressive and social reconstructionist thinking, and the influence of vocationalism. The mainstream practice of industrial arts was more a study of the skills needed to perform a trade than a study of the relationship of industry to society and the problems of life related to industry. The following influences mitigated against reaching the potential of early ideas associated with industrial arts: persistence of manual training practices, inbreeding of industrial education, federal funding for vocational programs, and diminution of women's voices. As concern grew about the theory/practice gap around midcentury, curriculum innovation exploded, the subject matter was named technology education, and a content outline was specified. Research from 1987-1993 painted a picture of a top-down curriculum revision in technology education meeting with superficial and limited success. Also revealing was what was not done. The focus of curriculum research on descriptions of status and curriculum development pointed to researchers who neither studied the effectiveness of technology education nor addressed issues of identifying and implementing integrated curriculum through technology education. Contemporary research and practice reproduced a technocratic rationality based in positivism, a deterministic view of technology, and monoculturalism. (Contains 88 references.) (YLB)

Struggling for a New Identity: A Critique of the Curriculum Research Effort in Technology Education

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In the United States technology education has evolved from the subject matter of industrial arts. Historically, industrial arts emerged from both general educational philosophy and vocational education philosophy and practices which underpinned manual training. The confluence of professionals who practiced both vocational education and general education forms of manual training created an ideological paradox for a subject matter purported by its practitioners to have liberal education goals. As a result of this paradox, both the contemporary version, technology education, and industrial arts have been misunderstood and often misidentified fields of educational study.

Industrial arts has often been equated with vocational education by the public. Having established, in the public's mind, a firm identity for industrial arts has led to even further confusion with the use of the contemporary replacement term, technology education. (In 1986 a professional association, the International Technology Education Association, declared a name change to technology education from the former subject matter title, industrial arts.) Today, in some cases, technology education is still associated with vocational education. It is sometimes even equated with instructional technology or educational technology.

This general confusion about the nature of technology education may very well be the result of the confusion exhibited by practitioners of technology education. Their interpretation of technology education through their own practices may be permitting the educational community and public the opportunity to assign an unintended meaning to the concept of technology education. These problems have been endemic to the field since its inception.

As a result of a review of recent research in technology education I am going to use an historical analysis and current research patterns to explore the confusion of vocational and general education purposes and practices in industrial arts and technology education. My objective will be to demonstrate how the historical and dominant curriculum theoretical frameworks and designs of industrial arts serve as roadblocks to change and reproduce, in contemporary research and practice, a technocratic rationality based in positivism, a deterministic view of technology, and monoculturalism. The purpose is to probe for explanations of the inability of technology educators in the United States to create a meaningful identity as a worthwhile subject of study in the schools and to provide suggestions for change in technology education which will address future educational needs of both students and society.

Definitions

Given the lack of a clear identity for technology education in general educational circles such as this one, defining technology education is in order. Technology education is a growing international trend to teach children about how people create, modify, and adapt the environment in order to survive, create comfort, and be productive. It includes the study of adaptive technological systems such as manufacturing, construction, transportation, and communication (Snyder and Hales, 1981) or technical systems such as electronic, mechanical, hydraulic, and structural systems (Hutchinson and Karsnitz, 1994) through laboratory based study involving problem identification, design of solutions, and the application of those designs through the creation of prototypes as well as mass production (Savage and Sterry, 1990). Technology education curriculum may be organized by the adaptive or technical systems, as well as, a focus on technical or social problems. The intent of technology educators is to provide educational opportunities for all children so that they may explore and experience how people create and use technology as well as develop ability to be critical consumers of our technological products and processes, technological problem solvers, and responsible citizens in a technological society (Zuga, 1989).

The intent of technology educators is not to prepare people for occupations, since that is the role of vocational educators. With respect to the instructional technologies, technology educators use them and, as a subtopic of study, address educational technology through the study of systems of communication, but, in the final analysis, their content encompasses all technologies rather than the selected technologies of education as instruction.

History

In the United States, technology education has evolved from an historical lineage of ideas which includes Bacon's realism, Pestalozzi's belief in the practical application of knowledge, Rousseau's naturalism, Herbart's sense realism, Dewey's progressive and social reconstructionist thinking, as well as, the influence of vocationalism (Bennett, 1926 and 1937). Some of the European programs which preceded industrial arts and influenced the development of technology education were the study of handicrafts prevalent in Europe since the introduction of Swedish Sloyd, British Arts and Crafts, and the more vocationally oriented Russian System of Tool Instruction. In the United States, industrial schools, manual labor, manual training, industrial education and vocational education preceded industrial arts (Barlow, 1967; Bennett, 1926, 1937). From these antecedent educational ideas and practices, people who espoused liberal education goals for industrial education regrouped in the early twentieth century and offered a school subject called industrial arts.

Prelude

Preludes for the earliest industrial arts programs were based in a belief in the value of an "industrial" education for underprivileged children (Bennett, 1937), a growing recognition and practice of manual training in private secondary schools for liberal educational purposes (Woodward, 1898), and Froebel inspired kindergarten programs (Herschbach, 1992) all of which gained in popularity during the nineteenth century. Elementary school industrial education and manual training programs which differed from the secondary school manual training emphasis on wood, drawing, and metalworking classes for boys directly preceded the beginning of industrial arts.

Industrial education programs designed for elementary schools originated in kindergarten classrooms and were aimed at instruction designed for all children, both boys and girls of all socio-economic classes, and incorporated a broad range of laboratory based activities such as block building, drawing, book making, embroidery, crocheting, paper folding, and construction (Bennett, 1937). Many of the manual training programs were criticized for being too rigid and thoughtless as a result of the influences of their origins in kindergartens (Dewey, 1916) and relationship to the rigidity of manual training as influenced by the Russian System of Tool Instruction (Bennett, 1937). Educators of the day were particularly critical of this kind of education in the elementary school. Soon, a number of different approaches to the teaching of manual training at the elementary school level, inspired by Swedish and British educational programs, such as arts and crafts and handicrafts, emerged. These educational programs banded under the name of industrial education where the term industrial was used not as an indication of the trades or a study of industry per se, but as a term equated with being industrious or occupied. Concerned about the use of the term, the second annual report of the Industrial Education Association in 1886 opened with an attempt to clarify the meaning.

> There is an industrial training which is neither technical nor professional, which is calculated to make better men [sic] and better citizens of the pupils, no matter what calling they may afterward follow; which affects directly, and in a most salutary manner, the mind and character of the pupil, and which will be of constant service to him [sic] through all his life, whether he be wage worker or trader, teacher or clergyman. The training of the eye and of the hand are important and essential elements in all good education. (Washington Gladden, 1985 quoted in Bennett, 1937, p. 413-4)

Unique to these industrial education programs was the participation and influence of both men and women such as Emily Huntington, a kindergarten teacher, Grace Dodge, an educational reformer, and Felix Adler, a philosopher of education (Bennett, 1937). These early education reformers provided a liberal educational emphasis and purpose for what they called industrial education.

By the end of the nineteenth century the practice of industrial education and manual training had taken hold in both elementary and secondary schools in the United States and several manual training teacher education programs had been initiated. For example, The Ohio State University began manual training teacher education programs as a part of the engineering program in the 1880's prior to the advent of the College of Education (Proceedings of the Board of Trustees, 1888). During that same time period, several normal schools began teaching Swedish sloyd or manual training. As a result of the work and success of the Industrial Education Association, New York College for the Training of Teachers was begun in the late 1880s with Nicholas Murray Butler, a professor of philosophy and education at Columbia University, serving as president (Hervey, 1900; Bennett, 1937). By 1893 the name of the college was changed to Teachers College and the faculty and courses in manual training were increased resulting in Columbia University providing several degree programs for manual training teachers. With the initiation of degree programs, including a Ph.D., Teachers College Columbia set a new standard for manual training teacher preparation and study (Bennett, 1937). As a result of this action, a number of influential educators interested in manual training for a variety of reasons gathered there and in other universities, such as the University of Chicago, where manual training degrees were being offered, also.

Of the faculty who gathered in manual training programs at universities, political ideologies and forces began to draw them in different directions. Several were committed to secondary education with a further division of those who proposed vocational education and those who proposed general education aims for manual training. Others were committed to elementary school education and were advocates of a liberal education purpose.

The growing trend to legislate vocational education at both state and national levels, forced a further redefinition of manual training. As the prospect of federal funding became more real, some manual training advocates placed greater emphasis on the vocational aspects of manual training. Prosser, Snedden, and other industrial educators became advocates of vocational education and participated heavily in the political movement to create federal funding for vocational education. As a result of their successful efforts in combination with agriculture, home economics, and business educators, federal support for vocational education was initiated with the Smith Hughes Act in 1917 and has been continued through a variety of federal acts (Barlow, 1967).

During the drive to gain federal funding for vocational education it appears as though the original coalition of people and meaning assigned to industrial education changed. Industrial was increasingly used to refer to industry as an economic institution and associated more with teaching trades. The people who were a part of the organization, the National Association for the Promotion of Industrial Education (NSPIE), advocated a vocational purpose for industrial education as they lobbied for federal funding.

Industrial Arts as Social Reconstruction in Theory

Even though the effort to secure federal funding for vocational education diverted the attention of many industrial education advocates, elementary school educators were still a factor in the industrial education arena. They kept alive a liberal education purpose for the study of what was rapidly becoming called industrial arts. Influenced by Dewey, perhaps by association at Teachers College, Frederick Gordon Bonser and Lois Coffey Mossman produced one of the first industrial arts texts for teachers, Elementary School Industrial Arts. In that text, they provided the emerging field of industrial arts with the definition of the subject matter which would carry them through the majority of the twentieth century. Of the industrial arts, they said:

> The industrial arts are those occupations by which changes are made in the forms of materials to increase their values for human usage. As a subject for educative purposes, industrial arts is a study of the changes made by man [sic] in the forms of materials to increase their values and of the problems of life related to these changes. (1923, p. 5)

By the time that this book first appeared in the 1920s, the definition of the term industrial education had become associated with vocational education and was explained by Bonser and Mossman (1923) as "a definitive, intensive training for productive work in some industry. . ." (p. 6). Industrial arts was distinguished from industrial education (as vocational education) as a study with general education purpose. Materials, tools, processes, and production were to be studied "for the values which such study affords in one's everyday life, regardless of his [sic] occupation" (p. 6). With Bonser and Mossman's definition and text, which was accepted by those who called themselves industrial arts educators, one can see that the term industrial had taken on its modern meaning related to industry as an economic institution in society (Towers, Lux, And Ray, 1966).

More important, however, was that the justification and purpose for the study of the industrial arts provided by Bonser and Mossman (1928) which incorporated the ideas offered by Dewey in his discussions of the study of the occupations (Dewey, 1916) and social reconstruction (Dewey and Childs, 1933). The purpose of industrial arts was, according to Bonser and Mossman, to study "such problems of citizenship as to share in the regulation of industry . . ." (1923, p. 7) which relates directly to Dewey's (1916) ideas about the social role of the study of occupations of which he stated, " The most direct road for elementary students into civics and economics is found in the consideration of the place and office of industrial occupations in social life" (p. 201). In the continuation of the quote he advocated the same ideas for older students.

As a result of the established practices of industrial education in the elementary schools and the influence of Dewey upon educators in general, during the first half of the century industrial arts was given a place in the schools

(Zais, 1976). Often, that place was to be a vehicle for the study of the occupations which permitted integration, acquisition, and application of practical knowledge to social problems. University laboratory schools such as The Ohio State University Elementary School and Kindergarten and public schools began to establish laboratories for the purpose of providing "for real participation by each student in each of these functions of living" (Publications Committee, 1935, p. 121).

While social reconstruction was the direction and intention of many elementary school and industrial arts educators of the time, their influence was not the mainstream direction taken by the industrial arts community as it moved forward into the twentieth century. Most of the voices advocating social reconstruction in industrial arts curriculum gradually became silent as industrial arts curriculum theorists focused on identifying better ways to teach skills (Selvidge, 1923; Selvidge and Fryklund, 1946; Fryklund, 1956) and unique content for industrial arts (Towers, Lux, and Ray, 1966). School practice became more vocational with a curriculum of woodworking, metalworking, and drawing (Schmidtt, 1963).

Industrial Arts as Vocational Education in Practice

Other than in theory and during the brief period of progressive education, the mainstream practice in industrial arts has been more of a study of the skills needed in order to perform a trade, rather than a study of the relationship of industry to society and the problems of life related to industry. Several influences have mitigated against reaching the potential of the early ideas associated with industrial arts. They are: the strong and persistent practices of secondary school manual training, the close association of all educators who dealt with industry related subjects, federal funding for vocational programs, and the diminution of women's voices in the industrial arts profession, thus the loss of an elementary school and general education purpose and focus.

Persistence of manual training practices. Highly resistant to prescriptive theory of what ought to be in industrial arts, the mainstream pattern of industrial arts curriculum was the manual training curriculum initiated in the 1870's. Woodworking, metalworking, and drawing dominated both junior and senior high school curricula throughout the United States. Additions to these topics were patterned after the original grouping of content and over the years graphic arts, auto mechanics, electricity, plastics, and other topics were added based not upon a logical pattern, but their invention and growing common use. The topics were based upon a mixture of materials and processes, just as the original content had been. With respect to what was taught as industrial arts, the familiar and successful patterns of manual training which relied upon tool instruction and material processing in order to learn specific skills predominated. The only major change in this pattern was to refocus the narrowly conceived manual training laboratory exercises of making throw away examples of selected joints, turnings, and other component parts in order to incorporate some of the Scandanavian handicraft methods and progressive thinking by the representation of projects which were useful items to be taken home (Barlow, 1967). This does not mean, however, that mainstream practice was in line with progressive thinking about the aims and purposes of industrial arts, because as students were guided in the making of teacher selected birdhouses, pump lamps, bookracks, and funnels the potential intrinsic value was stripped from industrial arts (Dewey, 1916). Teacher selected projects became activities which risked being insignificant drudgery to students because of the control exerted by teachers in the organization of the curriculum as projects were chosen for their role in teaching skills . While many students did enjoy the activities, they lacked, for as many, the meaningfulness associated with either personal or social purpose as teachers selected projects through manual training ideological filters in order to achieve vocational skill development. Lacking in industrial arts was an understanding and application of the pertinent exhortations of Tyler (1946) to create curriculum with a careful blending of subject matter, personal, and societal needs.

Inbreeding of Industrial Educators. The pattern of grouping together all of those educators who were interested in related forms of industrial education was a trend that was established with the first teacher education programs and has continued throughout the century to this day in the United States. As in the early programs at Teachers College Columbia and the University of Chicago, at most universities, industrial arts educators were trained in programs which were a part of the larger vocational education effort. These programs often were started before industrial education split clearly into a vocational faction and a general education faction and faculties continued to stay together in order to gain efficiencies in operating multiple programs.

These practices were problematic in that students were and are often prepared to teach industrial arts within the same courses and with the same texts as used by vocational students (Zuga, 1991). Therefore, while the texts may state that the purposes and time length of industrial arts classes in the schools were different than the vocational classes, every other prescription for curriculum planning and classroom practice was a prescription for planning vocational education by using task analysis (Selvidge, 1923; Fryklund and Selvidge, 1946; Fryklund, 1956). Naive teacher education students who were not tuned into the different purposes of general education practice versus vocational preparation were often not capable of creating a school practice which was anything more than a scaled down copy of vocational education, since that is what they were taught to do. Those who were more independent were either driven on to search for more guidance or were able to break free of their teacher education prescriptions, but those were not the majority of teachers.

Essentially, teacher educators continued the twentieth century tradition of industrial education as a study of industrial trades for vocational purposes through their programs. The dominant practice was so overwhelming that even in those schools such as Kent State University where the industrial arts faculty remained separated from the vocational education faculty both ideologically and physically within the college of education, practices with respect to curriculum in teacher education and prescriptions for practice mirrored the thinking in the rest of the country. Classes were structured about teaching skills in woods, metals, and drawing while teacher educators espoused a general education purpose for the field.

On Federal Dole. Sustaining the grouping of industrial arts and vocational educators together both in teacher education and in the schools, was the potential for gaining access to federal vocational education funds. It was a potential in that as the funds were distributed through state governments and there were some state governments which provided money for industrial arts and some which did not. Each state in the union had a complex history of interpersonal and working relationships with teachers, teacher educators, and state department vocational educators which created a patchwork pattern of practices related to the ability of industrial arts educators to access vocational funds. So, for example, in Ohio, Minnesota, and some of the other states vocational funding for industrial arts has been and remains elusive, while the money flows a bit more freely in New York, Florida, Wisconsin, and other states.

What the promise of vocational money did, under the guise of saving money and gaining efficiency in instruction, was keep the industrial arts professionals close to the vocational educators just in case there might be a potential to benefit from vocational moneys through supplements for teachers salaries, funded projects, reimbursements for teacher education, or other special programs. These practices, well established since the inception of vocational education funding, continue to this day as many technology educators seek ways to access vocational education "tech prep" moneys, maintain technology education teacher education in larger vocational education programs, and reach out not only to vocational educators, but a wider audience of industrial trainers and human resource educators, as well as, subverting long standing industrial arts education programs into university based vocational education programs to prepare, not teachers for the schools, but managers and technicians for industry. All of these programs have had the residual effect of creating teacher education curricula for undergraduates which is vocational in nature, diminishing the numbers of technology education teacher education programs and students (Volk, 1993), and creating confusion among the few who do make it into the schools as teachers.

No Place for Women. After having been integral to the effort to initiate industrial arts, women and their voices were shut out of industrial arts and industrial education. Given societal norms and the growing numbers of men who were taking control of all of the industrial education efforts, including industrial arts, the early female advocates and practitioners in industrial arts were slowly eliminated and the record of their participation in the field conveniently forgotten. Early in this century female industrial education and manual training teachers were not anomalies in schools (Bennett, 1937).

There are well documented and recurring societal pressures during history which accentuated differences with respect to gender roles at home and at work. These social mechanisms work to counter the progress women make towards equality. Most notable was the propaganda effort at the end of World War II initiated by government, industry, and media representatives and aimed at driving women out of industry back to the home and hearth in order to make way for returning veterans (Faludi, 1991). Also a factor has been the traditional back seat role taken by women, either unwillingly or willingly. In industrial education Bennett (1937) alludes to the presence of this problem in the 1880s with respect to the Industrial Education Association and the work of Grace Dodge when he said,

> This new organization brought men as well as more women into the work. General Alexander S. Webb, president of the College of the City of New York, was elected president, and Grace Dodge, vice-president, though she did the active work of a president. (p. 413)

As a subculture within the greater culture, the increasingly male dominated profession of industrial arts mirrored these social patterns and soon, even the early voices of the women, were erased through the way in which the industrial arts literature from the 1930s through the 1950s exhibits a lack of women's voices, while the literature from the 1880s through the 1920s and the 1960s through the present incorporates women's voices. There was a collective suppression of women's voices by simple omission such as the habit of referring in conversation and in press to the most frequently used definition of industrial arts, as the "Bonser" definition (Smith, 1981; Lux, 1981) and which is the Bonser and Mossman (1923) definition.

The gradual de-emphasis of women and their voices from industrial arts is slowly being reversed, again, as women are now beginning to take active roles in technology education. They are, however, working from the deficit created by past omissions in that about two percent, at best, of the total profession of teachers and teachers educators is estimated to be female (Wright And Devier, 1989; Quon and Smith, 1991). The effect of the loss of women's voices over the years probably has changed the course of industrial arts and technology education. The focus on industrial arts for elementary schools and, therefore, general education, was a result of the early participation of female industrial arts and elementary school teachers. There is no way of telling what may have been the course of evolution for technology education had women remained active and respected in industrial arts. At present, we can only speculate as to what effect the loss of their efforts and voices had on curriculum, as well as, what effect will be had on technology education as a result of the new female voices.

The Advent of Technology Education

As the industrial arts community approached mid-century, the theory/practice gap which had developed began to be a matter of concern. As a result of this concern and with the help of federal investment in education during the 1960s, curriculum innovation in industrial arts exploded. Local, state, and national curriculum projects and programs were the norm for the 1970s with several strong and distinct programs emerging.

A local effort called the Maryland Plan (Maley, 1973) stressed many of the progressive ideas about children providing curriculum coherence as selfactualization or personal curriculum. State and national plans such as the American Industry Project (Face, Flug, and Swanson, 1963) and the Industrial Arts Curriculum Project (IACP) (Towers, Lux, and Ray, 1966) stressed societal needs in a curriculum as technology format. A plan offered by DeVore (1980) stressed hierarchical subject matter as providing a foundation for curriculum in an academic rationalist manner.

New names were suggested for the subject matter and for a short period, industrial technology, based on the rationale of the IACP, appeared to have some currency. However, industrial arts professionals in the 1980s were becoming confused with the profusion of plans and ideas and actively sought a compromise through a series of meetings and the generation of a curriculum document designed to provide a consensus for the profession. In this plan, the ideas of Maley (1973), Towers, Lux, and Ray (1966), and DeVore (1980) were combined under the subject matter name of technology education (Snyder and Hales, 1981). While the document specified a content outline for technology education, the theory/practice gap and specific ways of resolving it were not addressed. It was as if the content outline was assumed to be enough to solve the difficulties caused by the confusion over competing plans, provide an identity for the subject matter, and reform school practice. Current conditions with respect to technology education indicate that the document had limited success in these endeavors.

While there is evidence of a contemporary consensus about technology education content (Weins, 1990; Oaks, 1991; Putnam, 1992, Greer, 1991) at the leadership level, a theory/practice gap with prescriptive theory focusing on a general education purpose for the field and descriptions of practice revealing a largely vocational approach to teaching about industry in both the schools and teacher education exists (Zuga, 1989, 1991). The renaming of industrial arts to technology education has not addressed this problem, and, perhaps, has further exacerbated the confusing image of the field by the widespread use in society of the term technology to mean computers as cutting edge technology and in the educational use of the terms educational technology and instructional technology.

Contemporary Research

I recently completed a review and synthesis of all published technology education research from 1987 through 1993 found either in technology education journals in the United States or in dissertation abstracts. The study included 220 reports, 115 of which were in professional journals or in the Educational Resources Information Center data base as conference papers and local reports, and 105 of which were dissertations. Surprisingly, half of the current technology education research focuses on curriculum and bears the influence of the history of the thinking in the field. Little change in the practices of the field are revealed by the contemporary research base.

A summary of the nature of research in technology education indicates that 50 percent of the research deals with curriculum, either curriculum status or development. Of the research which deals with curriculum, 62% of the studies are about the current status of curriculum and 38% of the studies are about curriculum development. Critically examining curriculum issues such as how teachers implement curriculum has been studied by only a few researchers (Cox, 1991, Scarborough, 1993, Zuga, 1987).

Positivist Research

The majority of curriculum status research is descriptive. Most of the curriculum development research uses a Delphi technique, originally developed for the purpose of predicting the future. In technology education it has been done by surveying selected panels of technology education professionals and industrialists in order to develop curriculum content. Very little correlational, experimental, historical, and qualitative research was done, these kinds of studies comprise 35% of all of the research done during that period and far less of the curriculum research.

Most technology education curriculum research on status is done in the positivist paradigm, relying upon descriptive research which charts the means of repeated cases in order to determine the status of practices in the field. Most frequently, the focus of this kind of research is about the beliefs of state supervisors and teacher educators, with just a handful of studies focused on teachers' beliefs and fewer studies on students' beliefs. These research practices illustrate either a hierarchical view with respect to the value of the beliefs of those people who are involved with technology education or a selection of research populations based upon convenience since identifying state supervisors and teacher educators is easily done through commonly available directories.

With a growing awareness that task analysis is an inappropriate method for deriving curriculum and a lack of alternative methods, development research tends to employ the Delphi method, first introduced to the field by Halfin (1973). The most common pattern of use for this method in technology education involves the researcher in the selection of a small panel of experts heavily weighted towards teacher educators, state supervisors, and industrialists. Two to three rounds of surveys listing potential curriculum content gleaned from content analysis are used to force the experts into agreement on content by dropping infrequently selected items and repeatedly requesting the panel to rate the remaining items. This method forces the panel to the mean response through repeated selection rather than using a multitude of observations, as the Delphi method still relies upon quantification in order to lend validity to the results of the research.

As fascinating as the reliance upon using positivist methods of research, is the tendency of technology education researchers, purporting to be deriving subject matter for general education, to rely upon a closed circle of technology education professionals and industrialists. Eliciting the attitudes of educators from other subjects, school administrators, students, or parents is not evident in this research. Including industrialists on the panels indicates the continuation of the twentieth century historical trend of focusing on industry for content.

A good deal of the curriculum research in technology education focuses on a closed circle of people, technology educators and industrialists, and searches for a singular definition and framework for content. This is not only evident in the kind of research effort which is put forth, but also in some of the topics of research. Several studies have dealt with the idea of national certification requirements (Bell, 1991; Wicklein, 1991) and have blamed the lack of change in the field on the lack of such requirements (Wright and Devier, 1989). This is further evidence of the tendency of technology educators to want standardization and control of the curriculum, showing their underlying positivist belief in one correct solution to the puzzle of selecting content for teaching about technology.

Curriculum Resistant to Change

With respect to the status of the field, researchers reported some change which could be characterized as superficial. For example, gradually the name of the field has been changed from industrial arts and industrial technology to technology education and has been accepted as the correct terminology by technology teacher educators and officially sanctioned by most state departments of education (Greer, 1991). With the change in the name, there is also a growing acceptance of reconfiguring courses from the traditional woodworking, drawing, and metalworking to the adaptive systems of construction, communication, manufacturing, and transportation (Putnam, 1992). Teacher educators have also endorsed the adaptive systems of technology in their responses to a survey by Lewis (1992 & 1993). He found that those teacher educators who were members of the ITEA professional association were the most committed to the new curriculum model. However, what is known about classroom teachers' beliefs and their practices indicates that they have not implemented widespread curriculum change.

In fact, the few technology education studies which survey teachers' stages of concern with respect to curriculum change in technology education, reveal that the change process which has been initiated at the professional association and state department level has not reached classrooms through teachers. Rogers (1992), Rogers and Mahler (1992), and Linnell (1992) have adapted the Stages of Concern Questionnaire (SOCQ) of Hord, Rutherford, Huling-Austin, and Hall (1987) to study the acceptance of the changes in technology education by teachers in Nebraska, Idaho, and North Carolina. Their results are all similar in that the majority of teachers had failed to accept or adopt the changes. Similar results were obtained with a survey conducted by Dryenfurth, Custer, Loepp, Barnes, Iley, and Boyt (1993) in Illinois. Teachers were found to be in the stages which related to exploration of the proposed changes, but not adoption. In an attempt to correlate attribute variables to agreement with new curriculum models, Hatfield (1988) found in Tennessee that the more teaching experience teachers had, the less likely they were to agree.

Several studies document the phenomenon of teachers' continuing support and prioritization of skill based goals for technology education (Larson, 1987; Morton, 1991; Yu, 1991). Even when teachers' believed that they had changed the nature of their practice, Heidari (1990) found their principals did not perceive a change in content and, in a unique qualitative study, Cox (1991) found that the majority of goals in play in two technology education middie school programs in Ohio were prevocational rather than general education goals.

Essentially, current research paints a picture of a top down curriculum revision in technology education which is meeting with superficial and limited success. The tradition of industrial arts seems to be very alive in the minds of experienced teachers. However, there is little research and evidence to indicate if teaching experience is the only factor which has inhibited change in technology education. Perhaps, newer teachers, who are being prepared by teacher educators to teach the new curriculum, are being socialized by the more experienced teachers and for this reason change is not taking hold in schools. Or, although a new curriculum model has been introduced, the underlying belief system which supports the existing model has not been addresses or changed. There has been little research about the factors within the school environment which would sustain the traditional ideology and view of industrial arts under the name of technology education.

Historical research points to an ideological bent towards industrial capitalism (Lakes, 1988), prevocationalism, masculinity, and classism (Loucks, 1991) present in industrial education and industrial arts at the beginning of the twentieth century. The difficulty in creating change points to a potential residual influence and, possible strengthening of the existing trends, by reproducing these values in succeeding generations. Zuga (1987) found preliminary evidence of a technocratic ideology, including positivism, in a qualitative study of teachers struggling to change curriculum in a single school district. However, there has been no serious, sustained research effort to explore the influence of traditional ideology in the current generation of technology educators.

Missing Information

Almost missing in technology education research about curriculum are many topics which are present, for good reason, in research in other educational subject matter areas and should be present in technology education research because of the expressed goals for technology education. Fundamental to contemporary technology education goal statements are ideas of constructivism through using a problem oriented method of instruction and the integration of technology education with other subjects, especially science and mathematics (Zuga, 1989). Yet, the current research data base is surprisingly limited on these topics. In addition, information about the effectiveness of technology education is rare.

Constructivism. Nine studies about or related to problem solving were conducted during the period of this review and most of these studies were descriptions of the use of problem solving both in the United States and abroad. While these studies generally tended to identify problem solving practices based upon surveys, one study surveyed teachers, who had been selected by the ITEA as outstanding, about their attitudes and practices concerning teaching methods and found that they preferred exerting control in their classrooms through the use of lecture and demonstration and chose giving student control as the least frequently used teaching strategy (DeLuca, 1991b). Research of this nature indicates that the necessary teacher attitudes for initiating a constructivist approach to curriculum could be missing from technology educators, reinforcing the suspicion that the ideology of technology educators is one of the problems with respect to implementing curriculum change.

Integration. Mentioned frequently in recent technology education goals are statements referring to the relationship of technology education to other subjects, yet, this is another area of research that is limited. While there are six studies related to science education (Ekwunife, 1987; Hall, 1989; Lewis, 1990; Brusic, 1991; Nicholson, 1991; Dugger & Johnson, 1992), two studies related to mathematics education (Rogers, 1990; Korwin and Jones, 1990), and one study related to language arts education (Ilott and Ilott, 1988), most of these studies focus on student performance in science, mathematics, or language arts as a result of participating in technology education. Their focus, in effect, identifies technology education as a method of instruction, rather than a unique content area which incorporates knowledge categorized also as science, mathematics, or language arts. This research tends to invert what one might expect of technology education research by asking how exposure to technology education improves learning in other subjects, rather than asking how knowledge from other subjects complements the study of technology. In the latter instance, the argument for technology education as a separate and applied subject which integrates academic subject matter is a stronger support for technology education rather than casting technology education as a teaching strategy which aids in learning academic subjects.

Inclusion of all students. Most disturbing of the trends in technology education research is the lack of research on students. Neither students' attitudes nor specific groups of students such as females, ethnic minorities, or physically and mentally challenged students have been the topic of much research. Recently, based upon an established European pattern of research about students' attitudes toward technology, a team of researchers from the United States and the Netherlands completed a students' attitude survey in the United States (Bame, Dugger, deVries, and McBee, 1993). In analyzing the data from this study, the attribute variable of gender was used to correlate attitudes about technology education and the researchers noted that girls who took technology education classes were more likely to believe that technology education was a male subject than girls who had not taken technology education classes. Findings of this nature beg for further study and begin to point out problems with subject matter and gender identity in technology education practices and can be related to feminist critiques of the masculine nature of technology (Wajcman, 1991).

Equally omitted from technology education research are studies which focus on ethnic differences. There are many potential topics with respect to the diverse ethnic groups in this country which could inform technology educators about curriculum. For example, African American students may associate technology education with low status tracking or Native American students could have value conflicts with Western approaches to technology. Attitudes of these and other ethnic groups should be of concern as technology education curriculum is planned and taught, but there seems to be little awareness or interest in these ideas on the part of technology educators.

Almost omitted from technology education research are studies about physically and mentally challenged students. Two such studies were identified in the review of research, both dealt with trying to identify teaching methods which would enable mentally challenged students to be successful in technology education. Technology educators do not know what role technology education has to play in the education of physically and mentally challenged students.

Given what has not been studied with respect to the diverse populations of students served by technology and the diverse populations which would be represented in a United States technology education curriculum, it appears as though the community of technology education researchers are blind to the diverse needs of our population. Perhaps, they see technology as neutral, which, in itself, is an ideological position which is becoming increasingly untenable (Winner, 1977; Franklin, 1990; Webster, 1991; Street, 1992). Once again, the existing research base of technology education points to a problem with ideology, particularly hegemony.

Cognition. Unlike researchers in mathematics and science education, technology education researchers have not done much to study cognition as it relates to technology education content. Five studies touched upon this topic, looking at things such as symbol systems in teaching orthographic projection (Heuberger, 1987), technology forecasting on retention of knowledge (Murray, 1987), the effects of using concept organizers (Siebold, 1989), teaching measurement (Peterson, Ridenour, and Somers (1990), and mathematical organization of text structure (De Luca, 1991a). These studies are a mixed bag of initial efforts, leaving technology education researchers plenty of opportunities to explore this vast and uncharted area of research.

One of the problems with cognitive research in technology education is related to the evolving nature of the curriculum content. There has been a good deal of effort dedicated to identifying content for instruction which may have derailed efforts to identify how students make sense of the content, when concepts should be taught, and to whom. However, questions related to the way in which students can best learn about technology are not unrelated to deriving technology education content. It could be argued that these efforts are linked and should be pursued in conjunction with each other.

Summary

As revealing as what has been done with respect to technology education research, is what has not been done. The missing research topics point toward a research base which is myopic. The focus of technology education curriculum research on descriptions of status and curriculum development points to researchers who are narrow, inwardly focused, and oblivious to the goals of their own field. They are not researching the effectiveness of technology education via the ability to meet the goals which the professionals in the field purport to hold. They are not addressing issues of identifying and implementing integrated curriculum through technology education for all children taught in a constructivist manner; all goals which are central to current technology education rhetoric.

Issues and Problems

Review of the history and current research base of technology education points to several issues and problems with respect to curriculum and the implementation of curricular change. Problematic are a theory and practice gap, the desire to implement constructivist curriculum without an adequate acceptance of the underlying theory, a lack of a well rounded research base, and bias against diversity. At issue is the ideology of the majority of practitioners in the field.

Positivist Technocratic Rationality

Clearly, the efforts of technology educators and their industrial arts ancestors have been to try to identify and maintain a coherent curriculum with widespread support and agreement. Industrial arts educators accepted the dominant woodworking, drawing, and metalworking curriculum of manual training and as this curriculum became increasingly dated and irrelevant, technology educators and researchers have begun the search for a singular thematic curriculum to replace it (Snyder and Hales, 1981; Savage and Sterry, 1990). There is an emphasis upon the need to identify a singular curriculum plan and create national standards for curriculum and teacher certification in technology education. This emphasis displays the tendencies of professionals in technology education to believe in absolutes and hierarchies, and typifies them as modernists and positivists.

It appears as mainstream technology educators believe that if one curriculum plan were being followed that they would gain power, perhaps, power within the school's overall curriculum. Yet, their search for a singular curriculum may not be the best strategy for the future of technology education in the postmodem world. Tradition in technology education may limit the potential of teachers to address the needs and wants of an increasingly diverse society which is showing evidence of those "others" within society gaining voice in the affairs of politics and education.

Reproducing Determinism

Technology education is often taught as if technology were a value free enterprise. The skill based curriculum tradition of industrial arts has moved into technology education practice and continues to be reproduced in classrooms around the country, reinforcing a neutral view of technology. The default effect of this approach to teaching technology education is the reproduction of a view of technological determinism, meaning that the view that people do not control our technological future is prevalent. Typical technology education activities conducted in the United States illustrate this view as children are asked to manufacture teacher selected projects by creating assembly lines, build house modules in order to learn about construction, complete computer driven instructional models about selected technical topics, and compete in preselected problem solving events such as an egg drop and CO2 cartridge model car racing. On the other hand, British children are asked to design and create devices to aid the handicapped, low cost alternative shelter, and communication vehicles such as computer generated newspapers. These typical activities illustrate a different view of the role of technology in the classroom as British students are being given much more control of technology and, hopefully, learning that they can control technology.

Curiously, it was the influence of Dewey that helped to support industrial arts educators at the beginning of this century, but it is the social reconstructionist purpose of industrial arts which Dewey (Dewey and Childs, 1933) advocated that has been diminished in technology education curriculum. As generations of industrial arts and technology education teachers parroted the Bonser and Mossman definition of industrial arts (1923), the last line, ". . . of the problems of life related to these changes." (p. 5) seems to have been forgotten.

<u>A Singular Cultural View</u>

The ideology of most technology education researchers is indicated by the way in which most research is conducted and it is positivistic. In fact, a quick review of what international research is available in the United States immediately demonstrates that studies from Great Britain (Reid, 1992; Shield, 1992) tend to use qualitative methods and focus on students and classroom practices, rather than the mainstream reliance upon quantitative and descriptive research practiced in the United States. There appear to be international differences in perspectives on research.

There are also international differences in the practice of technology education. As technology education in the United States evolved from a skills based industrial arts curriculum, innovation in technology education has been to adopt an adaptive systems of technology curriculum by using an engineering model, the input, processes, output, and feedback loop, for identifying adaptive systems curriculum. Using this model for curriculum development has maintained the tradition of industrial arts in technology education as curriculum is created by focusing on skills as processes. At the same time, craft educators in Great Britain, evolved from basing their curriculum on craft skills to basing their technology education curriculum on a problem solving approach in which skills are subordinated to the main goal of taking on a technological problem, designing a solution, and creating a prototype of the solution (Kimbell, 1982; Barlex and Kimbell, 1986). In two English speaking countries, two different approaches to the same problem evolving subject matter were taken. Ideological differences, particularly in educational beliefs, appear to be the stage for the variations.

The ideological differences between Great Britain and the United States are also illustrated by the now growing cooperation between technology educators from both countries. British problem solving models are being introduced in the United States not as ideas which have grown from tradition, here, but as imports. Problem solving activities generated in the United States have tended to involve competitive events which demonstrate a very different view of technological problem solving than a focus on social problems related to technology. The ability to successfully implement the British style of problem solving will depend upon the thorough understanding of the underpinning ideology of the British models and, there is evidence in the research base to indicate that teachers are not ready to accept that ideology.

Not only do technology educators in the United States cling to a singular cultural view of technology education, it is a view dominated by masculinity. Perhaps, this is due to the domination of a Western, male view of technology in general (Wajcman, 1991; Haraway, 1989; Haraway, 1991) and this view is reproduced within education (Smith, 1991) and, therefore, technology education as a subculture. Yet, no one in society or in technology education can afford to face the future with outmoded ways of thinking which will not address the needs of those whom they serve. The nature of technology, economies, and work is changing in our society. Haraway (1991) states:

> As robotics and related technologies put men out of work in 'developed' countries and exacerbate failure to generate male jobs in Third World 'development', and as the automated office becomes the rule even in labour-surplus countries, the feminization of work intensifies. Black women in the United States have long known what it looks like to face the structural unemployment ('feminization') of black men, as well as their own highly vulnerable position in the wage economy. It is no longer a secret that sexuality, reproduction, family, and community life are interwoven with this economic structure in myriad ways which have also differentiated the situations of white and black women. Many more women and men will contend with similar situations, which make cross-

gender and race alliance on issues of basic life support (with or without jobs) necessary, not just nice. (p. 168).

Technology educators need to address the future by beginning to address the diversity of the communities which they serve. Survival in the future for all of us will depend upon technological literacy which is often held as a goal of technology education, but it will not be enough to equip men with technological literacy as more families depend upon women for part or all of their survival needs.

Technology educators who are looking for a single, unifying curriculum may not be able to address the needs of all people. There is evidence that they have been reproducing a biased curriculum with respect to gender, class, and ethnicity. Legitimating and reproducing the traditional knowledge of manual training and industrial arts which was based upon the skills men needed in order to compete in an industrial society will probably be inadequate for the future. Postmodern theorists such as Foucault (1980) have helped to explain how knowledge which is legitimated by society sustains the power of the dominant group and reproduces unequal relations. That is the path on which technology educators are currently. In order to prepare for the future, technology educators need to begin to think of alternative ways in which to conceptualize their subject matter in order to reach the diverse population of citizens in this society. They must rethink the way in which they legitimate the knowledge of technology education for students in order to meet their needs and wants. About legitimate knowledge and diversity, Wright (1992) states:

> Thus the established order, as legitimate, sustainable social order, with its rationality referred to language rather than to nature, would have to encourage the legitimacy of social differences as a matter of principle, on

> the recognition that reflexive rationality is an issue of legitimate differences, of viable differences in position and perspective within any given order. The social commitment could not be to a 'true' set of specific *kinds* of people: property owners, market competitors, workers, and so on. Rather, the social commitment must be to legitimating the *principle* of difference, to encouraging and multiplying different kinds of people and positions and values for their own sake, within the bounds of social order, because it would be through the legitimacy of difference that new and necessary forms of rationality would emerge. (p. 212)

Technology education curriculum, as language about technology which is intended to be for all students, needs to incorporate the diversity of people, positions, and values in order to reach those students and to serve a role as a socially valued subject in the schools' curriculum.

As with postmodern theories, feminist theories also encourage diversity in view,

> Feminist theories, like other forms of postmodernism, should encourage us to tolerate and interpret ambivalence, ambiguity, and multiplicity as well as to expose the roots of our needs for imposing order and structure no matter how arbitrary and oppressive these needs may be. If we do our work well, reality will appear even more unstable, complex, and disorderly than it does now. (Flax, 1990, p. 56)

Both postmodern and feminist theories point to diversity as a direction for the future and can provide for technology educators some of the ideology for avoiding a restricted cultural view and creating change in the profession.

Summary

If technology educators wish to maintain a recognizable place for technology education in the schools' curriculum, they have important choices to make. The existing image and practices in technology education provide the public with a conception of a subject matter which is prevocational training for primarily healthy boys. Technology educators may be content with this image and wish to continue the tradition, although they will be serving an ever growing smaller segment of the population in the United States and they will continue to risk elimination in general education due to the inability to serve the needs of all students. If technology educators wish to meet the goals which they set forth for teaching all students about technology, then, they must address the hegemony which exists in their profession. Unless the public as students, parents, and other educators can be convinced that technology education is a valuable subject for all children to study, there should be no place for technology education as it is now constructed in the schools of the future. If nothing else eliminates technology education, a tight budget which does not permit spending money in schools on anything but classes for all children, will eliminate technology education. Failure to demonstrate significance for all students and to maintain the support of the majority of the public will lead to the elimination of subject matter in fiscally conservative times.

Improving the image of technology education and its relevance to all students is not a simple content problem. The results of the changes in content since the 1960s have not brought about widespread endorsement or recognition of the subject. Technology educators face a larger ideological issue; one that has grown in complexity due to 100 years of inbreeding and benign neglect and one that is evident in current classroom and research practices.

Significant changes must occur in the ideology of technology education in order to meet the challenges of future society. In order for technology education to be a viable subject for all students, technology educators must understand and accept the power associated not with hierarchies of singularity, but understand and accept the power associated with diversity in language and culture.

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