Developing Technology Teachers: Questioning the Industrial Tool Use Model

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Sanders (2001), in the conclusion of his study on the status of technology education practice in the United States, discussed the apparent "ambivalence regarding the relationship of technology education to vocational and general education" (pp. 52-53). He stated:

> These waters are muddy: the absence of meaningful dialogue within the profession regarding the relationship between technology education and vocational education has led to continuing confusion both within and beyond the field. It is time the profession addressed this issue in an articulate and thoughtful manner.

This article seeks to open this dialogue by questioning the role of technology teacher preparation programs that are based on an "industrial tool use" model to develop technology education teachers. It is the position of the authors that the manner by which technology education teachers are prepared may need revision and that technology teacher educators need to reanalyze the objectives and methods used to develop their protégés. The ideas posited in this article find their locus in the experience of the authors while directing the rewrite of the K-12 Technology Education Standards for the state of Texas.

Technical courses are those that focus on developing the knowledge and skills to use tools, machines, and equipment at a proficient level of capability. Technical courses taken at the high school level are referred to, in this article, as vocational-technical education. The technical courses taken after high school, but at a level less than the baccalaureate are referred to as technical education and are not the subject of this article. The technical courses taken in a baccalaureate program, such as industrial technology or engineering technology, are referred to as the industrial tool use model.

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Asking the Question

What is the desired outcome of a technology education program? In posing this question to the technology teachers involved in rewriting the technology education curriculum in Texas (Hansen, 1996), the authors discovered a clear dichotomy of opinion among the teachers about the purpose(s) of technology education. Teachers who described themselves as technology education teachers stated technological literacy, while teachers who called themselves industrial technology/arts teachers (they considered these to be equivalent terms) stated "career preparation." All of these teachers had completed industrial technology/arts teacher preparation programs, and one-half of them were adamant that the focus of industrial arts has always been vocational-technical skills development and that the purpose of the new technology education curriculum they were writing should remain vocational-technical skills development. This experience is confirmed by Sanders' (2001) study, which indicated that almost 40% of his respondents identified their programs with vocational education and that there appeared to be little change since 1979. He suggested that this may be because many technology education programs are still administered and funded under vocational education administrative structures.

Technology teacher educators, to a large extent, can articulate the differences in purpose and outcomes of industrial arts, technology education, and vocational-technical education. But if one observed the teaching of industrial arts and vocational-technical education in actual settings (in the classroom, at the university, or in the high school), could one detect any differences between them? If one analyzed the purpose, content, methodology of instruction, and clientele, could one tell the difference? Sanders' (2001) study indicated that 65.6% of the technology education programs still use either a "unit lab" or "general lab" for the instructional facilities. For the neophyte (parent, student, administrator, and counselor), it is suggested that there would be no perceived difference.

The perceived similarities between the laboratories and course titles of industrial arts and technology education programs should alarm the proponents of technological literacy since many industrial arts programs have "converted" to technology education without a recognizable shift in praxis. Texas, for example, was converted from industrial technology education to technology education at the stroke of an administrative pen. If the instructional methodologies, content, clientele, and purpose are pragmatically the same before and after the name conversion, aren't the new technology education programs really vocational-technical education?

How is it that the technology teachers, who are supposed to have different philosophical foundations, implement programs that look so similar? It is the authors' opinion that part of the confusion exhibited in the high school classroom in regard to the purpose, content, method of instruction, and clientele of the industrial arts and technology education programs has its origin in the technology teacher preparation programs, which are organized around an

industrial tool use mental model. If the use of this model to develop technology teachers persists, technology education may follow the same fate as industrial arts, teaching exclusively about tools, machines, and processes, and focusing on equipment and projects. The issue for technology teacher educators becomes one of implementation and practice as well as one of curriculum.

Owning the Question

The promulgation in practice of the rationale, structure, and standards for technology education described by the International Technology Education Association in its *Standards for Technological Literacy* (2000) is a critical issue for technology teacher educators. Wright (1996) asked technology educators:

> Are you trying to use a vo-tec paradigm for a fundamental area of education, a core subject or are you using an interrelated, general education sci-tech model that prepares all students, regardless of career goals, to make intelligent citizen, consumer, and career decisions? (p. 4)

If high school technology teachers require a paradigm shift, it appears that technology teacher educators might also need to shift their paradigms. Technology teacher educators can hinder change by resisting or neglecting critical revision in their programs and their instructional strategies. The issue at hand is an assessment of the organizational and programmatic structures by which technology education teachers are prepared.

Constraints on the Technology Teacher Development System

The organizational structures for programs providing technology teacher preparation have dual, if not multiple, missions. Brown (1993) suggested two classifications for technology teacher programs: (1) those housed in departments which support educational programs exclusively, or (2) those housed in departments supporting industry-oriented technical skills acquisition, i.e., industrial technology and engineering technology. Due to enrollment and budgetary constraints, the use of common courses and shared faculty for multiple programs is common (Brown; Israel, 1995; Pucel, 1997; Volk, 1997). Programs that service the largest number of students usually determine the content and methodology of the courses.

There has been an increase in the number of business- and industry-related technology programs, such as human resource development (HRD), developed by technology faculty in an attempt to secure their futures at their respective institutions (Ritz, 1997). In addition to these other options contributing to a decline in the number of students entering technology teacher preparation programs, as described by Daugherty (1997), they also dictate the content of courses in the major. In order to maintain an enrollment, undergraduate technical courses often consist of students in various "options," with the content of the course tailored to meet the needs of the majority.

The degree of technical expertise required of postsecondary students entering a technology-related profession might be significantly different from

that of prospective technology teachers (Brown, 1993). In addition, Smith (1997), in describing his perspectives on how technology teacher programs might change, suggested that the degree of technical proficiency required of future technology teachers is probably less than it was in the past and that a restructuring of the curriculum might be in order. Wright (1997) stated:

> The growth of industrial technology and engineering technology programs has presented a serious dilemma. Those programs generally focus on an in-depth study of fairly narrow areas of technology. They may offer a series of CAD courses or courses in robotics, hydraulics, CNC, and other similar topics. On the other hand, the technology education movement calls for a broadly educated teacher who understands topics such as control (integration of mechanics, electronics, hydraulics, pneumatics, etc.), automation (integration of CAD, CNC, robotics, etc.), and communication (integration of technical graphics, desktop publishing, and electronic media). (p. 32)

To a large extent, technical courses focus on developing the technical proficiencies of students to the exclusion of other knowledge and skills required for a technologically literate student, and it is these courses that often serve multiple clienteles. Israel (1995), in discussing the administration of technology teacher preparation programs, indicated that the "goals and objectives of the different technical programs and courses are usually not appropriate for the technology teacher education program" (p. 33).

If there are differences in the technical proficiencies needed to teach technology education compared to becoming an industrial or engineering technologist, should technology teacher preparation programs continue to organize themselves around an industrial tool use model? Can a "one-size fits all" perspective in developing the technical proficiency of teachers and technologists be justified? Technology teacher educators need to determine if there are differences between what a technologist needs to know and be able to do and what a technology education instructor needs to know and be able to do. Wright (1997) observed that:

> Many programs unrealistically expect the technology teacher education student to take a group of very specific, and often unrelated, courses designed for other majors and somehow develop the large picture without guidance from the technical course instructor. Also, the future teacher is expected to develop teaching skills and integrate the content from isolated technical classes in one or two professional classes. This expectation is unrealistic. (p. 32)

If, in fact, "we teach like we were taught," new technology teachers will tend to organize and teach their courses using models similar to the programs they completed. If their teacher preparation programs utilized an industrial tool use model, their objectives and strategies will reflect that model. A delineation of the knowledge and skills required of technology teachers to develop the technological literacy of students has yet to be determined, and will have critical

influence on sustaining the innovation currently underway in implementing technology education in public schools**.**

A Hypothesis on the Cause

Educators throughout the years have recognized that education about technology has the unique characteristic of being both content and method. Manual training, manual arts, industrial arts, and technology education have all taught *about* technology (content) and have also taught *with* technology (method). In describing manual arts, Cranshaw (1912) wrote: "History in a multitude of instances bears testimony to the fact that manual training is an essential educational means" (p. 18). Kilpatrick (as cited in Grinstead, 1930) stated, "Purposeful activity, under strong mind set, helps in all kinds of learning-habits, skills, attitudes, and appreciations as well as in things properly to be remembered." Lauda (1988), past president of the Council on Technology Teacher Education, stated, "Technology is the basis of the content in technology education and also the means by which it is taught" (p. 12).

The development of industrial arts education was guided by the underlying concept that "learning by doing" was an effective means of learning (Bennett, 1926; Shemick, 1985). Learning was to occur in a laboratory or workshop with some type of hands-on work incorporated into the activity (Scripture, 1899). Manual training, manual arts, industrial arts, and technology education were founded, to a large extent, on the premise that hands-on activities were an integral, if not required, component of learning about the human-made world. Learning about technology could not be done without experiences with technology and necessitated a new instructional environment: the shop. "The industrial arts shop provided the context in which students could experience the problems of industrial society and actively engage in manipulating its materials, technique, and knowledge" (Herschbach, 1996, p. 31).

Fales (1937), in discussing the relationship of industrial arts and the general education curriculum clearly divided shop-based learning into vocational and non-vocational education, and industrial arts was identified as non-vocational. Industrial arts education became synonymous with hands-on, activity-based education and eventually became synonymous with the location of the activity, the shop. Vocational-technical education, which also utilized hands-on, shop-based activities, has also become identified as shop. To the uninitiated, industrial arts and vocational-technical education looked the same and served the same purposes; they were both shop.

This confusion in program goals and implementation by teachers may have originated in the teacher education programs by the utilization of industrial tool use courses to develop the technical capabilities of industrial arts teachers. Industrial arts teacher preparation programs, located in industrial/engineering technology departments, also tend to focus on technical skills preparation (Wicklein, 1997). Brown (1993) indicated that new industrial arts teachers modeled their teaching and laboratories on the technical competency model used in college. The de facto teaching methodology and content for the preservice

industrial arts teacher became the same as that which was used for the technical skills development of industrial and engineering technologists. The shift in emphasis and time allocation from general education objectives to technical knowledge and skills objectives by the industrial arts teachers themselves effectively redefined industrial arts as vocational-technical education.

English (1992), in discussing the issues associated with aligning and auditing curricula, described the *written curriculum* that includes the published curriculum guides, state standards, and textbooks, the *taught curriculum* that includes the instruction, and the *tested curriculum* that includes standardized tests and teacher made tests. English (p. 8) stated, "These three curricula deal with content and express the absolute possibility that there could be in schools three unrelated 'contents floating around, unconnected to one another." Could this be true in industrial arts and technology education classrooms; that the written curriculum is neither taught nor tested? Is the taught curriculum an industrial tool use curriculum and not technological literacy? Is there actually a hidden curriculum focused on skill development (vocational-technical) rather than technological literacy? Obermier (1994) reported that the vast number of technology education programs he surveyed had their content developed by individual teachers acting on their own or with the recommendations of their colleagues. These teachers developed their course content without a proper "philosophical anchor" to guide their instructional design.

Could it be that the industrial arts teachers who resist the change to technology education teach a traditional unit-shop-based program focusing on skills development for specific occupations? Since they quite possibly view themselves as vo-tec educators, they legitimately resist the change because they recognize the pragmatic differences between vocational-technical education and technology education. In their minds, technology education as described by the International Technology Education Association does not adequately develop the technical skills a student needs to enter the world of work. Although they have degrees in industrial arts, and call themselves industrial arts teachers, they are by philosophy and practice vocational-technical educators as a result of their college academic experiences.

As industrial arts matured, it utilized hands-on learning as a basic argument for its continued place in the middle and high school curriculum. If that argument was true, industrial arts teachers operationally defined hands-on learning not as a strategy for instruction and learning, but as an end in itself. Rather than teach technology as a means to solve a problem or extend human capabilities, teachers taught the technical aspects of the technology (Wicklein, 1997). Teachers de-emphasized the general education objectives of industrial arts and emphasized technical skills training. Badger (1937) stated, "Too often, particularly in the field of education, we set up objectives and then forget about them and continue to emphasize subject-matter facts and skills for their own sake" (p. 160). In content and methodology, industrial arts became vocational-technical education. In describing his concern over the technical skill development issue in technology education, Wicklein (1997) editorialized:

> The critical issue is, to what degree should the curriculum be devoted to technical skill training? Historically, educators within technology education have given an exorbitant amount of instructional time to this area while slighting many of the other facets of the curriculum. An appropriate balance of tool skills with other curriculum areas is a key to a healthy curriculum. (p. 75)

Positing an Undesirable Future

Industrial arts education enjoys a rich and controversial history. Its visionaries were clear in describing industrial arts education as general education, suitable for all children (Smith, 1936). The discrepancy between the intent of industrial arts and its practice existed not so much between the visionaries of industrial arts and the general education advocates, but between what industrial arts advocates said it could do and what its teachers actually did (Foster, 1994). In the classroom it was difficult to describe exactly what the objectives of industrial arts education were since much of the content and methods were identical to those used in vocational-technical programs.

The theme of hands-on learning pervades the history of industrial arts (Foster, 1994) and became an axiom of technology-based education. Technology education has also claimed this axiom. Technology education advocates should be alarmed at the "blurring" of the distinctions between industrial arts education and vocational-technical education *by the industrial arts educators* themselves. The original objectives of industrial arts are very similar to the objectives of technology education (Foster). Simply stating that technology education is not vocational-technical education is not a sufficient safeguard against this shift in purpose and the eventual de-emphasizing of general education objectives.

Teacher preparation programs, adopting the technology education paradigm, while simultaneously utilizing an industrial tools model, may be producing pseudo-vocational-technical educators for the technology education classroom. Technology education teachers, who in philosophy and practice are really vocational educators, are likely to ignore or adapt technology education objectives to align with their vocational-technical education orientation. These technology educators will focus on classroom activities and projects and resist teaching technological literacy objectives because they are not occupationally specific. Rather than teach the objectives of technological literacy, they will revert to teaching only the restricted technical aspect of technology. Rather than using technology as a means to an end, they will teach and evaluate technical skills. The promised general education goals will not materialize, and technology education will be forced to justify its inclusion in middle and high school programs just as manual training, manual arts, and industrial arts have had to do. Only this time the failure of technology education may effectively inoculate parents, administrators, and other teachers against technology studies.

Or perhaps parents, administrators, and legislators will conclude that technology educators cannot provide technological literacy, delegating this important responsibility to those who they perceive as technology teachers, i.e.,

science and computer teachers or anybody who can manage a modular technology laboratory. The problem of who should teach technology education appears to be an issue that is not yet entirely resolved (Kanigel, 1986) and may eventually be resolved by those outside the field. Technology education is finding its subject matter being taught by unqualified teachers without the proper philosophical foundation (Sanders, 1997) or the appropriate technical training. As a result of the lack of adequate teacher preparation, the field will revert to playing technology games (bridge destruction contests and CO_2 drag racers) and doing technology busywork rather than developing technologically literate students.

Johnson, Evans, and Stem (1996), in discussing the National Association of Industrial and Technical Teacher Educators (NAITTE), stated:

> The assumption that underlies the structure and mission of NAITTE is that the programs of technology education, T & I, technical education, and industrial and military training are fundamentally similar across a wide range of characteristics. Of course these programs are not identical. Clearly, each program is based on a distinct philosophy, purpose, methodology, content area, and clientele. (p. 53)

Are the purposes, methodologies, content, and clientele distinctly different as these programs are implemented in the field, or do the differences exist only in the minds of the academicians? Teacher educators need to determine if the programs are different enough to merit separate preparation programs and if separate programs are not possible, how can they be organized to serve multiple objectives and still maintain their philosophical integrity?

A Plan of Action

Recognizing how our practices of preparing technology teachers may have exacerbated an already confused philosophy of technological literacy, it is critical that we unite and utilize our knowledge and skills as higher education faculty to create a new future for preparing teachers. Improving technology teacher education programs requires several coordinated efforts that leverage our collective experience and wisdom over the next five years. These efforts direct our focus on how we will respond on a national, university, programmatic, and individual level to the transition. A recommended plan of action for improving technology teacher preparation at a national level should include the following points:

1. All technology teacher education programs should be engaged in this process. This is not a problem limited to ITEA, NCATE, or CTTE membership. It is recommended that four national symposiums be organized over the next five years to provide the framework, planning, guidance, and evaluation of future activities. Programs in the various stages of transition must have a venue for managing and sharing their wisdom and "lessons learned." This hard-earned knowledge can assist others with the practices that helped and hindered the organization and faculty. The results

of these efforts should be promulgated as "best practices" in preparing technology teachers for technological literacy.

2. Technology teacher preparation programs need to perform curriculum audits to identify if they are providing the enabling knowledge and skills technology teachers require. English (1988) suggested that a curriculum audit may be necessary under the following conditions: (1) the stakes are high, (2) the status quo is not acceptable, (3) objectivity is necessary, (4) the past and present are not well understood, (5) public confidence and trust must be re-established or retained, (6) results count, and (7) cost is important. An affirmative answer to any *one* of these questions should trigger a curriculum audit in secondary and postsecondary technology education programs. We should be alarmed that we can affirm virtually all of the statements and may still be adhering to an inappropriate model for developing technology teachers.
3. It is the role of university and college faculty to define and research the questions related to a philosophy of technological literacy. It is university faculty who must lead the efforts to expand and extend our understanding of the critical importance of developing a technologically literate population.
4. Technology teacher educators must also identify and develop the content of technology teacher preparation programs that surpass the *Standards for Technological Literacy: Content for the Study of Technology* (2000). The proposed *ITEA/CTTE/NCATE Curriculum Standards: Initial Programs for Technology Teacher Preparation* (2003) are critical for establishing baseline outcomes for technology teacher preparation programs. We should commit to, if this is the best model for technology teacher preparation programs, adhering to these standards, regardless of our NCATE affiliations. The standards by themselves, though, cannot perpetuate the continuous improvement that must occur in the academic institutions. It is our intellectual responsibility not to teach to the standards.
5. Technology teacher preparation programs should be evaluated at several levels to truly determine their efficacy in promoting technological literacy. Kirkpatrick's (1975) four levels of evaluation attempt to answer the following questions: (1) were the participants pleased with the program? (2) what did the participants learn in the program? (3) did the participants change their behavior based on what was learned? and (4) did the change in behavior positively affect the organization? In colleges and universities, end-of-course teacher evaluations and teacher-made tests address levels one and two, respectively. Rarely, though, are levels three and four evaluated. A fifth level of evaluation has recently been added to Kirkpatrick's model, determining the Return on Investment to the organization. Do we really know what is going on in the high school technology classroom? Are technology teachers really striving to teach the goals of technological literacy? Or, are we relying on anecdotal evidence to support our favorite

programs and curriculum? Is there any evidence of the benefits, economic or otherwise, that technological literacy is providing?

6. We need to give serious consideration to what we will have to "let go of" to improve the probability that the planned changes will succeed. Technology focuses on innovation to solve problems. Innovation is stifled when one becomes fixated on the traditional solutions to problems. Traditions help us transfer our experiences and wisdom from one generation to the next, and they help us to resist fads. But, adherence to tradition often leads to traditionalism, which seeks to perpetuate tradition at the expense of the very meaning of the traditions it seeks to protect. We often react to the need for change, not by developing new paradigms but by patching up old ones. Keynes (as cited in Peters, 1997) states, "The greatest difficulty in the world is not for people to accept new ideas, but to make them forget about old ideas" (p. 78).
7. We need to recognize that this is not a "one shot" cure-all. It will be difficult to let go of the past and move toward a new beginning. Many innovations will not work well, ideas will appear ambiguous, and it will take repeated efforts to refine our programs and faculty. Thus, a national change management task force should be established to assist programs and faculty during this process.
8. We must redefine the role of the faculty in technology teacher education. It is not enough that we teach a workshop on grant writing or curriculum assessment or how to run this or that piece of equipment or software. It is not enough that we teach the technical content of our favorite areas (e.g., digital electronics, design processes, printing, digital image manipulation, materials, and processes). Our role as scholars in the academy demands that we discover new knowledge in technological literacy, that we subject this knowledge and the processes by which it was discovered to external peer review, and that we disseminate this new knowledge. It demands that we: (1) place the issues of technological literacy in larger societal contexts, (2) educate the non-technologists about technological literacy, (3) bring new insights to bear on the issues of technological literacy, (4) determine how technological literacy can help solve consequential problems. In addition, it demands that we understand that teaching is not simply about the transfer of technical knowledge and skills. Scholarly teaching requires transforming and extending our understanding of the learning process and how it relates to the development of technological literacy and technological thinking (Boyer, 1990).
9. It is imperative that models for the evaluation of technological literacy be developed and validated. Otherwise, we will not be able to determine if technology education has truly made a difference. These models must go beyond the assessment of knowledge and skills. They should include an analysis of the social, psychological, and economic returns of technological literacy.

10. Leadership training for program coordinators, department chairs, school directors, and college deans should be offered to help in understanding and supporting the physical and pedagogical changes and mental transitions that their faculty and students will undergo. They must be able to explain, encourage, and reward success as their programs change. Academic leaders must understand the nature of the changes before them and be prepared to guide their institutions and colleagues through the transitions.

Conclusion

Are we attempting to prepare pre-service teachers to teach for technological literacy (rationale, structure, and standards) with teacher preparation programs based on the traditional industrial tool use model? Without the support and cooperation of teacher preparation institutions to prepare teachers qualified to teach for technological literacy, the focus of secondary technology education programs will continue to be based on technical (tool use) competencies, and the goals of technological literacy will never be realized. Do we have the courage, wisdom, and fortitude to examine our traditional approaches to pre-service teacher preparation and to agree that it might be time for change?

The issue may be one of new wine and old wineskins. Ancient wisdom suggests that placing new wine into old wineskins is problematic. As new wine reaches maturity, it stretches old wineskins to the point of rupture. The wine and the wineskins are lost. Are technology teacher preparation programs putting the new wine of technological literacy into the old wineskins of industrial tool use programs? Do we have the courage, wisdom, and foresight to examine our well-worn wineskins and then to decide that it might be time for new ones?

We as technology teacher educators must ensure that we understand the differences between the various programs and that we build programs and build our professional activities around scholarship that allows teachers to function effectively and unambiguously in their classrooms and laboratories. If we cannot or will not do this, we have compromised our responsibilities as academicians and have violated the trust that the nation has placed in us.
No attempt to improve the teaching of technological literacy on a large public scale can succeed without careful attention to the training of teachers. Any effort to change what happens in the classroom will not be effective if it acts independently of the competence of the critical variable, the teacher. Our challenge is to figure out how best to implement and follow through on how teachers can best be prepared to teach toward technological literacy.

References

Badger, O. B. (1937). The contribution of industrial arts to two general secondary school objectives. *Education*, *58*(3), 160-162.

Bennett, C. A. (1926). *History of manual and industrial education up to 1870*. Peoria, IL: Manual Arts Press.

Boyer, E.L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. San Francisco: Jossey-Bass Publishers.

Brown, D. (1993). A study of three approaches for teaching technical content to pre-service technology education teachers. *Journal of Technology Education*, *5*(1), 6-20.

Cranshaw, F. D. (1912). *Manual arts for vocational means*. Peoria, IL: Manual Arts Press.

Daugherty, M. K. (1997). The future of technology teacher education: A faculty vision. *The Journal of Technology Studies*, *23*(1), 47-53.

English, F. W. (1988). *Curriculum auditing*. Lancaster, PA: Technomic Publishing.

English, F. W. (1992). *Deciding what to teach and test: Developing, aligning, and auditing the curriculum*. Newbury, CA: Corwin Press.

Fales, J. F. (1937). Exploration and general education through the industrial arts. *Education*, *58*(3), 148-151.

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

Grinstead, N. B. (1930). The learning situation afforded by industrial arts. *Industrial Education Magazine*, *21*(8), 291-193.

Hansen, J. W. (1996). Texas industrial technology education's basic understandings. *Association of Texas Technology Education Journal*, *39*(3), 12-14.

Herschbach, D. R. (1996). "What is past is prologue:" Industrial arts and technology education. *The Journal of Technology Studies*, *22*(1), 28-39.

International Technology Education Association (2000). *Standards for technological literacy: Content for the study of technology*. Reston, VA: International Technology Education Association.

Israel, E. N. (1995). Technology education and other technically related programs. In G.E. Martin (Ed.), *Foundations of technology education* (44th yearbook). Council on Technology Teacher Education. Peoria, IL: Glencoe.

ITEA/CTTE/NCATE (2003). *ITEA/CTTE/NCATE Curriculum standards: Initial programs for technology teacher preparation*. Retrieved October 8, 2003, from the Council for Technology Teacher Education Web site: http://teched.vt.edu/ctte/ImagesPDFs/NCATE%20Standards%206.03.pdf

Johnson, S. D., Evans, R. N., & Stem, J. (1996). The national association of industrial and technical teacher educators (NAITTE). *The Journal Technology Studies*, *22*(2), 47-57.

Kaniegal, R. (1986). Technology as a liberal art: Scene from the classroom. *Change*, *18*(2), 20-35.

Kirkpatrick, D. L. (1975). Techniques for evaluating training programs. In *Evaluating training programs.* Alexandria, VA: American Society for Training and Development.

Lauda, D. P. (1988). Technology education. In W.H. Kemp & A.E. Schwaller (Eds.), *Instructional Strategies for Technology Education* (37th yearbook). Council on Technology Teacher Education. Mission Hills, CA: Glencoe.

Obermeir, T. R. (1994). *Modular facilities and curriculums for technology education; Blessing or curse*? Paper presented at the meeting of the

Mississippi Valley Industrial Teacher Education Association, Nashville, TN.

Peters, T. (1997). *The circle of innovation: You can't shrink your way to greatness*. New York: Knopf.

Pucel, D. J. (1997). The current status and future of industrial teacher education and non-teacher education programs in institutions of higher education. *The Journal of Industrial Teacher Education, 34*(4), 64-79.

Ritz, J. M. (1997). *Issues in technology teacher education*. Paper presented at the 84th Conference of the Mississippi Valley Technology Teacher Education Conference, Nashville, TN.

Sanders, M. E. (1997). An (articulated K-12) curriculum to reflect technology. *The Journal of Technology Education, 8*(2), 2-4.

Sanders, M. E. (2001). New paradigm or old wine? The status of technology education practice in the United States. *The Journal of Technology Education*, *12*(2), 35-55.

Scripture, E. W. (1899, October). Manual training and mental development. *Manual Training Magazine*, 16-25.

Shemick, J. M. (1985). Preface. In J.M. Shemick (Ed.), *Perceptual and psychomotor learning in industrial arts education* (34th yearbook). American Council on Industrial Arts Teacher Education. Peoria: Bennett & McKnight.

Smith, D. F. (1997). A dean's perspective of the future of the profession. *The Journal of Technology Studies*, *23*(1), 43-46.

Smith, W. A. (1936). The place of the practical arts in a general education. *California Journal of Secondary Education*, *2*(3), 143-146.

Volk, K. S. (1997). Going, going, gone? Trends in technology teacher education programs. *Journal of Technology Education*, *8*(2), 67-71.

Wicklein, R. C. (1997). Curriculum focus for technology education. *Journal of Technology Education*, *8*(2), 72-79.

Wright, R. T. (1996). Is your paradigm shifting? *The Technology Teacher*, *55*(6), 3-4.

Wright, R. T. (1997). Council on technology teacher education (CTTE) evolution, goals, organization, and challenges. *Journal of Technology Studies*, *23*(2), 22-34.