Articles

Selected Leaders' Perceptions of Approaches to Technology Education

Patrick N. Foster and Michael D. Wright

The arena in which the history of technology education has been played out may be considered a marketplace of ideas. As far back as can be reasonably traced, several versions of formal industrial and technological education have existed simultaneously, often in competition with each other. There has never been complete consensus about which direction the field should take—and there probably never will be. At times, however, a proliferation of competing models has preceded major change in the field.

Is the present one of those times? The Jackson's Mill curriculum, released in 1981, was heralded as a demonstration of consensus in the field (see Householder, 1989), yet the debate regarding the direction of the field continued, only quieting after the American Industrial Arts Association changed its name in 1985 to the International Technology Education Association.[1]

But since then it has become clear that while a reasonable degree of consensus has been reached regarding the *name* of the field—"technology education"—a lack of uniformity has been ascribed to ostensibly more substantial characteristics of the field (Wright, 1992; cf. Petrina, 1993). In response, various approaches to technology education have been advanced. Bensen and Bensen (1993) suggested taking a new approach to the field, while Lewis (1994) implored technology educators to be true to the original objectives of the field (cf. Zuga, 1994; Petrina, 1995).

As demonstrated in the following review of the literature, if professionals desire to redirect the field in response to its problems and opportunities, they clearly have a wide variety of models of technology education from which to choose. In this study, selected leaders in technology education were asked to provide their opinions of the efficacy of these models.

Pertinent Literature

For as long as (industrial) technology education has been a part of American education, multiple approaches to the profession have been advanced and advocated. Technology educators may be well aware of current approaches to

---

Patrick N. Foster is an Instructor and Michael D. Wright is an Assistant Professor in the Technology and Industry Education Program, University of Missouri, Columbia, MO.

[1] Of course the debate was not entirely ended; see Feirer (1985), Nee (1993), Hutton (1992).

the field, but few are conversant with its history (Petrina & Volk, 1995). Pertinent literature was reviewed as an investigation of the history of competing conceptions of the field.

Before the 20th Century

At least three distinct conceptions of industrial education are often presented simultaneously as the early history of the field. These include "object teaching," a teaching method advocated by, for example, Pestalozzi and Sheldon (see Mossman, 1924, p. 3); "cultural industrial education" such as that represented by Comenius, Basedow, and later, Bonser and Mossman (Anderson 1926, p. 223-224); and programs of tool instruction or "manual training" for children and young adults operated by educators such as Woodward and Sheldon (see Barella & Wright, 1981; Snyder, 1992). These competing models and others would eventually interact to produce movements familiar today.

The First Quarter of the 20th Century

In 1907, Bennett contrasted a growing "industrial education" movement in the schools, which was "cultural by virtue of being highly vocational," with manual arts, which he defined as "work that is cultural first and then vocational" (p. 190). He recommended that the manual arts profession make specific and deliberate adjustments to meet more vocational demands (p. 193-195). A decade later President Woodrow Wilson signed the Smith-Hughes Act, which initially provided $1.86 million in funding for vocational programs in public schools. As Snyder (1992) noted:

> There were now two similar, yet distinctly different, forms of industrial education provided for by the American public educational system. Traditional general education programs, whether they were called manual training or industrial arts, were now in company with the new vocational education program (p. 90).

Meanwhile Teachers College, Columbia University faculty members Bonser, Mossman, and Russell were formulating the industrial arts movement in reaction to the lack of social and cultural context of manual training (Bonser & Mossman 1923; see p. 479). Whereas today the general-education conception of technology education can claim its theoretical basis directly from the cultural-industrial conception as interpreted by Bonser and Mossman (Foster, 1994), the actual *practice* of the field may in fact be more closely associated, at least historically, with the distinct movement of manual training (Lindbeck, 1972).[2]

From the 1960s to the 1980s

Cochran's (1968) dissertation and subsequent book (Cochran, 1970) provided detailed accounts of twenty competing approaches to industrial arts, primarily from the 1960s. What is of special interest is the means employed by

---

[2] See Petrina and Volk (1995; and in press) for a more complete (re)consideration of the time period following the work of Bonser and Mossman.

Cochran to divide the approaches evenly into four groups of programs—integrative, occupational-family, interpretation-of-industry, and technology-oriented—based on Swanson's (1965) four "visualizations" of industrial arts. Both Swanson and Cochran viewed varying conceptions of the field from the point of view of "a body of knowledge from which to draw…content" (Swanson, 1965, p. 59), whereas in this study, conceptions which viewed technology education as a process or methodology were considered along with content-oriented conceptions of the field.

In 1973 AIAA president DeVore suggested that the name of the association be changed to the "American Technology Education Association" (p. 484); soon he and Lauda were suggesting that the name of the profession be changed "to technology education to reflect cultural reality" (DeVore & Lauda, 1976, 145). By the turn of the decade, *technology*—instead of the traditional *industry*—was often being considered the content base for industrial arts in the US. This was evident in the influential *Jackson's Mill* curriculum (Snyder & Hales, n.d.), which refined earlier works by Warner (1947), Olson (1957), and others, and subdivided industrial arts into communication, construction, manufacturing, and transportation. The name of the American Industrial Arts Association was changed to the *International Technology Education Association* in 1985 (Streichler, 1985).

It should be noted that most of those who urged the profession to carefully consider the name change were not simply opposed to change. In fact, they were generally in favor of progress in the field. Other suggestions for advancing the field included teaching the industrial sciences (Lange & Hayes, 1981), industrial technology (e.g. Wright, 1985), aligning more closely with vocational education (Good & Good, 1981), and many others.

The Present

The recent technology education literature is replete with new approaches to technology education, a number of which have appeared repeatedly. Some are more commonly associated with certain levels of schooling (i.e. elementary, middle, high-school) than others.

Several of the approaches have an integrative theme, often involving science content or instruction. These include math/science/technology integration (e.g. LaPorte & Sanders, 1993), the science, technology, and society view (e.g. Roy, 1990), and the practical science approach (White, 1983). The engineering systems approach (e.g. Bensen and Bensen, 1993) is also a variation of this.

Many writers advocate viewing technology education from an organizational standpoint. A career-awareness focus has been suggested as part of an elementary program (e.g. Technology Student Association, 1994); the modular approach (e.g. Neden, 1990) is often advocated for middle or junior-high schools, and a "tech-prep" program as a part of—or the basis for—a high-school program (Conroy, 1995). Technology education has also been viewed as constructive methodology for teaching important content from other school subjects (Kirkwood, 1992a, 1992b), or as a student-centered means for increasing self-awareness and self-worth (Maley, 1973; Petrina & Volk, 1991).

Finally, others see new roles for technology education in schools. Examples of this include the process-driven design and technology (Todd & Hutchinson, 1991) or problem-solving (Sittig, 1992) view, and the quickly growing field of educational technology (Hornsby, 1993).

Purpose of the Study

Although the alternatives for technology education today may differ from those advanced in the early 1980s, it is clear that the profession has many directions from which to choose. The purpose of this study was to identify the opinions of leaders in technology education in the United States regarding future directions for the field at the elementary, middle, and high-school levels.

Specifically, the study was designed to address three research questions:

1. Which approaches are perceived by the selected leaders of technology education as most appropriate for elementary-, middle-, and high-school technology education?
2. Are the opinions of the different groups of leaders regarding appropriate approaches for technology education similar or different?
3. Do leaders feel that the same approach(es) to technology education are applicable at all three levels of schooling?

Methodology

Perceptions of Members of the Profession

In the field of technology education, a common method of determining the perceptions of individuals has been the use of a survey instrument. For example, Bensen (1984) randomly sampled AIAA members, asking their opinion regarding the name of the profession. That survey generated data which allowed comparisons between different groups of industrial-arts professionals. Shortly after the Bensen study, Dugger coordinated a series of annual “surveys of the profession” (e.g. Dugger, French, Peckham, & Starkweather, 1991). The surveys were designed to collect various data, most prominent among them high-school course offerings. They have often been used in the literature to show a lack of change in the field over time (e.g. Komacek, 1992).

Population

An effort was made to include a broad array of leaders in the profession, including classroom teachers, supervisors, teacher educators, pre-service teachers, and members of the boards of directors of professional associations.

Leaders among those in the latter category were the eight members of the American Vocational Association’s Technology Education Division (AVA-TED) board and the twelve members of the Board of Directors of the International Technology Education Association (ITEA). Leaders among pre-service teachers were the six student officers of the Technology Education Collegiate Association (TECA).

The forty-six recipients of the 1994 ITEA Teacher Excellence Award were the leaders among classroom teachers; department chairs, or the person responsible for the technology education program, of the twenty-nine technology education programs accredited by the National Council for Accreditation of Teacher Education (NCATE) were selected as leaders among college professors. Finally, leaders among technology education supervisors were the fifty-five state and territorial supervisors for technology education and/or industrial arts.

Thus the raw total population for the study was 156. In two cases, an individual's name appeared on two different lists of leaders. Their names were removed from the larger of the two lists on which they appeared. This brought the population to 154. Furthermore, five state supervisors for technology education whose surveys were returned by the US Postal Service as undeliverable were removed from consideration for this study. Thus the total population was 149.

While many leaders in the field may not be members of the groups selected for this study, and despite the population limitations of any such study in technology education (see Volk, 1995), this methodology provided a mechanism to select leaders recognizable as such to their peers.

Instrument

A careful review of the literature resulted in a list of approaches to technology education to be included on the instrument. The instrument was reviewed by six leading researchers in technology education from six different states and was refined on the basis of their recommendations.

The final survey instrument contained a list of twelve approaches to technology education which have appeared recently in professional literature. Each was assigned a letter from A to L. The instrument also included blank lines for write-in responses. The approaches included on the instrument are listed in Table 1. Every item on the list was further described with a parenthetical statement. For example, the item "constructive methodology" was described as "hands-on activities for teaching school subjects."

Respondents were asked to rank the three approaches they felt were the most appropriate at the elementary, middle, and secondary school levels. Thus each instrument contained fields for nine responses: one each for the respondent's first, second, and third choices at each of three levels of schooling. This was to be done by writing the letter corresponding to the respondents' choice in each of the fields.

Data Collection

The data were collected in the first quarter of 1995. One hundred fifty-four surveys were prepared. Each potential respondent was assigned a distinctive identification number which distinguished them as an individual and as a member of one of the six population groups (TECA officers, AVA-TED board members, ITEA board members, teacher excellence award winners, state supervisors, and chairs of NCATE-approved technology education programs). The surveys were coded using the same scheme.

Table 1
Items Included on Survey

A. applied or practical science approach (e.g. principles of technology; unified science & technology)
B. career emphasis (career awareness/exploration; career clustering)
C. constructive methodology (hands-on activities for teaching school subjects)
D. computer emphasis (educational technology)
E. design/problem-solving approach (e.g. TIES magazine; modified U.K. model)
F. engineering systems approach (engineering as basis for technology education; e.g. Bensen & Bensen approach)
G. extra- or non-curricular activities (e.g. TechnoKids, TSA; in-school, non-curricular projects)
H. math/science/technology integration
I. modular approach (self-contained learning stations)
J. socio-cultural approach (liberal-arts focus; STS)
K. student-centered approach (Maley, Dewey)
L. tech prep (school-to-work; articulated 2+2 program; parallel track to college-prep)
-- (fill-in)

Each potential respondent was mailed a personalized letter, the appropriately numbered survey, and a postage-prepaid envelope. The letter informed the addressee of the intent of the research and thanked him or her for participating.

Individuals who did not respond within a specified time frame were mailed or faxed follow-up letters. In all, 131 individuals (87.9%) returned usable instruments. Group response rates were as follows: state supervisors, 83.7%; teacher educators, 89.2%; teachers, 84.8%; ITEA board members, AVA-TED board members, and TECA officers, 100% each.

Data Analysis

Since respondents were asked to rank their choices, responses were weighted in the following manner: one point for each third-choice response, two points for each second-choice response, and three points for each first-place response. These points were summed to determine each item's *weighted score* assigned by each group at each grade level.

To address the first research question, ranks were computed for the items based on these weighted scores. At each level of schooling, a separate ranking was calculated for each group of leaders; in addition, a ranking based on the responses of all groups was calculated for each level of schooling.

To address the other two research questions, which related to agreement among groups and among grade levels, the Kendall concordance (W) statistic was employed.

Results

Research Question 1: Which approaches are perceived by the selected leaders of technology education as most appropriate for elementary-, middle-, and high-school technology education?

Based on all responses, the total weighted score of each item was calculated for each of the three levels of schooling (elementary, middle and high school). Table 2 lists the top five choices of the aggregate sample at each level of schooling. Item names in this table have been abbreviated from those in Table 1.

Table 2
Leaders' Perceptions of the Most Appropriate Approaches to Technology Education: Top-ranked Choices of all Respondents [n=131 (87.9%)] by Level of Schooling

Rank	Elementary	Middle School	High School
1	Constructive methodology (221)[a]	Modular (158)	Math/science/technology integration (129)
2	Design/problem-solving (99)	Design/problem-solving (137)	Design/problem-solving (127)
3	Career emphasis (80)	Career emphasis (88)	Tech prep (123)
4	Math/science/technology integration (72)	Math/science/technology integration (83)	Engineering systems (92)
5	Student-centered (71)	Constructive methodology (80)	Applied/practical science (91)

[a] The number is the item's weighted score at the respective level of schooling.

The table suggests strong agreement regarding the most appropriate approaches to elementary-school technology education; *constructive methodology* was the top choice of more than twice as many respondents as any other approach. At the middle-school level, the *modular approach* to technology education was the highest-ranked of the aggregate, although *design/problem-solving* received strong support as well. At the high-school level there was, in essence, a virtual tie among three approaches.

Additionally, two items were highly ranked at all three levels of schooling. *Design/problem-solving* was ranked second at each level by the aggregate; *math/science/technology integration* was ranked among the top five at each level. Finally, four of the top five items at the elementary-school level were also among the top five choices at the middle-school level.

It should be noted that the aggregate listings in Table 2 consider each respondent equally, and thus differ from "true rankings" Kendall (1947, p. 410) in Tables 3, 4 and 5 which are based on group data, not individual responses.

Table 3
Leaders' Perceptions of the Most Appropriate Approaches to Technology Education at the Elementary School Level by Group

Item	ITEA Board *n=12*	TED Board *n=8*	Dept Chairs *n=25*	State Sup's *n=41*	Tchr Awrds *n=39*	TECA Offcrs *n=6*	*M*
Constructive methodology (C)	1	1	1	1	1	1	1.00
Design/problem-solving (E)	2	3.5	3	4	2	4	3.08
Career emphasis (B)	4	3.5	5	2	6	4	4.08
Extra/non-curricular activs. (G)	3	2	6	5	5	6	4.50
M/S/T Integration (H)	5	8	4	3	7	2	4.83
Computer Emphasis (D)	9	6	7	6	3	4	5.83
Student-centered (K)	7	5	2	7	4	11	6.00
Socio-cultural (J)	6	8	8.5	10	9.5	7.5	8.25
Applied/practical science (A)	8	11.5	8.5	8	9.5	7.5	8.83
Modular (I)	11.5	11.5	10	9	8	11	10.17
Tech prep (L)	11.5	8	12	13	13	11	11.42^{b}
(other)	11.5	11.5	12	11	11.5	11	11.42^{b}
Engineering systems (F)	11.5	11.5	12	12	11.5	11	11.58

Sum of Squares: 5332.5; Kendall's W: 0.8139; Adjusted W: 0.8357 (p<.01)
^{b}Indicates tie

Table 4
Leaders' Perceptions of the Most Appropriate Approaches to Technology Education at the Middle School Level by Group

Item	ITEA Board *n=12*	TED Board *n=8*	Dept Chairs *n=25*	State Sup's *n=41*	Tchr Awrds *n=39*	TECA Offcrs *n=6*	*M*
Modular (I)	5	2	2	1	1	1	2.0
Design/problem-solving (E)	3	5	1	2	2	2.5	2.6
Career emphasis (B)	2	4	4	3	5	10.5	4.8^{b}
M/S/T integration (H)	4	7.5	3	4	4	6	4.8^{b}
Constructive methodology (C)	6.5	3	6	5	3	5	4.8^{b}
Student-centered (K)	1	1	5	6.5	8	10.5	5.3
Engineering systems (F)	8.5	11.5	8	10	9.5	2.5	8.3
Applied/practical science (A)	10	9	7	8	7	10.5	8.6
Computer emphasis (D)	11.5	11.5	10	9	6	4	8.7
Extra/non-curricular activis. (G)	13	7.5	12	6.5	9.5	10.5	9.8
Socio-cultural (J)	6.5	11.5	10	13	12.5	7	10.1
(other)	8.5	11.5	10	11	11	10.5	10.4
Tech prep (L)	11.5	6	13	12	12.5	10.5	10.9

Sum of Squares: 4107; Kendall's W: 0.6268; Adjusted W: 0.6391 (p<.01)
^{b}Indicates tie

Research Question 2: Are the opinions of the different groups of leaders regarding appropriate approaches for technology education similar or different?

A ranking of the items on the instrument (including an item for "other choice") was identified for each of the groups surveyed. Research Question 2 concerned whether these six rankings were in agreement. Kendall's concordance (W) statistic (see Hays, 1976) is specifically intended for this purpose. It is a measure of "general agreement" among more than two rankings (Kendall, 1947, p. 410), and as such was the appropriate means for addressing this research question.[3]

Tables 3, 4, and 5 present the results of the calculations for each level of schooling. Again, item names have been abbreviated.

Table 5
Leaders' Perceptions of the Most Appropriate Approaches to Technology Education at the High-school Level by Group

Item	ITEA Board *n=12*	TED Board *n=8*	Dept Chairs *n=25*	State Sup's *n=41*	Tchr Awrds *n=39*	TECA Offcrs *n=6*	*M*
M/S/T integration (H)	1	2	2	2.5	2	3	2.1
Design/problem-solving (E)	4	7.5	1	4	1	1	3.1
Tech Prep (L)	7	1	4.5	1	4	2	3.3
Applied/practical science (A)	3	3.5	3	5	3	12.5	5.0
Engineering systems (F)	2	10	4.5	2.5	5	10.5	5.8
Constructive methodology (C)	6	5	6.5	6	6	12.5	7.0
Socio-cultural (J)	5	3.5	10	12	13	5	8.1
Modular (I)	11.5	10	8.5	8.5	7	4	8.3
Career emphasis (B)	8	7.5	11	10	8	7.5	8.7
(other)	9	12.5	8.5	7	10	7.5	9.1
Student-centered (K)	11.5	6	6.5	11	12	10.5	9.6
Computer emphasis (D)	11.5	10	12.5	13	9	7.5	10.6[b]
Extra/non-curricular (G)	11.5	12.5	12.5	8.5	11	7.5	10.6[b]

Sum of Squares: 3648; Kendall's W: 0.5569; Adjusted W: 0.5659 (p<.01)
[b]Indicates tie.

The six groups were found to be significantly in agreement at all three levels of schooling (p<.01 in all cases).[4] Kendall's original test for significance (Kendall, 1948) was employed over the more common chi-square equivalent (Hays, 1976) because of the number of rankings.

The concordance figures indicate that the six groups in the study were considerably more in agreement regarding the appropriateness of approaches at

---

[3] All Kendall's W figures have been adjusted for ties per Kendall (1948).

[4] Due to the number of items being ranked, the degrees-of-freedom figures used in the test for significance were relatively large. Therefore, for example, although less than 57% of the possible agreement existed at the high-school level, the concordance figure was easily significant at the .01 confidence level. It should be noted that the test for significance of W is a test of the (null) hypothesis that the rankings do not represent a significant departure from randomness.

the elementary level (W_{adj} = .836) than at the middle-school level (W_{adj} = .639); they were in less agreement about the high-school level (W_{adj} = .566) than the middle-school level. Symbolically, this may be expressed as $W_{elementary} > W_{middle} > W_{high\text{-}school}$; in general, the groups of leaders in technology education surveyed tended to agree about which directions would be most appropriate for the field at each level of schooling.

Research Question 3. Do leaders feel that the same approach(es) to technology education are applicable at all three levels of schooling?

The benefit of testing for the significance of Kendall's W calculated for agreement among groups of leaders (Research Question 2, above) is that significant concordance among a set of rankings implies that a "true ranking" of items exists. Significance was found for intergroup concordance at the elementary, middle, and high school levels, so the orders in which the items appear on Tables 3, 4, and 5 may be considered "true." According to Kendall (1947, 1948), a "true ranking" is the order assigned to a series of objects judged by three or more concurring judges.

Research question 3 concerned the concordance of these three rankings. Kendall's W was used again, in this instance to identify agreement among the true rankings at the various levels. The result (W_{adj} = .122) was found not to be significant ($p>.05$), suggesting that no true ranking of items on the instrument exists when level of schooling is not taken into account. Three pairwise post-hoc Spearman's rho (r_s) tests were performed to determine whether significant correlations could be found between any of the pairs of grade levels. Again the results were not significant ($p>.05$). Table 6 summarizes the statistics calculated for this research question.

Table 6
Agreement Among Rankings at Various Levels of Schooling

test	*levels compared*	*result*	*significant?*
Concordance of true rankings	elementary, middle, and high school	W_{adj} = .1221	no ($p>.05$)
Correlation of true rankings	elementary and middle school	r_s = .4876	no ($p>.05$)
Correlation of true rankings	middle and high school	r_s = .2569	no ($p>.05$)
Correlation of true rankings	elementary and high school	r_s = -.0330	no ($p>.05$)

There was a perceptible, albeit statistically insignificant, correlation between favored approaches to elementary- and middle-school technology education, and a weak correlation between approaches at the middle- and high-school levels. It is clear from the comparisons of opinions at the elementary- and high-school levels, as well as from the simultaneous comparison of all three levels of schooling, that the groups felt that technology education should be approached quite differently at the elementary level than in secondary technology courses.

Discussion

The review heretofore of the results of the study has begged a serious question: what do the items on the instrument mean? Did they mean the same things to all respondents and to all groups? The overwhelming support for *constructive methodology* at the elementary level suggests some degree of shared meaning within and across groups, yet a variety of interpretations might still be possible. On the other hand, the groups were clear in recommending an emphasis on design at all levels, and a career awareness emphasis in elementary and middle school.

Two major points may be made about the results of this study, neither of which are hampered by possibilities of multiple interpretations of specific instrument items.

It is clear from the results of the study that there is significant agreement about approaches to technology education among widely varied groups of leaders in the field. This agreement is very strong at the elementary level, less so at the middle-school level, and even less so at the high-school level. This may confirm the sense some professionals have that the field's high-school program has yet to be solidified (e.g., Savage & Bosworth, n.d.). Although the ITEA and AVA-TED have historically represented significantly different philosophies (Bell, 1964), there was surprising agreement between the boards governing the two. Both felt that the *student-centered* approach was the most appropriate at the middle-school level, for example—although this approach received very little support from any other group. The boards—both of which were comprised of individuals represented by three of the other groups (teachers, supervisors, and teacher educators)—also supported a *career emphasis* at the elementary and middle-school.

Second, the six groups of leaders indicated that an approach to technology education appropriate at one level of public education may not be as appropriate at another. Respondents overwhelmingly chose to view technology education as a *method* at the elementary level; at the middle school level, they regarded it from an *organizational* standpoint. There was less agreement at the high school level, where the top choice related to the *content* of technology education and its integrative nature. Despite this variety, at all levels the leaders placed the *process* of design second among all priorities at every level of schooling.

The implications for K-12 curriculum and program development, including the impending national technology education standards, may be that technology education cannot be explicated by a single model which is simpler at lower grade levels and more complex in later schooling. Perhaps the form which such a curriculum would take should vary. At the high-school, for example, a list of what students should know might be sensible if technology education at that level has a content focus. But elementary-school technology education, the results of the survey suggest, is not simply a watering-down of secondary curricula.

Final Thoughts

For technology education, “it is clear that the good old days no longer exist” (Johnson, 1993, p. 45). It seems unlikely that the profession can survive in the current educational climate without redefining its role in the public schools. If this is to be done, the field has a variety of approaches to and models of technology education among which to choose.

This study has raised and addressed a number of questions about appropriate models for technology education at different levels of schooling. The purpose in raising such questions is not to accentuate division in the field—in fact a substantial degree of consensus was found. On the other hand, the purpose is not to employ this consensus to understate the seriousness of the immediate problems the profession faces. Rather, the purpose in raising these questions is to identify agreement and diversity in the field. Such inquiry should be an ongoing process and should help to ensure that leaders in the profession have appropriate information upon which to base decisions about the future of the profession.

References

Anderson, L. (1926). *A history of manual and industrial school education*. New York: Appleton.

Barella, R. & Wright, R. (Eds). (1981). *An interpretive history of industrial arts*. Bloomington, IL: McKnight.

Bell, C. A. (1964). *A comparison of the American Industrial Arts Association and the Industrial Arts Division of the American Vocational Association with opinions concerning certain issues in industrial arts*. [Unpublished Doctoral Dissertation.] Columbia, MO: University of Missouri–Columbia.

Bennett, C. (1907). The manual arts: to what extent shall they be influenced by the recent movement toward industrial education? *Manual Training Magazine, 8*(4), 189-195.

Bensen, M. (1984). Educational research—Study of a name change for the American Industrial Arts Association. *Man/Science/Technology, 43*(8), 23-26.

Bensen, M. & Bensen, T. (1993). Gaining support for the study of technology. *The Technology Teacher, 52*(6), 3-5; 21.

Bonser, F. & Mossman, L. (1923). *Industrial arts for elementary schools*. New York: MacMillan.

Cochran, L. H. (1968). *A comparison of selected contemporary programs in industrial education.* [Unpublished Doctoral Dissertation, Wayne State University].

Cochran, L. H. (1970). *Innovative programs in industrial education.* Bloomington, IL: McKnight & McKnight Publishing Company.

Conroy, M. (1995). Tech ed and tech prep—The missing link. *Tech Directions, 54*(8), 21-23.

DeVore, P. W. (1973). The president’s report, 1972-1973. In American Industrial Arts Association, *Industrial Arts and the Challenge of an Urban Society: Representative Addresses and Proceedings of the American Industrial Arts Association’s 35th Annual Conference at Atlantic City, NJ.* (pp. 481-488). Washington: AIAA.

DeVore, P., & Lauda, D. (1976). Implications for industrial arts. In L. Smalley, (Ed.) *Future alternatives for industrial arts*. (pp. 137-162). Encino, CA: Glencoe.

Dugger, W. French, B., Peckham, S. & Starkweather, K. (1991). Sixth annual survey of the field shows changes and challenges. *School Shop/Tech Directions, 50*(7), 21-23.

Feirer, J. (1985). Industrial arts - Does it have a future? In N. Andre & J. Lucy (Eds.), *Proceedings of Technology Education Symposium VII, Technology education—Issues and trends* (pp. 75-86). California, PA: California University of Pennsylvania.

Foster, P. (1994). Technology education: AKA industrial arts. *Journal of Technology Education 5*(2), 15-30.

Good, J. & Good, M. (1981). Industrial arts education: should it be vocationally oriented? *Man/Society/Technology, 41*(2), 2-3.

Hays, W. L. (1976). *Statistics for the social sciences*. New York: Holt, Rinehart and Winston, Inc.

Hornsby, D. (1993). What makes an award-winning tech ed program—Beechwood. *Technology Education for Children Council Newsletter*, Fall, 1993, 8-9.

Householder, D. (1989). The emerging curriculum. *The Technology Teacher, 48*(3), 11-14.

Hutton, D. (1992). To nology or not to nology? *Tech Directions, 52*(1), 37-38.

Johnson, S. D. (1993). Abandon ship, change course, or ride it out: A reaction to Walker. *Journal of Industrial Teacher Education, 30*(4), p. 43-48.

Kendall, M. G. (1947). *The advanced theory of statistics*. [Vol. 1]. London: Charles Griffin & Company, Ltd.

Kendall, M. G. (1948). *Rank correlation methods*. London: Charles Griffin & Company, Ltd.

Kirkwood, J. J. (1992a). Teaching children about simple machines. *The Technology Teacher*, *52*(1), 9-11.

Kirkwood, J. J. (1992b). Elementary school math and technology education. *The Technology Teacher*, *52*(4), 29-31.

Komacek, S. (1992). Transportation technology education: Rationale, structure, and content. In J. Wright & S. Komacek, (Eds.) *Transportation in technology education* (p. 33-70). Peoria, IL: Glencoe, Inc.

Lange, R. & Hayes, B. (1981). Industrial sciences—technology education for the 80s and 90s. *Man/Society/Technology, 41*(2), 8-10.

LaPorte, J. & Sanders, M. (1993). Integrating technology, science, and mathematics in the middle school. *The Technology Teacher, 52*(6), 17-21.

Lewis, T. (1994). Limits on change to technology education curriculum. *Journal of Industrial Teacher Education, 31*(2), 8-27.

Lindbeck, J. (1972). *Practical guide to industrial arts education*. New York, NY: The Center for Applied Research in Education, Inc.

Maley, D. (1973). *The Maryland Plan.* New York: Benzinger, Bruce & Glencoe.

Mossman, L. (1924). *Changing conceptions relative to the planning of lessons*. New York: Teachers College, Columbia University.

Nee, J. (1993). Unity through diversity. *Tech Directions, 52*(8), 47-49.

Neden, M. (1990). Delta County technology project. *The Technology Teacher, 50*(3), 25-29.

Olson, D. W. (1957). *Technology and industrial arts.* Columbus, OH: Epsilon Pi Tau.

Petrina, S. (1993). Diversity, not uniformity; United, not standardized: a reaction to Wright's "Challenge to all technology educators." *Journal of Technology Education, 4*(2), 71-78.

Petrina, S. (1995). The end of technology education: A response to Theodore Lewis and Karen F. Zuga. *Journal of Industrial Teacher Education, 32*(3), 75-82.

Petrina, S. & Volk, K. (1991). Using technology education to help urban students develop positive values. *School Shop/Tech Directions, 50*(9), 23-26.

Petrina, S. & Volk, K. (1995). Industrial arts movement's history, vision, and ideal: Relevant, contemporary, used but unrecognized—Part I. *Journal of Technological Studies, 21*(1), 24-32.

Petrina, S. & Volk, K. (in press). Industrial arts movement's history, vision, and ideal: Relevant, contemporary, used but unrecognized—Part II. *Journal of Technological Studies*.

Roy, R. (1990). The relationship of technology to science and the teaching of technology. *Journal of Technology Education, 1*(2), 5-18.

Savage, E. & Bosworth, F. (n.d.). *Secondary grades technology education: Technological literacy and problem-solving in action*. Reston, VA: International Technology Education Association.

Sittig, L. (1992). Kinder-tech. *The Technology Teacher, 51*(7), 7-8.

Snyder, J. & Hales, J. (n.d.). *Jackson's Mill industrial arts curriculum theory*. Charleston, WV: West Virginia Department of Education.

Snyder, M. (1992). *The transition from industrial arts to technology education in the United States: A historical perspective*. [Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University].

Striechler, J. (1985). AIAA becomes ITEA—A welcome and a perspective. *Journal of Epsilon Pi Tau, 11*(1&2), 2-3.

Swanson, R. S. (1965). Industrial arts—What is its body of knowledge? In G. Wall, (Ed.) *Approaches and procedures in industrial arts: Fourteenth yearbook of the American Council on Industrial Arts Teacher Education*. Bloomington, IL: McKnight and McKnight.

Technology Student Association. (1994). *TechnoKids*. Reston, VA: Author.

Todd, R., & Hutchinson, P. (1991). Design & technology: good practice and a new paradigm. *T.I.E.S., 4*(3), 4-11.

Volk, K. (1995). *The politics of technology education: Right to the end*. Paper presented at the 1995 International Technology Education Association Conference, Nashville, TN.

Warner, W. E. (1947). *A curriculum to reflect technology*. AIAA Feature Presentation, April 25, 1947. Columbus, OH: Epsilon Pi Tau Inc.

White, K. (1983). Early adolescence: Practical technology. *Science and Children,* October.

Wright, R. T. (1985). The nature and scope of industrial technology education. In N. Andre and J. Lucy (Eds.), *Proceedings of Technology Education Symposium VII - Technology education: Issues and trends* (pp. 21-26). California, PA: California University of Pennsylvania.

Wright, R. T. (1992). Building a defensible curriculum base. *Journal of Technology Education, 3*(2), 67-72.

Zuga, K. F.(1994). Whose authenticity? *Journal of Industrial Teacher Education, 31*(3), 79-84.