The Soul of Technology Education: Being Human in an Overly Rational World

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Introduction

I grew up in a small town located just north of Gettysburg, Pennsylvania. Proximity offered me plenty of opportunities to visit the historic town and its surrounding battlefields. Like most visitors to Gettysburg, I would try to imagine what it must have been like to be there on those three days in July of 1863. Many of the battlefield landmarks, including the Peach Orchard, Devil's Den, Seminary Ridge, and Little Round Top invoked powerful mental pictures for me. The one site that inspired the most overwhelming sense of history was the line of trees that represented the starting point of Pickett's Charge. It was there that approximately 13,000 Confederate soldiers lined up in preparation for marching across a mile of open field against a heavily armed and protected Union position. The men who formed up behind the line of trees to begin the march must have been frightened of the almost certain doom they faced. To this day, I cannot help but be amazed at the courage it must have taken for each of them to do their duty. The noted Civil War author Shelby Foote once said, "If you stop to think about it, it would have been much harder not to go then to go. It would have taken a great deal of courage to say [to General Lee] I ain't goin'. Nobody's got that much courage" (Ward, Burns, & Burns, 1990). By this point in the Civil War the soldiers who took part in Picket's Charge were deeply committed to the friendships they had formed with their fellow soldiers, resolute toward fighting to save a Southern way of life and its culture, and in possession of an undying belief in the invincibility of General Lee as their commander. These factors, both large and small, compelled each man to form rank and march forward into the great grinding jaws of the Union Army on that hot July day.

It is sometimes hard to understand how rational people can become swept up in events that, in hindsight, seem irrational. However, throughout the course of the human experience larger forces that appear to be beyond the control of the individual often sweep us up and move us in directions that we would not choose under different circumstances. Pickett's Charge is just one dramatic example.

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Just like the armies of the Civil War fought to determine the future of the United States, opposing forces are currently struggling to determine the future direction of technology education. Even a casual examination of the current literature and a listing of the topics presented at conferences indicate that efforts are well underway to make engineering education the model against which to measure technology education curricula (ITEA, 2007; ITEA, 2008a; Custer and Erekson, 2008; ITEA, 2008b). These efforts represent political, economic, and cultural forces compelling the profession to move in directions that, in the opinion of this author, will not be in the best interest of all students. Some see technology education from a broad, holistic perspective. Others focus on the world of engineering. In this struggle for the direction of technology education, members of the profession must ask themselves how they see technology education curricula contributing to a better understanding of humankind's ongoing relationship with technology.

Technology reflects through its many artifacts and systems the spirit and humanistic qualities and values of its designers, makers, and users (Norman, 2004). In *Standards for Technological Literacy* (ITEA, 2000), four of the standards were devoted specifically to technology and society. Those four standards (4, 5, 6, and 7) explored the non-technical aspects of technology and the relationships between technology and the social/cultural milieu in which it exists. Unfortunately, even those four standards generally overlooked the role of humanistic qualities and values such as emotions, intuition, and aesthetics in the development and use of technology. In the first chapter of *Standards* the definition of technological literacy reads as follows:

> Technological literacy is the ability to use, manage, assess, and understand technology. 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…. A technologically literate person will be comfortable with and objective about technology, neither scared of it nor infatuated with it. (pp.9-10)

If technology reflects the spirit and humanistic qualities and values of its designers, makers, and users, then the ability of a technologically literate person to be objective about technology may be difficult at best. It is important to recognize that historically humanistic qualities and values have played an integral role in both the creation and the use of technology. Furthermore, later in this article a brief review of the history for the profession of technology education will show that such qualities and values also have played both an explicit and subtle role toward the study of technology.

Once again referring to *Standards*, the study and use of design is clearly a cornerstone toward building technological literacy. Design, in its various forms, was the explicit focus of four of the standards (8, 9, 10, and 11) and an underlying component of the other sixteen standards. In discussing design, *Standards* repeatedly addressed the creative act. However, it was done so with clinical detachment. Creativity and design are human activities heavily laced with emotions and subjectivity (Norman, 2004). In the words that follow I will show that this matter-of-fact presentation of creativity and design in *Standards* indicates an attitude toward the study of technology that is significantly different from the approaches taken by progressive educators of the past, as well as a few individuals from the present. Should technology educators ignore or reject the value of studying the role of humanistic values related to the creation and use of technology, they would significantly reduce the richness of the subject.

Thorndike verses Dewey: A Battle of Ideas

To determine whether technology education curricula should include the emotional, spiritual, and intuitive aspects of the human experience with technology, it is helpful to determine if those humanistic characteristics and values ever had a historical precedent. An investigation of educational philosophy is one place to start such a determination. Two contemporary publications have specifically addressed the philosophical struggles that have fundamentally shaped the nature of American education for the last century. The struggles have been between educational philosophies that represent a humanistic view and those that represent a mechanistic view to the processes of teaching and learning. The most recent article was written by Gibboney (2006) for the *Kappan* and was entitled *Intelligence by Design: Thorndike versus Dewey*. The second document was written by Lewis and Zuga (2005) and was entitled *A Conceptual Framework of Ideas and Issues in Technology Education*. Each of these documents contributed to an understanding of how contemporary models of both general education and technology education have taken their current form.

Lagemann (1989) is quoted in the opening passages of Gibboney's (2006) work to summarize the main point of the article. Lagemann's quote reads: "One cannot understand the history of education in the United States during the twentieth century unless one realizes that Edward L. Thorndike won and John Dewey lost" (p. 170). Most technology educators have a working familiarity with the educational philosophy of John Dewey. Gibboney described Dewey's humanistic approach to teaching and learning in the following passage:

> Dewey believed subject matter in schools exists to make the quality of democratic life as good as it can be under given conditions. He asserted that a teacher ought to try to arouse a continuing interest in learning throughout a student's life…. [Dewey] argues that the goal of schools ought to be developing an attitude – the love of learning. And ultimately, schools should be judged on how well they meet this difficult goal. In other words, what is transferred when a student learns something that is truly important is intangible and immeasurable by test. It is an attitude, the desire to learn. (p.170)

Arguably, Thorndike's work is not as well recognized by technology educators. At best, his name may be one that is vaguely remembered from a distant college course on educational psychology. However, his approach to understanding the workings of intelligence and the processes of teaching and learning could very well claim to be the foundation of contemporary public education, most notably in recent years with the *No Child Left Behind* legislation and the extensive use of standardized tests to measure what students have learned. In short, Thorndike's perspective on the proper approach to teaching and learning was very mechanistic in nature. Gibboney summarized Thorndike's beliefs in this area by stating:

> [Thorndike] believed in the possibility of a science of education so powerful that experts alone would be able to decide what to teach, how to teach it, and how to evaluate it…. [He also] believed that such value-laden matters as setting the aims of education could be done efficiently by experts, using the kind of science he was developing. (p.170)

Gibboney later drew the distinctions between Dewey and Thorndike in very succinct terms by writing "Thorndike saw humans in the image of the machine; Dewey saw them in the image of life" (p.170).

Several factors may have contributed to the ultimate success of Thorndike's mechanistic approach in the struggle for the compass of American education. Though the ideals of progressive education espoused by Dewey were actively embraced by academics, they did not easily fit into the broader American culture. That culture was being driven by the measurable and mechanistic paradigm of the twentieth century industrial revolution, the simplified world of politics, and the increasingly prevalent sense of progress that was defined by the rules of science. Gibboney described this effect by stating, "Thorndike and his successors surely won the minds and hearts of their countrymen. Dewey, ignored in the rough and tumble of legislative halls and teachers' meetings, has lived on in a few protected scholarly havens" (p.171). In the second half of the twentieth century other social-cultural forces were at work such as the political climate created by the Cold War. For example, in the late 1950's and through the 1960's the space race between the United States and the Soviet Union resulted in a major drive in public education to produce engineers and scientists (Lopez & Schultz, 2001). Those efforts compelled American public schools, as well as colleges and universities with science and engineering programs, to produce graduates that would enter these respective fields quickly, thus addressing the needs of the market place as perceived by the general public (Flemming, 1960). In both subtle and obvious ways, the curricula and the philosophies of schools at all levels were changed by these many forces (Herschbach, 1997). As a result, Thorndike's mechanistic view slowly overwhelmed the progressive, humanistic views of educational leaders such as Dewey.

Thorndike and Dewey: The Ripples Move through the History of Technology Education

A natural question resulting from this brief overview of American education is how did these philosophical struggles manifest themselves in technology education? Even a brief review of literature for manual training and industrial arts, the immediate predecessors of technology education, reveals that influential writers and thinkers from those fields had a deep investment in the worth of teaching about technologies within the context of humanistic qualities and values. Selected examples of this type of philosophical foundation, beyond John Dewey, can include Calvin Woodward (1887), who reminded his contemporaries that:

> The word “manual” must, for the present, be the best word to distinguish that peculiar system of liberal education which recognizes the manual as well as the intellectual. I advocate manual training for all children as an element in general education. I care little what tools are used, so long as proper habits (morals) are formed, and provided the windows of the mind are kept open toward the world of things and forces, physical as well as spiritual. (p. 202)

Almost 40 years later, with the transition from manual training to industrial arts fully underway, Frederick Bonser and Lois Mossman (1924) (as cited in Miller and Smalley, 1963) stated that:

> Since the desire for beauty in all that we possess or produce is so fundamental, it is readily seen that the industrial arts and the fine arts are closely and vitally related. Any attempt to separate them completely is artificial. (p. 72)

This passage clearly indicated that Bonser and Mossman identified connections between the study of technology and the humanistic values of beauty and aesthetic pleasure, values so prevalent in the fine arts. In succeeding passages, Bonser and Mossman discussed in detail the values and objectives of industrial arts, which included “(1) a health purpose; (2) an economic purpose; (3) an art or aesthetic purpose; (4) a social purpose; and (5) a recreational purpose” (p.72). Though each of these values and purposes had varying degrees of measurability, a significant component of the mechanistic approach advocated by Thorndike was designed to help students become “efficient in the selection, care, and use of the products of industry, and to become intelligent and humane in the regulation and control of industrial production” (p.72) and were thus primarily humanistic in their goals and objectives.

Between 1940 and 1980, the humanistic qualities and values espoused by Dewey were still on the front page of the professional discussions in the literature. Hornbake (1957), Wilber (1967), and Maley (1973) were leaders in the field who advocated the study of industries and their processes and products within the scope of general education. Time and time again they discussed the importance of the values learned by young people who took industrial arts classes. Topping the list of values discussed in the writings of these individuals and their peers was the importance of learning the principles of democracy. Like Dewey, each of these authors believed that the use of industrial arts education in the general education curriculum contributed toward the overall development of a young person’s ability to grow and mature into a fully informed and participating member of a democratic society. Bode (1942) (as cited in Miller and Smalley, 1963) perhaps summed it up best when he stated, “The task confronting our teachers of industrial arts is to make their subject-matter a gateway to a philosophy of life in an industrial democracy” (p.100).

These progressive voices were not the only ones speaking to the profession in the first half of the twentieth century, however. One individual in particular, who seems to have had a rather twisting philosophical journey, was William E. Warner. Warner left a large footprint on the profession through such activities as founding the Epsilon Pi Tau honorary society and the American Industrial Arts Association, mentoring numerous graduate students over the course of a long career, and the development and presentation to the profession of *A*

Curriculum to Reflect Technology (Warner, et al, 1947). This curriculum project, released to the profession in 1947, represented one of the first major efforts to specifically address the study of technology using industrial arts curricula as the means. Ironically, early in his career Warner took courses at Teachers College, Columbia University with both Dewey and Bonser (Lux, 1981). With such mentors, it would be natural to assume that Warner also would advocate industrial arts curricula that were humanistic in nature. However, as Lewis and Zuga (2005) noted, “Perhaps, it [was] because of his essentially conservative nature that he was able to promote a view of industrial arts as a technology based field of study and ignore the social prescriptions for the curriculum which were so evident in the work of Bonser and Mossman” (p.22). Warner’s curricular efforts, and the work of his protégés, lead to a broad acceptance of mechanistic thinking toward the teaching and learning processes developed and used by industrial arts. For example, Wilber, one of Warner’s protégés, is credited with being the first to define and apply the concepts of behavioral psychology to the field of industrial arts (Thorndike was a behavioral psychologist). Lux (1981) asserted that a “review of standard practice today would document that most industrial arts teachers indeed start their syllabi with lists of behavioral objectives. [Wilber] heavily impacted upon theory, [and] affected the documentation teachers produce to describe their courses and curricula…” (pp.215-216). As noted earlier, Wilber still incorporated humanistic qualities in much of his writing. However, like Warner, he contributed to the steady march away from the humanistic approach advocated by Dewey and Bonser.

Beginning in the 1950’s, the tide began to change significantly for industrial arts. Lewis and Zuga (2005) described the reaction of industrial arts leaders toward the social-cultural milieu of that time with this passage:

> Given the backdrop of society and culture in the United States during the 1950’s and 1960’s, it is easy to see how the leaders in industrial arts education began to distance themselves from the work of Dewey and social reconstruction. Dewey had come into question during the McCarthy era and his ideas were not in favor. Tradition in industrial arts leaned towards industry as a result of many years of alliance with vocational education. Even Warner and his followers, who fought to establish an industrial arts organization separate from the American Vocational Association, did not separate themselves from industry and corporate America, nor did Warner and Olson’s students who became the next generation of leaders in industrial arts. [Donald] Maley, [Paul] DeVore, [Donald] Lux, and [Willis] Ray all had ties to William Warner and his influence by either being his students, being students of Warner’s students, or working with him. So, as innovation in industrial arts took hold, many of the ideas of Warner and Olson made their way into the thinking and prescriptions for the field by the leaders who created their own curriculum plans and collaborated on the Jackson’s Mill compromise. (p.26)

Maley and DeVore: Carrying Forward the Deweyan Heritage

With perhaps the notable exceptions of Maley and DeVore, the shift in industrial arts away from the humanistic approach to education advocated by

Dewey would continue unabated. Lewis and Zuga (2005) described Maley as "the most Deweyan of the new generation of leaders" (p.26). His focus was unquestionably on the student and how the industrial arts curriculum could aid his or her intellectual, social, and cultural development. The program that bore his stamp was *The Maryland Plan* (Maley, 1973). It set the standards for a generation of student-centered industrial arts programs (Kirkwood, Foster, & Bartow, 1994; Rudisill, n.d.). DeVore could be described as a standard bearer among his generation of professional leaders for the value of the study of technology. As early as the 1960's DeVore was calling for the organization of the content of the study of technology into categories that described the human activities of production, communication, and transportation (Kirkwood, Foster, & Bartow, 1994; Lewis & Zuga, 2005). DeVore's humanistic credentials were found in his writings, which "re-introduced into the literature of the field, ideology and sociology with respect to the study of technology" (Lewis & Zuga, 2005, p. 28). Although these individuals significantly influenced the transformation of industrial arts into technology education, their Deweyan perspectives seemed to diminish with the compromises that were necessary to facilitate that transformation.

The Jackson's Mill Industrial Arts Curriculum Theory (Snyder & Hales, 1981) represented a benchmark in the creation of content organizers for the study of technology. These organizers included manufacturing, construction, transportation, and communication. Ultimately, the document represented a compromise between various interpretations of industrial arts curricula and the study of technology. Lewis and Zuga (2005) identified the three primary factions of compromise being between the interpretations of the group advocating the *Industrial Arts Curriculum Project* (IACP), DeVore, and Maley (represented by his supporters and former students at the Jackson's Mill gathering). From the humanistic perspective, the *Jackson's Mill* document presented the profession with a conceptual framework that encompassed the adaptive systems of ideology, sociology, and technology, any one of which could be used as the platform for the exploration of technology. However, the real importance of the *Jackson's Mill* document, and later *A Conceptual Framework for Technology Education* (Sterry & Savage, 1991), is that these documents started the process of moving industrial arts toward the study of technology as the subject matter for the field.

Technology Education Embraces the Standards Movement

Perhaps the most significant movement to formalize the study of technology was initiated through the release of the document *Technology for All Americans: A Rationale and Structure for the Study of Technology* (International Technology Education Association, 1991), which served as the conceptual precursor of *Standards for Technological Literacy* (International Technology Education Association, 2000). The increasing acceptance of *Standards* as the de facto measure of technology education curricula across the United States (Russell, 2005) indicates a profession that has embraced the mechanistic perspectives to intelligence, learning, and teaching advanced by Thorndike. The perception that the profession even needed a set of standards indicated that the educational culture of the last twenty years had taken a conservative path; a path that was mechanistic in its expectations of accountability by measurements (Herschbach, 1997). The humanistic view of these matters seems, for the most part, to have been relegated to history books about progressive education. The mechanistic influences on the development of *Standards* can be seen in the funding agencies, *The National Science Foundation* and the *National Aeronautics and Space Administrati*on (Lewis, 2004), and the individuals who reviewed the document while it was under development: members of the *National Academy of Engineering* (Pannabecker, 2004).

Standards represented an important contribution to the intellectual and philosophical underpinnings for the content of technology education. They also represented the latest example of a continuing struggle for the values embraced by the profession. Though the document still included aspects of the humanistic origins, they were a mere shadow of what they could have been when viewed from the Deweyan perspective. Essentially, Thorndike's mechanistic view continues to dominate the values of technology education.

Contemporary Voices of Descent

Within the profession of technology education there are still a few voices representing the human aspects of the study of technology. Herschbach (2009) identified several of the key individuals who have applied concepts of critical theory and constructivism toward the pedagogy and curricular content of technology education. The writings of Braundy (2004), Pretzer (1997), Seemann (2003), Duncan (1996), Hansen (2000), Hatch (1988), Kolodner (2002), and Satchwell and Loepp (2002) were identified as representative examples of critical and postmodern writings in the contemporary professional literature. Two individuals who were highlighted as representing the leading edge of these philosophical perspectives were Stephen Petrina and Karen Zuga. Herschbach noted that Petrina (1993a, 1993b, 1998, 2000a, 2000b, 2004) created an extensive list of publications. These writings:

> First, …questioned the limited scope of the concept of technological literacy. Second, [Petrina] argued that technology education grounded in an instrumental, essentialist framework fails to convey an understanding of the larger historical, sociological, political, and human dimensions of technology, an understanding that is crucial to an informed citizenry. Third, [Petrina] offered an alternative vision of technology education that takes as its starting point the human and cultural dimensions of technology. (p. 208)

Zuga's contributions (1992, 1999) contained a theme of critical feminist theory. This theory called into question the masculine dominance of the language, the activities, and interpretations of the nature of technology within technology education. Herschbach observed that:

> Zuga (1999) argued for a fundamental restructuring of technology education, a fundamentally different technology education for women and a rethinking of

> both content and practice. She observed that the development of technology itself is an activity directed toward the control of nature and the material world. A different technology education would not only help "dispel the dominance of masculine thinking" (p.64), but would also sensitize individuals to the often overpowering influence of technology on our lives and its potentially destructive effects on the natural world. (p. 211)

Progressive authors and thinkers, like Petrina and Zuga, continue to carry a torch for technology education that represents a program of study that is broad and encompassing of all of the elements of what it means to be human in a technological world. However, their perspective is being overwhelmed by increasing pressures to embrace a model of technology education that seems to be a page right out of Thorndike's vision of education. That model is fashioned after engineering.

The Influence of Engineering on the Value System of Technology Education

Pannabecker's (2004) interpretation of the influence of engineering toward *Standards* carried with it words of caution for our profession. His analysis found the mechanistic model of teaching and learning, as controlled by experts and endorsed by Thorndike, deeply entrenched in *Standards*. Pannabecker wrote:

> How might the influence of engineering relate to the ideological emphasis on the "effects" of technology in *STL* standards 4, 5, and 7? By designing these standards around "effects," the development of technology can be separated conceptually from social values, thus reinforcing the evaluation of technology as "end result." The artifacts can then be controlled and fixed by engineers. It might be government agencies that employ engineers to evaluate the technologies and recommend "fixes," but engineers remain in control of fixing, redesigning, or retrofitting the technology. This approach contrasts with an instructional model that integrates social conscience or responsibility within the design and construction process, and that sanctions the expression of critical reflection (such as "whistle-blowing") for both engineers and the public.
>
> Instead, *STL*'s dominant tone is one of implied neutrality, but with the "engineer in control." Although ethics is mentioned a few times in the *STL* narrative of standards 8-13 (pp.97, 98, 104, 111), it is clearly not central to the standards of design and development. This is subtle politics that isolates the discourse of social responsibility from the design and construction process, focusing social responsibility at the end use, or "effects" stage. Historians labor to uncover and understand these kinds of politics, the study of which should be included in teacher preparation and graduate programs in technology education. (p. 76)

If Pannabecker's observations are correct, then technology education should move with caution in developing closer ties with engineering or risk completely severing all ties to its humanistic heritage.

One final caution on this matter comes from the field of engineering itself. Florman's (1994) work entitled *The Existential Pleasures of Engineering* discussed how that profession had lost some of its own humanistic anchors. The author described the difficulties that engineering schools had in keeping promising students in their programs. He also described how the culture of engineering school had evolved a mentality that advocated that engineering education be organized as a type of filtering mechanism. Florman observed that:

> Young people are dropping out of engineering school for the same reason they shunned it in the first place: The program is laborious and in many respects disagreeable. The "hands-on" approach is largely gone, increasingly replaced by scientific theory. "Research" is in while "teaching" is out, a casualty of the way engineering education has been funded for several decades….
> Once the major problem has been identified, the solution seems stunningly obvious. We should stop looking at engineering school as a boot camp designed to eliminate all but the most dogged recruits. We should stop making the first two years the obstacle course they have become – consisting of calculus, physics, and chemistry. We should bring practical, creative, "fun" engineering into every year, particularly the first, and teach mathematics and the sciences as enabling complements to engineering rather than isolated afflictions to be endured. We should help young people perceive how important technology is in the scheme of things. We should advise and nurture the students at every step along the way, paying particular attention to the needs of women and under-represented minorities. Thus will we attract talented young people to engineering, keep them from dropping out, and at the same time improve the quality of our graduates. (p. xv)

This passage reads like a list of all the things that technology education should try to avoid. His suggestions for reforming the culture of engineering school resemble the types of things that a humanist like Dewey would have encouraged. In light of this, perhaps the tables should be turned and the conversation should be about how engineering education would benefit by adopting the humanistic models of the study of technology instead of how technology education would benefit by being more like engineering education.

A Whole New Mind: Reclaiming the Soul of Technology Education

Sirotnik (1983) summarized the dominant American public school paradigm of the late 20th century by stating, "…the 'modus operandi' of the typical classroom is still didactics, practice, and little else" (pp16-17). With the current pressures of standardized testing, school accountability, and adequate yearly progress the application of the types of mechanistic teaching practices that were so prevalent more then two decades ago are still, sadly, the basic method of operation in most classrooms and in most schools. However, even under these pressures a mechanistic approach to teaching, especially in technology education, is questionable in value. Caine and Caine (1991) argued that the role of emotion toward the learning process was essentially ignored by the dominant school paradigm. They, like the progressive educators from technology education's past, advocated the value of making connections between the material being taught and student interests. Johnson (2006) noted that with the changing landscape of the global marketplace the emphasis ought to be on helping students to develop right brain thinking patterns instead of the analytical, logical patterns that are the primary focus of an engineering education. Johnson noted that, "Successful players in this new economy will increasingly be required to develop and use the right-brain abilities of high concept (seeing the larger picture, synthesizing information) and high touch (being empathetic, creating meaning)" (¶ 3). The author then builds on the writings of Daniel Pink in his book *A Whole New Mind: Moving from the Information Age to the Conceptual Age* (2005) to elaborate on how schools can teach students to become successful players in this new economy:

> [Pink suggests] we work toward developing in ourselves (and by implication, in our students), six right brain 'senses' to complement our left-brain, analytic skills. We need to realize the value of:
>
> - Not just function, but also design.
> - Not just argument, but also story.
> - Not just focus, but also symphony.
> - Not just logic, but also empathy.
> - Not just seriousness, but also play.
> - Not just accumulation, but also meaning.
> - And I would add a final conceptual age skill to Pink's list:
> - Not just knowledge, but also learning.
>
> In the age of educational accountability, we seem to be gearing all of our instructional efforts to helping students master left-brain skills, because that's what the tests measure, of course. But to what extent should we also be helping kids develop design sense, storytelling abilities, synthesis, feelings for others, humor, and the ability to detect the importance of the information they learn? Our society and educational system sadly sees many of these opportunities that develop conceptual-age skills as extras – frills that often are the first to be cut in times of tight budgets. It's tragic that by doing so, we are doing a disservice to our students as future workers and citizens. (¶ 4-5 & 7)

Johnson's message is especially pertinent to the field of technology education. The list of conceptual age values is laced with terms and concepts that would resonate with a progressive educator such as Dewey. The list could almost be identified as a comparison between engineering education and the ideals of a humanistic approach to technology education. Reflective educators should recognize that diverse thinking, learning, and teaching styles are important variables in determining the value of a subject matter and a program.

It is important to recognize that technology education can naturally offer an alternative to the dominant paradigm of American education. Wolk (1998), who came from an elementary education background, described project-based education as the best means of achieving the ideal blending of knowledge, experience, and thinking skills advocated most recently by Pink (2005) and Johnson (2006) but also by Dewey (1916, 1938) generations earlier. Wolk's own observations were that project-based education, "offers the possibility of truly breaking free from traditional schooling, of making learning a meaningful and democratic experience" (p. 96). The author later defined a project in the following way:

> To me, projects are open, long-term, integrative inquiries done in a social setting that [is] created and/or developed with much student input and

> ownership. I strive for our projects to be *authentic* [italics in original source] as possible, meaning they're for real purposes, using "real world" sources. (p. 96)

Wolk's interpretation of project-based education was constructivist in philosophy. Furthermore, the process of learning was as valuable to him as content knowledge. This was emphasized in his writing when he stated that:

> No longer is the process simply a means to an end. It is knowledge in itself. This vision not only offers different methods for teaching, it profoundly changes *the purpose of school* [italics in original source]. The ideals and attitudes that are learned through the democratic process become an important part of the intended curriculum. (p. 97)

The structure of Wolk's interpretation of project-based education had components that included students and teachers involved with planning, research, documentation, development and creation of artifacts, presentations, and assessment. In short, Wolk's project-based education is simply design-based technology education by another name. His model of excellence is one that represented the type of progressive ideals that technology education can emulate and readily replicate, if the profession should choose to move in that direction.

Conclusions

If technology education is to become a vital part of the general education curricula, it must recognize the importance of the humanistic aspects of teaching and learning. To achieve this goal it will need to examine the story it wishes to tell. If we choose the storyline written by Edward Thorndike then we will never be able to teach technology education with the full richness it deserves. An alignment with engineering could limit our profession achieving diversity among the students and narrow the content in our courses. Taking this direction would further enhance the mechanistic and analytical views of teaching and learning advocated by Thorndike. If, however, we choose the storyline written by John Dewey, we put out the welcome mat to all students in the public schools as we not only talk about, but also live the philosophy of a democratic classroom. In the battle for the heart of American education, Thorndike may be winning, but in the long-term conflict for the soul of technology education we have to ask, do we want to embrace the machine or the human?

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