April 2009

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Abstract

Technology education has experienced significant changes over the past decade. This article will address the history of technology education and the current status of technology education. Specifically, the article will discuss the historical changes within technology education and how those changes have lead to current initiatives such as the Standards for Technological Literacy.

Introduction

The field of technology education is certainly no stranger to change, particularly in the area of curriculum. Putnam noted in 1992 that curriculum innovation is not new in the technology education field of study. Technology education has taken many shapes over the years, starting with manual training in the early eras of American life to industrial arts, vocational education, and career education.

The name technology education has resulted from many years of transition and change. The earliest form of education addressing industrial and technological topics in the United States was referred to as manual training. The objectives of manual training included keeping boys in school, developing leisure-time interests, as well as providing instruction in the basic principles, processes, and materials of industry (Foster, 1997). The educational curriculum of industrial arts can be traced back to the late eighteenth century and early nineteenth century to Johann Heinrich Pestalozzi (Nelson, 1991). Pestalozzi is credited with the development of the ideals for early industrial arts curriculum. His ideas on the purpose of industrial arts, including the issue of narrow vocationalism versus a broader educational background in preparing people for the world of work is still to some extent debated today (Nelson, 1991).

 In the early 1900s, John Dewey had heated debates over the purpose of industrial arts education with David Snedden and Charles Prosser. The industrial revolution at the turn of the twentieth century brought about an increase in the demand for individuals with specific vocational skills. Snedden and Prosser's philosophy, an essentialist view, looked at vocational education as a means of educating society for jobs rather than culture (Lynch, 1997). Their belief was that organized vocational training was an efficiency device, and could more effectively meet the societal demand for single-skilled labor (Prosser & Quigley, 1949). One of Snedden and Prosser's strongest beliefs about vocational education was that vocational education should be separated from the general education system. They believed that traditional faculty was unqualified to administer vocational programs, and vocational programs would not receive the attention they needed under traditional school authorities (Lynch 1997).

Snedden and Prosser's main opponent in reference to the purpose of industrial education was John Dewey. Dewey's philosophy, a progressive view, thought that the purpose of education was to develop informed citizens for a democratic society, and that education was an opportunity to prepare students in broad problem solving skills, experimentation, and full participation in democratic processes (Lynch, 1997). He believed that a system that taught specific skills training limited the opportunities of the individual. The system that Dewey proposed saw vocation as a "direction of life activities"; related subjects and courses should help prepare students for change and for alternative careers (Lynch, 1997). Dewey not only disagreed with Snedden and Prosser on the purpose of vocational education, but also on the governance of vocational education. While Snedden and Prosser pushed for the separation of general education and vocational education, Dewey believed that such an action was a violation of a student's rights. Dewey argues that building separate systems of education would separate groups of people to be educated, serve other than the students' democratic interests, lead to conditions where students' rights might be superseded by the needs of

the economy or the state, and create the undesirable condition of separating culture and the vocations (Lerwick, 1979).

In 1917, President Wilson signed the Smith/Hughes act and ended the efficiency debate. The legislation was a victory for Snedden and Prosser and called for a separate system of education, training workers to meet the nation's labor needs, and training limited to preparation for jobs that required skills and academic abilities below college level (Lerwick, 1979). Also the legislation specified particular vocational programs in agriculture, trade and industries, and home economics (Tanner & Tanner, 1980).

Around the same time the Smith/Hughes act was signed, Bonser and Mossman (1923) were developing an alternative view which attacked the prominent inadequacies of vocational training in schools. Bonser and Mossman are credited with developing the ideals of industrial arts as a reaction against manual training (Foster, 1997). Industrial arts was a product of the progressive education movement, which was popular between the two World Wars. Bonser and Mossman's text, *Elementary School Industrial Arts*, outlined industrial arts purpose as to provide instruction in industrial and technological subject matters at all levels to all students. Industrial arts was distinguished from industrial education (vocational education) as a study with a general education purpose (Zuga, 1995).

Although never fully implemented, industrial arts was given a place in schools during the first half of the century. The progressive education movement of the early 1900s allowed some aspects of industrial arts social reconstruction into the mainstream educational system. Several factors prevented a full realization of industrial arts ideals including a strong and persistent practice of secondary school manual training and the close association of all educators who dealt with industry related subjects (Zuga, 1995). Another factor was federal funding for vocational programs. Although the focus of industrial arts was general education, the promise of vocational money kept the industrial arts professional close to the vocational educators just in case they could have benefited from federal vocational moneys (Zuga, 1995).

Following World War II, the term technology education began to emerge into education (Herschbach, 1997). The prosperity of the post war era and the rapid industrialization and technological changes placed new demands on schools to develop the scientists, engineers, technicians, and skilled workers to propel the economy forward in the new technological age (Herschbach, 1997). Researchers such as Warner (1936) and Olson (1958) began to develop industrial arts curriculum that reflected the new focus on technology, however, both failed to create a practical curriculum with guidelines that teachers could follow (Herschbach, 1997)

Following the work of Warner (1936) and Olson (1958), Devore (1964), Face and Flug (1965), Lux and Ray (1969), and Ziel (1971) began to develop the conceptual roots for technology education as a curriculum. Their work in the era of the late 1960s and early 1970s brought about many different curriculum developments stressing progressive ideals such as societal needs in a curriculum as technology format, and providing a foundation for technology curriculum in an academic manner (Devore, 1980). The Maryland Plan (Maley, 1972), was the first curriculum development plan for industrial arts that took the focus off the content areas in order to "emphasize 1) technology, its evolution, use and significance, 2) industry, its organization, materials, occupations, processes, and products, and 3) problems and benefits that result from technological and

industrial activities" (Zuga & Cardon, 1999, p. 147). Technology and its processes were becoming the new focus of industrial arts. Finally in the late 1970s, the Jackson's Mill curriculum theory of industrial arts provided a common unified curriculum for technology education. The new focus for technology education was the productive activities of communication, construction, manufacturing, and transportation. Jackson's Mill curriculum is still the most widely used curriculum model in technology education (Oaks, 1991).

In 1978, the United States Office of Education funded the Standards for Industrial Arts Programs Project at Virginia Polytechnic Institute and State University. According to Dugger (1980), the three objectives were (a) to develop a database on industrial arts and industrial arts student organization activities, (b) develop a set of standards and related handbooks to ensure quality industrial arts programs, and (c) to familiarize, publicize, and demonstrate the industrial arts standards.

According to Herschbach (1997), "technology education came into favor in response to the widely held view that industrial arts was linked to an older production system" (p. 22). In 1985, the American Industrial Arts Association changed its name to the International Technology Education Association (ITEA), and the industrial arts division of the Association of Career and Technical (ACTE) education changed its name to the technology education division. The late 1980s found technology education leaders redefining technology education to build agreement on content and in 1990 ITEA released *A Conceptual Framework for Technology Education*. Savage and Sterry (1990) described technology as:

> a body of knowledge and the systematic application of resources to produce outcomes in response to human needs and wants…The use of technology is a global phenomenon with no country immune to the need for extending the potential of the human being…No longer is the greatest asset capital or natural resources, but rather the ability to use information. Information is one of the most useful resources in developing and managing technological systems. Countries who have access to and can manage technical information have definite competitive edge in the worldwide marketplace. (p. 7)

Since the early 1980s, the professional literature has focused on the curricular transition from industrial arts to technology education. Putnam found in 1992 that 71.4 percent of states in the United States had a focus on the Jackson's Mill curriculum theory, and 34.7 percent had adopted technology education as the official program descriptor for the state. The Jackson's Mill curriculum theory for technology education uses an analysis of technical human-adaptive systems and embraces a holistic perspective of the subject matter. This new curriculum opened the door for the current focus of technology education.

Current Status of Technology Education

In its broadest sense, "technology is the process by which humans modify nature to meet their wants and needs" (NAE, 2002, p.2). In the late 1980s and early 1990s, educators began to recognize the importance technology and technological advancements were making on American society. In 1983, the Commission on Precollege Education in

Mathematics, Science and Technology (CPEMST) called for an increase in the technological literacy of society stating (NAE, 2002):

> We must return to the basics, but the "basics" of the 21st century are not only reading, writing, and arithmetic. They include communication and higher problem-solving skills, and scientific and technological literacy-the thinking tools that allow us to understand the technological world around us. (p. 16)

The ideals and curriculum of what was once industrial arts was changed to technology education with the understanding that the future lies not in the technology alone, but in the people's ability to use, manage, and understand it (ITEA, 1996). In 1996, the International Technology Education Association's (ITEA) *Technology for All Americans: A Rationale and Structure for the Study of Technology* defined technology education as the study of technology and the preparation of learners to be technologically literate (ITEA, 1996). To be technologically literate, students must know how to use technology to identify problems and opportunities to solve problems or meet human needs; identify, select, and use appropriate technological processes; and evaluate finished solutions (ITEA, 1996).

The current field of technology education is described through a rationale and structure of universals of technology. The ITEA states that, technology consists of a universal process, knowledge and context base because of its "involvement in the generation of knowledge and processes to develop systems that solve problems and extend human capabilities" (p. 16). The processes are those actions that people undertake to create, invent, design, transform, produce, control, maintain, and use products or systems. The processes are divided into four subsets which include 1) designing and developing technological systems, 2) determining and controlling the behavior of technological systems, 3) utilizing technological systems, and 4) assessing the impact and consequences of technological systems (ITEA, 1996).

Hirsch (1988) pointed out that literate people in every society and every culture share a body of knowledge that enables them to communicate with each other and make sense of the world around them. Universals of technological knowledge include the nature, history, and evolution of technology; linkages based on impacts, consequences, resources, and other fields; and technological concepts and principles (ITEA, 1996). Technological knowledge also includes the relationships between technology and other disciplines, and how technological processes are developed, applied, and used (ITEA, 1996).

The universal of contexts is used to categorize the systems used and developed to solve problems. The systems are categorized as informational systems, physical systems, and biological systems (ITEA, 1996). With these universals of technology, technology has been established as its own intellectual domain, which every student should learn along with science, math, and other general subjects (Dugger, 1999).

By its very nature, technology education has the power to motivate students of every age (Loveland, 2003). Technology education provides multiple opportunities for students to participate in a hands-on, interdisciplinary environment that can be more exciting than the typical academic class. From an early age, today's children have become familiar with computers, video games, cell phones, and various technological

advancements. Technology education utilizes these technological advancements to provide appropriate projects involving design and production, which allow students to use creativity and problem-solving skills in order to increase their technological literacy (Loveland, 2003).

Although technology constantly changes, a technologically literate person is more equipped to deal with the effects of constant change. Woncott (2001) states that a person should be able to access information in a knowledge-based world and understand the process and products of technology within a historical and cultural context. A technologically literate person is able to use, manage, assess, and understand technology (ITEA, 2000). In addition, ITEA (2000) states that a technologically literate person "understands, in increasingly sophisticated ways that evolve over time, what technology is, how it is created, and how it shapes society, and in turn is shaped by society" (p. 9). The National Academy of Science (2002), along with the ITEA (1996) observed that a technologically literate person has a degree of knowledge about the nature, behavior, power, and consequences of technology.

According to the ITEA (1996) technology education at the elementary level provides students with the opportunity to develop perceptions and knowledge of technology, psychomotor skills, and a basis for informed attitudes about the interrelationship of technology, society, and the environment. At the middle school level, technology education provides a deeper look at the workings of technological systems and students begin to explore the various technological processes (Loveland, 2003). The high school level of technology education enhances the learner's understanding of technology and develops a relationship between technology and other subject areas (ITEA, 1996). Additionally, the high school level provides the link between technological literacy and the workforce. Technology education at the high school level consists of courses such as communication technology, drafting and design, graphic communication, manufacturing production technology, power and transportation, and applications of technology. New standards-based technology education courses include titles such as Foundations of Technology, Technology Assessment, Issues in Technology, and Engineering Design Fundamentals (ITEA, 1999).

Technology education curriculum provides students the opportunity to develop necessary skills for successful careers of the future. Technology is the driving force of the economy, and an increasing number of jobs are requiring technological skills (Rausch, 1998). The Secretary's Commission on Achieving Necessary Skills (SCANS) report stated that a technologically literate worker is more likely to possess a broad range of knowledge and abilities which the workforce has deemed as critical skills (Department of Labor, 1991). Studies by Volk and Peel (1994) and DeLeon and Borchers (1998) sought to identify the specific skills required by manufacturing firms in North Carolina and Texas for future employees. Both studies asked manufacturing firms with over 400 employees to rate categories of skills including communications, computer skills, reading, writing and math, critical thinking, group interaction skills, personal development, technological systems, and leadership skills. The results of both studies reflected a need for more intrinsically humanistic skills such as critical thinking, group interaction, and communications, rather than specific technical skills. Technology education provides a focus on the importance of group interaction, employability, and

personal development skills which employers have identified as their most pressing need for future employees (Volk, 1995).

As studies have identified skills needed by the employees of the future, research addressing methods of incorporating these skills into the nation's schools has followed. Research conducted by the National Skill Standards Board (NSSB) centered on a proposed system of portable skills certificates (Homan & Clark, 1997). The goal of NSSB is to promote the growth of high performance work organizations in the private and public sectors, raise the standards of living and economic security of American workers, and encourage the use of world-class academic, occupational, and employability standards (Homan & Clark, 1997). The NSSB's research to determine methods for addressing the identified needs of employers resulted in over 70% of employers responding that skills standards should be developed by partnerships of educators and industries. These findings have enhanced the importance technology education will play in the future of America's workforce, and emphasize the need for its inclusion in the curriculum of American schools.

Technology education programs throughout the United States have varying degrees of structure and content (ITEA, 2002). Therefore, knowledge gained by a student in technology education in one area of the country may be significantly different than a student in another area. Additionally, the rapid changes in technology have made it difficult for programs to remain up-to-date in the classroom (Dugger & Naik, 2001). In 2001, Newberry indicated, based on the No Child Left Behind (NCLB) act, that the last two decades have seen states moving towards mandating a core set of subject areas for all students as a way to meet national educational standards and provides a means of accountability. In order to better incorporate technology education into the state curriculum, leaders of the Technology for All Americans Project and the ITEA began the process of developing standards for technology education (Loveland, 2003).

The development of the *Standards for Technological Literacy* was started with funding from the National Science Foundation (NSF) and the National Aeronautical and Space Administration (NASA). Using these funds, the ITEA established the Technology for All Americans Project in 1994. This project called for a change in technology education to focus on the development of technologically literate individuals. A definition of what a technologically literate person is was developed along with the definition of how the technology education curriculum would be integrated into K-12 schools (National Research Council, 2003). The project consisted of a three-phase process, developed to phase in the standards over an eight-year period (Dugger, 1999).

In 1996, the first phase of the project, known as *Technology for All Americans: A Rationale and Structure for the Study of Technology* was developed. The goal of the project was to develop standards for technology education for grades K-12 (Dugger, 2002). The first phase established importance of a technologically literate society and provided the groundwork for what would become the *Standards for Technological Literacy*. The second phase of the project resulted in ITEA's release of *Standards for Technological Literacy: Content for the Study of Technology*. The standards marked a significant step towards the integration of a national technology education curriculum. Over 4000 individuals from the elementary, middle school, high school, post-secondary, and administration levels worked over a four-year draft period to finalize the document (Dugger, 2002). Phase three of the project developed standards guiding student

assessment, professional development of teachers, and the program infrastructure associated with the study of technology in grades K-12 (ITEA, 2003).

The release of the *Standards for Technological Literacy* resulted in 20 standards grouped into five categories. The categories consist of the nature of technology (standards 1-3), technology and society (standards 4-7), design (8-10), abilities for a technological world (11-13), and the designed world (14-20). A complete list of the standards is included below:

The Nature of Technology
Standard 1. Students will develop an understanding of the characteristics and scope of technology.
Standard 2. Students will develop an understanding of the core concepts of technology.
Standard 3. Students will develop an understanding of the relationship among technologies and the connections between technology and other fields of study.
Technology and Society
Standard 4. Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5. Students will develop an understanding of the effects of technology on the environment.
Standard 6. Students will develop an understanding of the role of society in the development and use of technology.
Standard 7. Students will develop an understanding of the influence of technology on history.
Design
Standard 8. Students will develop an understanding of the attributes of design.
Standard 9. Students will develop an understanding of engineering design.
Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Abilities for a Technological World
Standard 11. Students will develop the abilities to apply the design process.
Standard 12. Students will develop the abilities to use and maintain technological products and systems.
Standard 13. Students will develop the abilities to assess the impact of products and systems.
The Design World
Standard 14. Students will develop an understanding of and be able to select and use medical technologies.
Standard 15. Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16. Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17. Students will develop and understanding of and be able to select and use information and communication technologies.

Standard 18. Students will develop an understanding of and be able to select and use transportation technologies.

Standard 19. Students will develop an understanding of and be able to select and use manufacturing technologies.

Standard 20. Students will develop an understanding of and be able to select and use construction technologies.

The *Standards for Technological Literacy* provide a consistent content for the study of technology education and provide a guide for developing curriculum. In addition, the standards were created with the basic features of providing a common set of expectations for what students in technology laboratory-classrooms should learn, it is developmentally appropriate for students, it provides a basis for developing meaningful, relevant, and articulated curricula, and promotes a content connection between technology and other fields of study (ITEA, 2000). By providing the essentials for the development of technology studies, educators can effectively create a curriculum which focuses on the growing need for a technologically literate society.

The *Standards for Technological Literacy* provide educators with benchmarks for meeting each standard. The benchmarks provide the knowledge and abilities that enable students to meet a given standard (ITEA, 2000). Benchmarks define the outputs of the educational process, as opposed to the inputs of the system. Bybee (2000) pointed out that historically education has focused on inputs, such as teaching techniques and textbooks, with the hope of improving outputs such as greater student learning. The benefit of the *Standards for Technological Literacy* is that they not only establish the inputs, but they also define the outputs. These benchmarks are developed and provided for each standard at the K-2, 3-5, 6-8, and 9-12 grade levels.

Studies by Putnam (1992), Newberry (2001), and Meade and Dugger (2004) have established a commitment by states to write technology education into the state curriculum framework. In 2004, Meade and Dugger found that 73% of states had included technology education in their state curriculum, with 78.8% state supervisors reporting using the *Standards for Technological Literacy* in someway. Technology education availability in the classroom varied widely by school district with 23% of states requiring technology education as a core class and 42% listing it as an elective. Studies have also found that there are approximately 40,000 technology education teachers, trained at 105 technology education college programs (Meade & Dugger, 2004, Newberry, 2001, and Weston, 1997). In 2003, ITEA developed *Advancing Excellence in Technological Literacy: Student Assessment, Professional Development, and Program Standards*, a document to aid technology education teachers in the implementation and utilization of the *Standards for Technological Literacy*. This document provided teachers with guidelines for the implementation of the standards, as well as standards for the development and training of technology education teachers.

Technology education has taken years of debate and scholarly work to reach the point it is at today. From the first efforts to make industrial and technological subjects part of American education, educators have debated its purpose and relevance. Although not all educators believe that technology education, or the *Standards for Technological Literacy* are the answer to this age-old debate, evidence has shown that currently technology education ideals are the expected norm of the time. It was a great piece of

work, well done, a lot of effort has been put into this work. Good scholarly citations. The paper has only two headings. A lot of content in paragraphs without any dividing of topics. It would be nice if this information was broken down into sub topics so it does not take the reader out of the context when reading. Also it is good if you can analye critically most of the stuff which is written. I feel this is merely reporting information and synthesize aspect is missing in this report. Overall quality is GOOD. Great JOB!

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