Values in Technology: Approaches to Learning

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Introduction

Current debate and rethinking on the nature of technology and the form of school curricula for technology education is one of the most hopeful signs in the field. The competing and often conflicting conceptions of the various constituencies of interest participating in the debate, far from threatening the survival of technology education, as is feared by some, are in fact ensuring that it remains alive and well. From the advocates of the 'new vocationalism' in the USA (Lewis, 1991), with their renewed emphasis on the development of basic generic skills; from the industrialists' concern for a skilled work force; from the educators' preoccupation with the personal development of children and the attendant pedagogical issues, from policy makers' political concerns for national development and wealth creation; and no less from the society's need to respond dynamically to forces within and without itself, technology education will evolve from the fledgling subject it now is, to a clearly defined discipline in its own right. This article will give voice to yet another facet of the educational perspective, already shared by many — the need to treat with the inherent values component of technology and technology education. The *a priori* question at issue is, 'What constitutes good technology?' Two other questions arise from this one, namely 'What shall we do in technology education?' and 'How shall we do it?' In an attempt to grapple with these questions this article will seek to:

(a) lay bare some of the values issues inherent in the nature of technology;

(b) examine the nature of values and values education in general;

(c) develop a typology of values that should be addressed in technology education; and

(d) make tentative suggestions with regard to approaches to the teaching and learning of values in technology education.

Values Issues in Technology

Justifications for the inclusion of technology in school curricula focus primarily on the development of occupational skills and fitness for fullest participation in a technological society. The much touted goal of technological literacy subsumes both of these outcomes. Arguments about the ineffectiveness and inappropriateness of schools for imparting occupational skills and about the near impossibility of predicting those occupational skills that would be needed in the future have led to a diminished emphasis on this outcome, and are in fact a major point of departure between industrial arts and the new subject called technology or design and technology.

Participation in a technological society demands an understanding of the ways in which technology is changing society. The complexity of this relationship cannot be overstated, for technology both shapes and is shaped by society. There is a sense in which technology, both its products and its processes, represents the embodiment of the culture. We create the things we value, the things we think beautiful or useful. We devise tools, machines and systems to accomplish the ends we value. It is the relics of these that will describe, to future civilisations, the way we have lived our lives. Our beliefs, our values, our philosophies, our experiences, in short our culture, is made manifest, in part in the artefacts and systems we create. Riggs and Conway (1991) suggest that technology 'is shaped by perspectives and priorities forged out of experience, culture and beliefs' (p.31).

It is clear then that there is no neutral technology — it is a heavily value-laden enterprise. Indeed, no aspect of this enterprise is value-free, from identification of a problem or need, through the design and evaluation of the technical means or systems, to production and implementation, each stage involves value-based decision-making. Every technology is the result of conscious or unconscious, value-based choices.

> 'As technology is directed toward a societal goal, every new technology involves questions of ethics and values, which must be judged from aesthetic, historical and philosophical viewpoints. Furthermore, technological change has economic, sociological and behavioural implications for both the country and those individuals directly involved.' (Truxal, 1986, p.12.)

The goal of technology is the enhancement of the quality of human life. This goal although readily acceptable in principle, poses serious difficulties in its implementation; for notions of what constitutes enhancement of the quality of human life are underpinned by beliefs and values about the essential nature of man and about what constitutes the good life. About these there is little consensus. Experience has

shown that the solution of one problem sometimes creates other unanticipated problems, and that the same technology that brings great benefits to some often puts others at great risk. Technology brings unequal benefits and costs. The question always arises as to who benefits and at whose expense. Whether or not these questions are confronted, value statements are made with the implementation of each new technology. Whenever we implement new technologies without adequate consideration of the negative consequences we make the value statement that progress must be made at any cost and that financial gain is the major factor to be considered in technological advancement.

The situation in developing countries where a large percentage of the technology is imported raises a whole new range of values issues. When the profit motive is the major factor in technology transfer there is a risk that such transfer may result in social and cultural disharmony and negative labour market effects.

The concept of appropriate technology needs to be fully explored. What are the criteria of appropriateness? Surely in developing countries one of them must be the question of ownership of the technology and the resultant feelings of self-determination that are engendered when indigenous technologies are designed by local people to meet local needs. Underlying the whole issue of technology transfer/indigenous technology are implicit value statements about the nature of development — a term which each nation should define for itself.

One of the essential characteristics of human life is the ability to think and do and create. It is by the things we do and create that we define ourselves. Technical means and adaptive systems extend the range of possibilities for doing and creating in the context of our environment. So our technical means help define our humaness in the present, and, by altering the environment, to which future technological activity must respond, technology is also defining our humaness in the future. The basic value question here is 'What kind of future do we want?' It is in this sense that the modalities of decision- making about technology can be said to perpetuate themselves.

Technology education that gives children technological capability without equipping them to discern and deal with the underlying values issues is not only shortsighted but downright dangerous. In England and Wales, the proposed consolidation of the four attainment targets of the National Curriculum Design and Technology into two has been described as representing a move from 'divergent to convergent thinking' and is ensuring that the 'heart of Design and Technology will now be the Designing and Making Tasks' (Eggleston, 1992). This carries with it the danger that the values issues, so central to Attainment Targets 1 and 4 will be underplayed. It is true that values are inherent in designing and making but the fact that values as educational outcomes are not readily measurable in terms of competencies, makes it more likely that in the absence of those attainment targets that specifically pertain to values, the balance in the teaching and evaluation of, design and technology will shift from technological literacy to technological capability. It must always be remembered that the agenda in technology education is not only the education of future technologists and technicians, but of the entire population, who must participate in a technological society and control technology so that it can best serve the interests of all citizens. The emphasis in technology education should not be on 'learning how to use the latest piece of hardware but (on) asking when and why it should be used'(Boyer,1983).

A major challenge of technology education is to sensitise children to these values issues in real-world technology and to teach them how to justify and make explicit the value-bases of their own decision-making in technology, in the relative safety of school technology.

The Nature of Values and Values Education

Schwartz (1992) defines values as 'the criteria people use to select and justify actions and to evaluate people (including the self) and events' (p.1). Clearly, values relate to some notion of goodness. The basic value question is 'What is good in human life' or put differently, 'What contributes to human wholeness?'

Values have both a cognitive component and an affective one. The cognitive component is the underlying beliefs in which values are grounded. What one believes about the nature of human life both on the individual and corporate levels, will determine one's values.

The affective component relates to the feelings and attitudes towards the objects of value, that are engendered by the beliefs held. It is this affective component of values that makes values the chief predicator of behaviour, and distinguishes values from beliefs, which are purely cognitive. Changing values or developing values through technology education must therefore address the cognitive component, by exposing children to all the relevant knowledge, as well as engaging their feelings by placing technology in a human or social context that is meaningful and real.

Schwartz suggests the following characteristics of values:

(a) they are grounded in concepts or beliefs;

(b) they pertain to desirable end states or behaviours;

(c) they transcend specific situations;

(d) they guide selection and evaluation of behaviour or events; and

(e) they are ordered by relative importance (p.4).

While values may be personal, i.e. held by individuals independently of and sometimes in contradiction to those of the group, they are not to be regarded as personal preferences. Preferences cannot ever be justified or validated on rational grounds, on the other hand, 'beliefs and values make appeal to data external to the individual' (Poole, 1990, p.67).

One of the reasons for the common avoidance of explicit values education in the classroom, is their supposed relativity. In fact values are not at all relative. The essential nature of man is universal and it must be that the qualities that are conducive to its flourishing are themselves universal. What is relative is the expression or operationalisation of the value. Adherence to the same value could quite easily, in two different social contexts, require two completely different courses of action. This is often the case in the use or implementation of technical means or adaptive systems. The value of 'improved living standards' might, in one socio-economic context, require a shift in the mode of production of a particular good, to a technology that increases productivity. The transfer of the same technology, which is capital — rather than labour-intensive, to another socio-economic setting, where there are widespread unemployment problems and which lacks the means of maintaining the technology, might in fact cause a lowering of living standards for many. It is the means of improving living standards that is relative but the improvement of the human condition must be the concern of good people everywhere.

The last of the Schwartz (1992) characteristics suggests that values may be ordered hierarchically in terms of their relative importance. Technology often poses real ethical dilemmas in which there are no obvious right answers or altogether satisfactory solutions. In such cases the challenge is to weigh all relevant contextual factors and to be guided by the value deemed to be more important in that situation.

Discussions about values education have centred largely on the issue of indoctrination. Should schools attempt to transmit the values of society or should children be taught to examine the values that underlie the institutions and practices of society and be provided with settings in which to make value decisions and study the effects of those decisions from a variety of perspectives? Technology education viewed as education through and about technology indicates the latter approach. Technology is itself rapidly changing the environment in which future technological decisions will have to be made and it is only an informed and technologically literate citizen, who would be able to make decisions about technology and assess its broad social impact on family structure, inter and cross-cultural relations, national and international functioning, its economic impact on business, commerce and government, as well as its environmental impact on agriculture, food production, and waste disposal in both the short and long term.

■ Toward a Typology of Values in Technology

The diversity and complexity of the values issues involved in technology make their inclusion in technology education a formidable task. I would like to suggest a typology by which to categorise the values issues in technology so as to ensure that all relevant areas of concern may be addressed in technology education. Schwartz (1992) suggests that values have both content and structure. The content refers to the goal or area of concern of the value, while structure refers to the inherent conflicts or compatibilities

between values. Both of these concepts, content and structure, are

useful in the selection of learning experiences intended to teach values in technology education.

Schwartz and Bilsky (1987, 1990) have identified three substantive content types or motivational concerns into which values in general fit. These are:

(a) values that relate to the needs of individuals as biological organisms;

(b) requisites of co-ordinated social interaction; and

(c) survival and welfare needs of groups.

These categories of values might be useful as a base on which to build a typology of values related to technology.

Traditionally definitions of technology have emphasised the process aspects of the enterprise. Little has, however, been said about its purposes. The process emphasis is revealed in the fact that most definitions mention the resources — matter, energy and information used in technology, and the activities — the identification of needs, the designing, making, and implementing of technical means and systems. Whenever the purposes of technology are stated, they are described in terms that are intrinsic to the processes themselves. The most commonly stated purpose is 'to solve human problems'. The fact that each technical means is designed to solve a particular problem implies that the problem is intrinsic in the design, manufacture and implementation of the means of solving it. What is necessary is a statement of purpose, of technology that is extrinsic to the solution of the problem. I would like to suggest that this purpose might be stated as 'the enhancement of the quality of human life and relationships on the personal, community, national and international level'. The emphasis here on relationships is deliberate for it is the quality of relationships, not the possession of wealth that determines the quality of human life.

The usefulness of this statement of purpose is that it immediately provides a means by which we can distinguish between 'good' and 'bad' technology. The value question thus becomes, 'does this or that technology contribute to the quality of human relationships?' It is the task of technology education to help students to discern and make decisions about these values issues.

It is on this statement of purpose, that the next level of the proposed typology, the subcategories of content subsumed in the three basic content areas already outlined, is based. The first basic content area will include those values that relate to individual physical, physiological and psychological needs. The basic questions here are: What conditions best promote individual's physical, physiological and psychological well-being? Will this or that technical means enhance the quality of life for individuals in these three aspects? What negative consequences will it have on these three aspects of the lives of the individuals who will be affected by it'.

The subcategory here might thus be called 'Personal'. The second basic content category is described as 'requisites of co-ordinated social interaction'. This relates to those values involved in the promotion of harmonious and mutually beneficial social interaction among members of social groups at the community, national or international level. The value questions of concern here are: What technical means will promote harmonious and mutually beneficial relationships? What are the positive and negative consequences of this technology on social relationships within the group? Which members of the group will benefit and which members will be disadvantaged by this technology? The subcategories here might include 'Social' and 'Economic'.

The third content area is 'survival and welfare needs of groups'. This category includes all those values that promote the interest of groups within national and international communities. The questions for consideration here are: Which interests groups will benefit and which will be disadvantaged by this technology? What technical means might be employed to promote the welfare of minority groups? The concept of appropriate or alternative technology is relevant here. The subcategories here might be 'Environmental', 'Political' and 'Cultural'.

The following figure represents this typology and provides an initial and tentative sample of the values included in each subcategory. The list of value types and values is far from exhaustive and is presented here to serve as a stimulus for further consideration.

A TYPOLOGY OF VALUES IN TECHNOLOGY EDUCATION

Basic content categories	BIOLOGICAL NEEDS OF INDIVIDUALS	COORDINATED SOCIAL INTERACTION		SURVIVAL AND WELFARE NEEDS OF GROUPS		
Sub-categories	PERSONAL	SOCIAL	ECONOMIC	POLITICAL	CULTURAL	ENVIRONMENTAL
Values	Industry Creativity Independence Competence Health Safety Interest Wise Decision-making	Benevolence Conformity Equity Social order	Wealth — creation Wealth — distribution Productivity	Needs of minorities of gender, race, ethnicity, disability	Tradition Aesthetics	Environmental sensitivity

Fig. 1.

In addition to the identification and categorising of values in technology some attempt must be made to prioritise them in the context of specific situations. This is necessary because there are inherent conflicts and compatibilities among the values identified. For example, the value of independence clearly conflicts with that of conformity, and while creativity and benevolence are not inherently in conflict, they may be incompatible in a specific context. Values education in technology should aim at developing in students the skill of identifying the relevant contextual factors needed to make value-based decisions in the designing, implementing and evaluation of technology, in situations that are ethically complex.

■ Approaches to the Teaching and Learning of Values in Technology Education

Considerable progress has been made in the field of technology education. The nature of technology has begun to be elucidated, the scope of technology education has in some measure been delimited and the components of technological literacy and capability are gradually becoming apparent. Perhaps the least progress has been made with respect to the pedagogical aspects of technology education. How are the aims of technology education best realised? By what learning experiences do children become technologically capable and literate? In the teaching of values in general, and more so in the teaching of values in technology, we are all groping for answers.

The typology presented above when applied to the stages in the technological process, provides cues for the identification of the relevant values issues at each stage. These values can then be prioritised and used as inputs in the decision-making that is inherent in each stage of the process.

Fig. 2 is a representation of the stages in the technological process. Fig. 2 makes it apparent that value-based decisions are made at each stage of the process. Searching the six value types at each stage of the process will ensure that no important values issues will be neglected. The typology will be of greatest use if it is borne in mind that the values identified are at once the values to be inculcated in students through their involvement in the

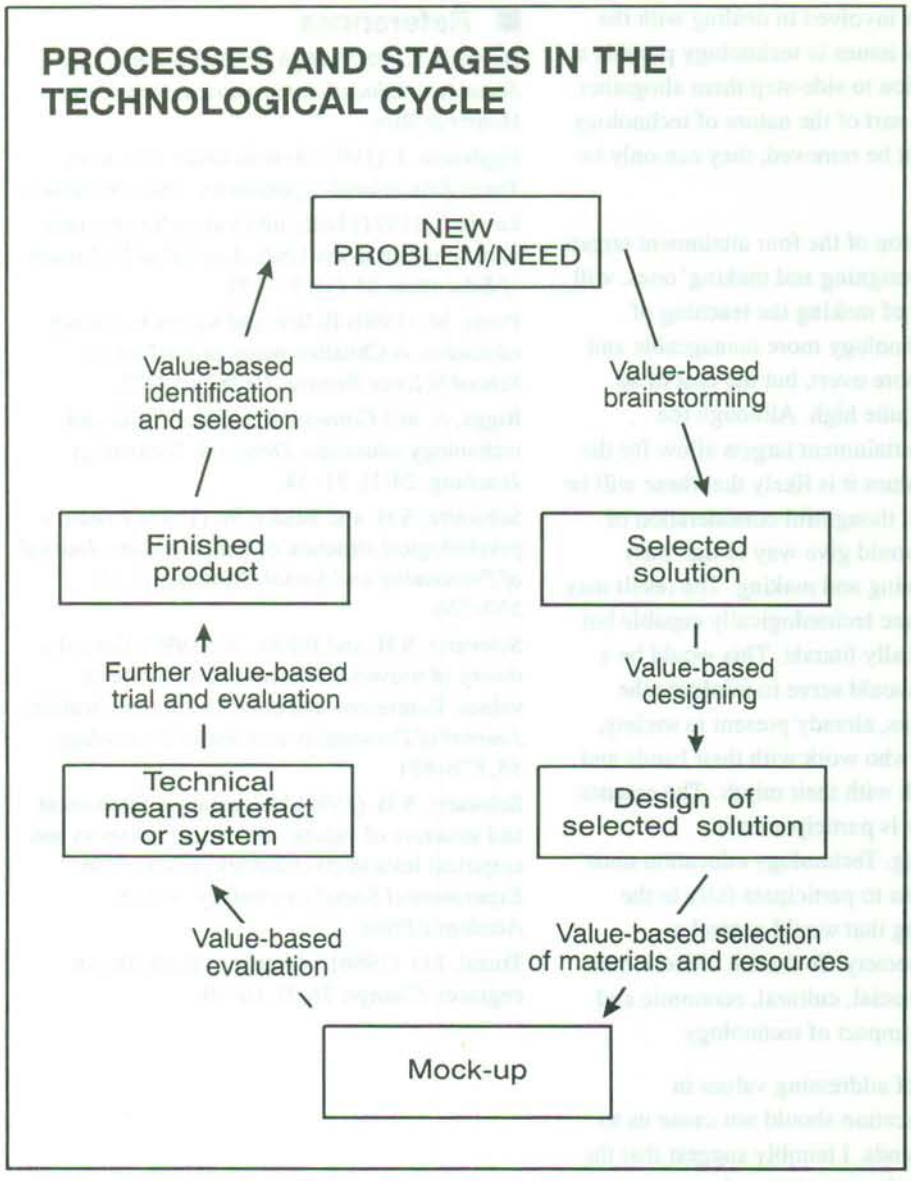

Fig. 2.

stages of technological activity, and the value criteria to be used in evaluating both classroom and real-world technology. The teaching strategies by which pupils can be made to confront the values issues in technology must involve giving them opportunities to make decisions and to reflect on those decisions. The development of curriculum materials that raise values issues is the first step in the provision of such learning experiences for students, but by far the most crucial factor is the sensitisation of teachers to these issues, for this is the only way to ensure that what is contained in the manifest curriculum is also what is experienced by students.

At the secondary level, case studies could be used successfully. Such questions as 'what were the intended and unintended outcomes of the use of the technology?' 'Who gained, who lost?' Case studies of technology transfer could be used to encourage children to see issues from perspectives other than their own. What were the benefits and costs to the recipient country? Here the categories of values outlined in the typology could be used to ensure that the widest range of issues are confronted.

The study of the technologies of other cultures provides an opportunity to make children aware of value-systems that differ from those of their own culture. There are, however, some peculiar difficulties that attend this aspect of technology education. The practice of having people of one culture evaluate the technological solutions to problems of other cultures carries with it the subtle implication that some cultures, the more 'developed' ones, hold all the answers. What is important here is that children develop a sense of respect for technologies that are forged out of experiences and cultures that are different from their own, and a sense of appreciation for what is their own. As far as possible children ought to be helped to take other perspectives beside their own and to be allowed to see problems and solutions through the eyes of those who own the problems. A teaching strategy that involves the use of simulated situations might be usefully employed here.

Even young children can be encouraged to confront the values issues embedded in design, by strategies that allow them to generate a variety of designs for the solution of the same problem. An analysis and comparison of the designs based on the categories of values suggested in the typology could help students to be explicit about their own value-based interests and decision-making.

Conclusions

I have attempted to expose some of the values issues associated with technology and technology education, pointing to some directions and providing some stimuli for the hard thinking that is yet to be done with respect to the pedagogical aspects of values in technology education. The organisation of the curriculum to reflect a values emphasis, the selection of teaching resources, the design of appropriate learning experiences and the very important area of evaluation of learning outcomes related to awareness of values issues are thorny areas that demand our consideration. It is clear that in technology education the 'conceptual cows have yet to come home'.

The difficulties involved in dealing with the inherent values issues in technology provide a

The difficulties involved in dealing with the inherent values issues in technology provide a strong temptation to side-step them altogether. But values are part of the nature of technology and they cannot be removed, they can only be obscured.

The consolidation of the four attainment targets into the two 'designing and making' ones, will have the effect of making the teaching of design and technology more manageable and its outcomes more overt, but the cost of so doing may be quite high. Although the proposed new attainment targets allow for the treatment of values it is likely that these will be de-emphasised; thoughtful consideration of values issues would give way to the 'busy work' of designing and making. The result may be pupils who are technologically capable but not technologically literate. This would be a great pity and would serve to reinforce the class distinctions, already present in society, between those who work with their hands and those who work with their minds. The essence of a democracy is participation in decision-making. Technology education must equip all citizens to participate fully in the decision-making that would control a technological society. To do this citizens must appreciate the social, cultural, economic and environmental impact of technology.

The difficulty of addressing values in technology education should not cause us to throw up our hands. I humbly suggest that the problems of implementation and management experienced with the original Technology Order derived less from any problems with the Order itself than from our own inexperience and lack of conceptual clarity about the teaching of technology. Our response to this should be a commitment to bending our best efforts and our best minds to the development of a curriculum that truly reflects the nature of real-world technology and to the development of a pedagogy that would result in citizens who are technologically aware, capable and literate. We fail to do this at our own peril.

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