Problem Solving in Technology Education: A Taoist Perspective

Jim Flowers

Problem solving and product design experiences can empower students by presenting unique learning opportunities. Although the problem solving method may have been important to technology education, as well as industrial arts, as far back as the 1920s (Foster, 1994), the movement to incorporate more problem solving and product design in technology education kept surfacing in the 1990s. For example, the Commonwealth of Virginia introduced a series of high school technology courses grouped together as *Design and Technology* (Virginia Department of Education, 1992); *TIES Magazine*'s web site offered 70 video tapes "that will support the teaching of design, problem solving and technology" (Ties, 1998); the use of design briefs was emphasized (Ritz & Deal, 1992); the popularity of a textbook titled *Design and Problem Solving in Technology* (Hutchinson & Karsnitz, 1994) continued to grow; and smiling students and their technological inventions were featured in articles (Edwards, 1996), at fairs, and in promotional materials. In the newer approaches to technology education that center on design, students are often asked to design new products. They creatively invent products like: pizza cutters with built-in flashlights; roller skates that work in sand; hats with built-in fans for cooling; and yet another way to store compact discs.

Subtly, the definition of technology education has evolved to reflect this movement, since "much technological activity is oriented toward designing and creating new products, technological systems, and environments" (International Technology Education Association, 1996, p.18). While there are many definitions of technology (Dyrenfurth, 1991), a number of them are oriented toward a product design and problem solving model. Some of these definitions of technology center on "control" over the "human-made and natural environment" to better meet "human needs and wants." For example, Wright and Lauda (1993) include these elements in their definition of technology as "a body of knowledge and actions, used by people, to apply resources in designing, producing, and using products, structures and systems to extend the human potential for controlling and modifying the natural and human-made environment" (pp. 3-5).

This is a shift in meaning from the days of the pump handle lamp and other woodshop projects. Back then, the student often began with a project idea, not with a problem to solve. As this shift in approach occurs, one problem faced by

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Jim Flowers is an Assistant Professor in the Department of Industry and Technology, Ball State University, Muncie, IN.

today's teachers of product design is that students tend to subvert a prescribed design process. For example, a typical teacher may ask a student to engage in such a design process, beginning with the student identifying a problem to solve. Often this is a need or want. Next, the student may be asked to gather information and then to formulate many possible solutions to the problem, eventually choosing the best. In reality, some students approach the activity with the thought, "I want to get a CD rack out of this class," or some similar sentiment that begins with one particular solution. In order to satisfy the teacher's requirements, they then craft a need to fit this product idea. While most of their designs are fanciful and lack practical application, a few do, in fact, make sense. However, the entire approach of asking students to design yet another product to satisfy our needs and wants may be misguided, for two reasons.

First, few, if any, of today's products are designed (by technology students or professional product designers) to meet actual needs. They are almost always designed to meet open markets, and then human wants can be engineered to meet the product availability. A common joke asks, "If necessity is the mother of invention, how come so many inventions are unnecessary?" The phrase, "The customer is always right," and its more cynical corollary, "Give the customers what they think they want," are not without merit, and have led to economic success for many capitalists. However, the result of product design activities for technology students is that these students learn materialism to an extreme. They are taught that just because something *can* be invented or produced, it *should be*. They are taught that creatively designing products is a good thing, regardless of the outcomes. The ultimate criterion for success is money.

Second, problem solving and product design are not the same; the best result of a sound problem solving process is often something other than a new product. Maybe the solution to a problem would be a change in corporate policy, new legislation, a consumer education program, or changes in how a product is marketed. These are each examples of design, but it is a system, not a product, that is designed or redesigned. Maybe the best solution is non-action, and acceptance of the situation without change. There have been numerous examples of technological products or "fixes," such as DDT, that have backfired. We need a global citizenry that can entertain a wider variety of solutions than merely a new technological product. Yet if students are told (even tacitly) that their solution must be a physical product or model, then we are restricting their diversity of solutions, and thereby asking them to choose what may not be the best solution. Maybe that approach to problem solving is part of how teachers are taught. Boser (1993) compared problem solving educational specialists in two groups, technology teacher educators (TECH) and other researchers who were not technology teacher educators (EXT). "Members of the TECH panel tended to rate most highly those procedures practiced within the field, such as design-based problem solving, R & D experiences, and innovation activities. EXT panelists considered techniques such as simulation and case study, which are perhaps more widely used in content areas outside of technology education,

as appropriate delivery vehicles for the recommended problem solving procedures," stated Boser.

Some might point to a definition of technology and argue that the goal of technological acts is control over the environment to meet our needs and wants. But does technology really give control over the environment? Or is this just one western (or stereotypically male) approach? Surely technology education should accommodate people of different religions and belief systems. Yet, there may be a bias against certain belief systems because of the underlying and unquestioned assumptions inherent in a definition of technology and a rationale of technology education.

A Taoist philosophy is summarized in the Tao Te Ching, translated here from Lao Tsu's words (1972) from 6th Century BC China. The numbers in parentheses correspond to the reference numbers in the actual document. Lao Tsu suggested that less and less should be done "until non-action is achieved. When nothing is done, nothing is left undone. The world is ruled by letting things take their course. It cannot be ruled by interfering" (#48). The philosophy of Taoism, like some other belief systems, does not put humans on an adversarial battleground with nature. Instead, a harmonious existence is thought to be a proper relationship. "Do you think you can take over the universe and improve it? I do not believe it can be done. The universe is sacred. You cannot improve it. If you try to change it, you will ruin it. If you try to hold it, you will lose it" (#29). It is difficult to delineate the separation between human and nature, and just as difficult to find the real difference between the human-made and natural environments. It is nearly impossible to name any terrestrial environment that is all human-made (without having been affected by the sun, for example), or one that has not been influenced by humans. These distinctions seem to isolate people from the world around them in an "unnatural" way. Yet, definitions of technology often attempt to make just such a distinction. From a Taoist perspective, some definitions of technology seem more like creeds about the nature and purpose of humans.

A host of values dominant in much western culture are de-emphasized in Taoist texts, including materialism: "Having and not having arise together" (#2); "One gains by losing and loses by gaining" (#42); one "who knows that enough is enough will always have enough" (#46); and one "who is attached to things will suffer much" (#44). It is common for western students to strive to improve, to take pride in their work, and to expect and receive praise. Yet, Lao Tsu suggests, "Working, yet not taking credit. Work is done, then forgotten. Therefore it lasts forever" (#2), and "Not exalting the gifted prevents quarreling" (#3). Technology students are especially encouraged to be innovative, and to want to improve the current situation (or solve the problem): "Give up ingenuity, renounce profit, and bandits and thieves will disappear" (#19); "Without desire there is tranquility" (#37). It is especially difficult for educators to question the value of education itself, but Taoism does: "In the pursuit of learning every day something is acquired. In the pursuit of Tao, every day something is dropped" (#48); and "Give up learning and put an end to your troubles" (#20). While some Taoist doctrines may cause some to discount the

entire philosophy, that would be a mistake. Instead, it would be better to see what questions are raised by such a stance.

The emphasis on design in technology education may be related to the current abundance and diversity of technical artifacts. Would more artifacts be an improvement? While there are positive and negative outcomes of nearly any technological change, we should question the assumption that more is better. Does a major league pitcher concentrate on new baseball prototypes? No. The pitcher practices and experiments with the art of pitching, often hoping to achieve just a fraction of the skill enjoyed by some of the great pitchers in the history of the game. The aim is "the essence of pitching." However, technology is an important factor. As the clap-skate was introduced to Olympic speed skating competitions in 1998, the athletes altered their notion of "the essence of speed skating." As technology becomes more transparent to the end user, the user is required to know less technical information to use the technology. A few decades ago, computer programming was being pushed in the public schools. Now, the emphasis is more on the use of professionally prepared programs. Software is updated so often that it can be difficult to develop comfort with one particular version. This has let to some computer users feeling more comfortable with an older, and sometimes more reliable, version of a program. Their goal may not be to use the most advanced word processing program, but to write.

Is the goal to achieve a sustainable future, or to keep accelerating? "There is no greater sin than desire, no greater curse than discontent, no greater misfortune than wanting something for oneself. Therefore [one] who knows that enough is enough will always have enough" (#46). Are there enough designs? Is there enough technology?

Would it be possible to reconcile technology, technology education, and a Taoist perspective? Yes. But technology would not be the essence of human control over others and the environment. It would not be a master, but a tool. The goal would not be materialistic or technological, but to live life on a harmonious path. Will that entail problem solving and technology? Yes, but the goal of the problem solving activity may not be what it seems.

Recommendations

Therefore, I suggest a different approach to teaching problem solving in technology education. Students should be encouraged to concentrate not on whimsical wants or fanciful products. They should apply their considerable problem solving skills to improving the human condition, and the condition of non-humans, sometimes in spite of what some people want or think they want. They should be encouraged to find solutions from a broad range of technological and non-technological realms. Effective and responsible national leaders and corporate executives are those with enough backbone to do what they believe is best for the nation or corporation, in spite of mass opinion. They are not afraid to upset people, even friends, if these people had to be upset by the leader's pursuit of their course. While they may be mindful of the concerns of the workers, citizens, consumers, etc., they are willing to lose their job because they did what they thought was best, in spite of common opinion. The solutions (i.e.,

way) they choose are holistic, sometimes relying more on technology, other times involved with laws, communication, and other social arenas. They do not blindly accept the premise that their current product or service is the single best solution to a problem. They "know when enough is enough," and when the choice to not pursue a technological avenue is the wisest choice. If this is the type of person a technology teacher hopes their students will become, then specific educational experiences should be designed to empower students with those independent, risk-taking abilities where the goal is what is best, not necessarily only what the clients want or think they want. They must practice the skills involved in deciding when the best path may not be a new technological product.

Teaching problem solving in technology education will continue to offer students invaluable learning experiences. The suggestion is that the focus and procedure be allowed to shift. This can be directed by how the teacher helps the student select a problem and frame the context of a problem. Here are four examples of situations a teacher may pose for students.

- In Costa Rica, some of the urban-dwellers move into the dwindling tropical rainforest, clear an area of trees, and try to live a better life than they had in the city.
- In Ghana, there is a shortage of skilled industrial workers, yet many of the students in Ghana's trade schools consider such jobs beneath their qualifications.
- In New York, a woman who played guitar and piano for many years has to give up these instruments because the guitar causes problems with her neck and back, and both instruments have resulted in carpal tunnel syndrome.
- In Delaware, a wife and husband in their seventies were given their first VCR, but the instructions sounded too intimidating for them to actually play or record a tape.

In each example, there is a statement of a situation that might (or might not) be improved by a creative solution. Some solutions may be technological, but maybe the best solution is not technological. Students should examine such situations (both big and small, near and far, individual and societal) and use their creative problem solving abilities to try to plan what is best. This means weighing short-term gains and costs with long-term gains and costs. It means asking what is best: best for the individual, for the culture, for future generations, and for the environment. It means considering educational reform, personal lifestyle changes, new technology, and governmental action. The Japan External Trade Organization (1998) concluded that "a fundamental gap exists between the way Japanese companies and many of their overseas partners, especially in the West, view problems." Greater attention to both the diverse views of problem solving and to holistic approaches may improve the benefits of education in problem solving. Oddly, this more holistic approach to problem solving is contrary to popular belief and some research results:

> The tendency in education has been to employ the term "problem solving" generically to include such diverse activities as coping with marital problems and trouble-shooting electronic circuits. The results of this study suggest that such generalization may be inappropriate. Instead, problem solving should be viewed as nature specific. In other words, different types of problem situations (e.g., personal or technological) require different kinds and levels of knowledge and capability. This is substantiated by this study's findings that individuals manifest different style characteristics when addressing problems of different natures. (Wu, Custer, & Dyrenfurth, 1996, p.69)

However, the best solution to a technological problem may be non-technological. Students who are practiced in considering this wider range of alternatives will be better prepared to face the demands of global citizenry than those who merely make yet another CD rack.

A technology teacher can incorporate elements of a Taoist approach in subtle ways. These may include less emphasis on the product, less praise (from an external source), acceptance of some situations as they are, and an attitude of doing something because it needs to be done, and then moving on. There would certainly be less emphasis for some on solving problems by designing new products.

Finally, it is critical for a technology teacher to revisit their definition and philosophy of technology, analyzing its assumptions and bias. That definition should be individually crafted by that teacher, so that it is honest and accurate, and accommodates a variety of belief systems. That definition can lay the path for a wondrous technological journey for the student and teacher.

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