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ABSTRACT

Technology education serves vocational and general education purposes at the same time. Education is embedded in culture, which is itself technologically constituted. The recognition of the centrality of technology to culture leads to an historical reflection about its role in everyday life. In contrast to stereotypical images of male-dominated and science-based technologies as the form of technological capability one seeks, technology everywhere has had a broader base in culture. One way of seeing through the current stereotype is to look at how women have sustained culture through their contribution to technology. If one accepts the idea that education is in fact a unified concept, then technology must be fitted into the curriculum. The urgent challenge for technology education is to broaden the subject to comprise these dimensions: culture studies, technology and making, and technology and practical action. Questions for research are what values are actually taught and the way in which teachers interpret and implement curriculum policies. One aspect of research that ought to be underscored is that of the cross-cultural. Technology has to lead individuals back to where they live and how to live better. Individuals need to be reminded of appropriate technologies and appropriate technological education that surely will be culture specific with diversity apparent in approach and method. (Contains 16 references.) (YLB)

Present and Possible Futures in the Technology Curriculum*

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The joy and the curse of technology education is that it is both a new and an old subject. This makes considering the future an adventurous task, and in this paper I will venture into this difficult terrain. Fortunately, there are guides and I have to express my debt to David Layton having been stimulated by his own search for fundamentals (Layton, 1994).

In the first part I will discuss the tension between the general and vocational roles technology education is expected to play. In the second part of the paper I want to raise the question of the relationship of technology in schools to science and vocational education. It seems to me that dialogues amongst these subjects will be very important in determining what happens in the future. All of these subjects will in turn be the subject of critical scrutiny from outside school systems. Critics of schooling ask how subjects can help make a better world. These subjects will not escape the critical gaze of those interested in the evolution of school and society for social justice.

The mention of research brings me to the final part of this paper. The future of technology education will be shaped by how schools cope with new subjects and new ways of teaching. Often, for example, technology is defined as a focus for developing problem solving skills, as in say, an emphasis on design or technological capability. How do schools interpret these kinds of educational goals? What is the spread between vision and school reality? Who in schools knows how to achieve these goals? The future of technology education will depend on policies that are sharpened by the hard edge of school reality, and thus there is a vast challenge given to educational research by many emerging visions of technology in schools. Let me begin with the question of the role of technology education.

Technology, Culture and Education

Vocational and general education often are taken to be the two strands of schooling. Often they are given meaning in more concrete terms. Kerre (1994) for example, says that "vocationalization" of the school curriculum is everywhere called for

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> Vocationalizing the school curriculum is a call heard in many parts of the world and not just in developing countries. A major challenge to the modern school curriculum, however, is not whether vocational education should be included but rather, how much at what level. It is, briefly, a question of the balance between general (liberal) education and vocational education in school (p. 106).

Vocational education means preparation for work. On this view, activities within vocational education must serve the way work is done , usually defined in terms of the techniques used in the workplace -- especially in many places the use of computer controlled machines which work with materials other than wood or metal, indeed with machines that process no material at all! As Kerre (1994), points out:

> In order to repair these deficiencies, there is a need for appropriate conceptualizations of technical and vocational curricula that are relevant to Africa's environment and modern problems of production of goods and services. In Africa there is a dual need for vocationally trained labour as well as a scientific and technologically literate society. The traditional linear and demarcated curriculum structure derived from Western countries ... will not suffice (p. 114).

Vocational and general education remain separate in this conception, with parallel roles: training and technological literacy. However, it may be that readiness for work and for coping with other aspects of living in a technological society are served by a common education which does not separate working from other activities which go on after school; that is to say, life after school isn't just work and other things, but a unified life which is made better because of education. As Kerre (1994) points out:

> In traditional African education no discernible dichotomy between general (liberal) and vocational (practical) education existed....Vocational education and training were considered critical in preparation for adult life. From cradle to grave, the knowledge, skills and attitudes of a community were handed down through customs, songs, poems, taboos, riddles, proverbs and apprenticeships in various occupational areas including ironmongery, blacksmithing, construction, making utensils, food preservation and medical practices (p. 104).

Learning to make things was education for living which included working, but other things as well. Yet, in modern time, work is separated out as requiring its own special education. How has the split come about?

The general education value of making this is expressed most clearly in the Scandinavian Sloyd tradition -- which harkens back to the basic idea of poesis or making advanced by Aristotle (McKeon, 1947):

> In making the maker must have technical skill, but also a feeling for the matter to be worked with, and for its purpose. But if, on the other hand, art imitates nature, and it is the part of the same discipline to know the form and the matter up to a point (e.g. the doctor has a knowledge of health and also of bile and phlegm, in which health is realized, and the builder both of the form of the house and of the matter, namely that it is bricks and beams, and so forth): if this is so, it would be the part of physics also to know nature in both its senses....For the arts make their material (some simply 'make' it, other make it serviceable), and we use everything as if it was there for our sake.... The arts, therefore, which govern the matter and have knowledge are two, namely the art which uses the product and the art which directs the production of it (Physics. Bk. II: Ch. 2).

Aristotle thus distinguishes, as we do now ever more so, two parts of making: knowing the form and knowing how to shape matter. Yet art imitates nature and the artists need to know about both form and matter:

> That is why the using art also is in a sense directive; but it differs in that it knows the form, whereas the art which is directive as being concerned with production, knows the matter. For the helmsman knows and prescribes what sort of form a helm should have, the other from what wood it should be made and by means of what operations. In the products of art, however, we make the material with a view to the function, whereas in the products of nature the matter is there all along (Physics. Bk. II: Ch. 2).

Although Aristotle distinguishes two parts of making for purposes of analysis, they are not two different things; but aspects of the same thing. So it is that Sloyd unifies learning about form and matter in the same making process. The point is that things are made for a purpose, and when well made are beautiful. The question of fitness for purpose arises as part of making. Sloyd did not stand outside of general education; it was part of the goal of education for work -- but also for life -- a unified idea. As Kananaja (1994), speaking from a Scandinavian perspective points out:

> Cygnaeus clarified the concept 'education' or 'upbringing' in his many writings. He did not want to limit general education to the mere acquisition of knowledge and skills for the work force and to make the pupils unthinking imitators of technologies and artifacts. Rather, he wanted to educate them for carefulness, accuracy, creativity and dexterity (p. 47).

So Sloyd originally was part of a general education which included work as an educational concern, and other things as well. Work education, being then within general education, is the germ from which a more comprehensive view of education grew; at least in the conception of Cygngeus and those he influenced. Work education was not to one side, but central to general education.

In this spirit, one might well ask: "what does work education mean now, given the kind of society we live in?" If we retain the original spirit of Sloyd, or making things, then we have an idea that does not separate work from life (through separate vocational training) but continues to ground education in the idea of work and life as being integrated. So rather than setting Sloyd idea aside, work education evolves from it stimulated by the way crafts have evolved; which is to say the way earlier technologies have become those of today, thus avoiding the false dichotomy between craft and technology.

As many authors point out, technologies as systems are ancient, have their own cultural form and logic and are only recently influenced, but not defined by, the appropriation of science knowledge for the purpose of making. The technologies now evident in our modern culture are more constitutive of it than were earlier ones, but not fundamentally so. Failure to see technology historically and culturally leads us to the false distinction between craft and technology and blinds us to the pervasive influence of technologies as such in human society from earliest times. The advent of science gives certain additional, and potentially destructive power to technology; it does not materially alter its nature.

Hence it is interesting that Kananoja (1994) urges that new courses in making take their direction from the Sloyd tradition:

> Technology education should, according to the vision of the writer, be a combination of the old crafts education, *sloyd*, and the new technology, a combination of old and new, *sloyd* and *tech*. Sloyd can provide some well-tested guidelines for technology education including functional work and design; common sense logic for work; and contact with the historical-cultural development stages of work. The technological aspect entails contact with science and mathematics and gives scientific logic; machines, electronics and computers to work with; and contact with a developed concept of work. Both of these aspects include: education for the type of civilization characteristic of modern society; independent activity by students; motivational experiences; and rational work (p. 56).

This evolutionary approach does not create fundamental distinctions between craft and technology.

What I am suggesting about the centrality to general education of technology ability and understanding is partially echoed in Dyrenfurth's (1994) idea that technology education serves vocational and general purposes at the same time.

> An ongoing tension between those who see technology education as a general education subject and those who see it as the front end of the vocational/technical education continuum. Hard-liners exist favouring each position to the exclusion of the other. This author, however, sees technology education as embodying the characteristics of both - a situation that is plausible given technology's permeating of both our everyday home and work lives (p. 73).

I want to add to that: that vocational and general education are the same thing because at the heart of general education is vocational education, which means education in how things are made and how made things affect our lives. There are two lines of thinking that lead me to this.

1) *General education is about culture. Culture is constituted in many degrees by technology. I've noted that idea above.*
2) *Narrow training as preparation for work doesn't work at work.*

Work is complex and embedded in culture, and narrow training is often obsolete, but worse, detached from the broader themes of culture. Broad based conceptions of technological education are a response to this narrow vocationalism. But I want to go beyond the idea of technology as still separate and say it is central to education; just as Sloyd was in earlier times. Education is embedded in culture which is itself technologically constituted everywhere.

One effect of the recognition of the centrality of technology to culture is that we would be lead to an historical reflection about its role in everyday life; now and before. Rather than be guided by stereotypical images of male dominated and science-based technologies as the form of technological capability we seek, we would see that technology everywhere now and before, has had a broader base in culture. One way of seeing through the current stereotype (which has overtones of power and control) is to look at how women have sustained culture through their contribution to technology.

Ursula Franklin (1990) documents women's contributions to modern technologies:

> Standard histories of technology rarely acknowledge the contributions of women to the development and spread of modern technologies. Yet it is entirely fair to say that without

the work of women, their willingness to do extremely delicate but repetitive jobs, and their ability to learn intricate work patterns, the electrical and electronic technologies could not have developed in the way they did. It has often been stressed how poorly women were paid in the new technological order; it has been stressed much less how essential their skill and perseverance have been for the development of the technologies themselves (p. 105).

But just as important as the ability to make the new thing is the role women played in making them work, and in exploring their real potential. She notes the role that women telephone operators played in exploring the possibilities of the new technology:

> Telephone operators could take and relay messages and they could link up with other operators. In fact, you could do a conference call in 1890. Telephones at the turn of the century provided more than two-way individual communication. A reporter on a sports field could describe an important match and the phone brought back to him the cheering and booing of those who listened to the phone on this giant party line, connected just for the occasion. The listening audience was large, in the range of many thousands. Some events were, in fact, "broadcast" over the telephone. In Paris one could, for five centimes, listen to half an hour of The Paris Opera, and follow the performance by phone "as it happened" (Franklin , 1990, p. 105).

Her point is that these unanticipated, but central roles for the technology were not planned; they evolved through the use operators made of them. These uses were not designed in advance.

Another way of seeing past ahistorical and acultural technological stereotypes is to understand the role women have played in agriculture and associated domestic technologies. The research Appleton and Ilkkaracan (1994) cites of salt extraction in Sierra Leone is striking. Women have developed a very sophisticated means for extracting salt from silt at the base of the tree Avicennia africana:

> The salt-laden silts are collected, mixed with sea water and left to filter through the mud-lined baskets, the shape of which has evolved in order to achieve more efficient filtration. The filtrate is boiled in evaporating dishes until the salt crystallizes. The salt is then dried either in the sun or by heat from the fire (p. 150).

The women have to do this very carefully:

> The skill level of the operators is the most crucial element in determining the final quality of the salt, as the operation involves careful control of the boiling in order to obtain the

> crystallization of pure salt (sodium chloride) and prevent the crystallization of bitter magnesium salts and the burning of the final product....The fire has also been adapted. The women have developed a protected wall fire which uses less firewood and can accommodate any size or shape of evaporating dish (p. 150).

Now, likely, these women cannot give a propositional account of the science involved in distillation, but they know how to use distillation to achieve the desired effect; along with their knowledge of the apparatus they use. Not only that, but a social structure exists which enables them to monitor and refine this process: they have the time to do this and share knowledge. Are we to view this as anything other than an advanced technological system?

This example helps us appreciate that the general education of these women easily involves the capacity to use natural means to garner salt. Who would want to set that capacity aside and assign it to vocational education? This technology is partially constitutive of their culture and their general education prepares them for this life.

Technology in the Curriculum

Let us say we accept this idea that education is in fact a unified idea -- not general, not vocational -- but educational. What does that say about how the curriculum should be organized? Where does what we now call technological education fit in? I want to turn to that question now.

One of the consequences of the artificial division of education into general education and vocational stream is that there exists a hierarchy of prestige in education. General is more valuable than vocational, because general is suffused with symbols and is thinking rather than making. Abstract, propositional knowledge is valued over knowing-how. Physics is "Queen" and so on down to "Shop". This much regretted, invidious hierarchy in schooling is universal. The prestige in society of science and abstract thinking in general helps maintain this hierarchy. Vocational educators aspire quite naturally to enhance the prestige of the subject.

This is done, I believe, though stressing the cognitive elements in making - a distinction as old as Aristotle, as we saw earlier. The emphasis comes at a time when educational systems are influenced by pressures to account for practice. The problem is how to define outcomes in terms acceptable to influential stakeholders? My view is that learning outcomes defined as psychological capabilities is a response to these pressures. Thus the definition of the subject becomes assessment driven These outcomes are influenced by cognitive theories such as information processing. Capabilities, which are said to be enhanced by symbol-rich subjects like science and mathematics, are seen to have correlates in mental activities. Science is said to strengthen those general mental capabilities. And, so it is said, do certain aspects of vocational education -- especially design and planning. Gathering evidence of development of these mental capabilities becomes the point of assessment and ultimately of the curriculum itself.

Kimbell (1994), for example, draws attention to the limitation of reducing technological capability to what he calls "increasingly atomized criterion-referenced assessments". He urges a more holistic view of capability:

> This is not to deny the importance of using criteria to identify strengths and weaknesses in the work; it is merely to assert that there has to be an interactive relationship between our understanding of whole capability and our understanding of its constituents (p. 80).

My concern goes beyond this. Actually we do not know what capability ought to be and that what is currently taken to be capability is overly influenced by how scientific capability is defined and each in turn overly influenced by theories of mental functioning and by striving for accountability through tying learning to such mentalistic outcomes. Technology education is further affected by striving for curricular status through convergence with science.

I see these trends coming to a head in the overemphasis of the design component in technology, as deVries (1994) points out:

> The developments in England and Wales are regarded as models for technology education by many. For example, the recent introduction of the idea of design in some American states clearly is the result of English/Welsh influence. However, conversations with colleagues in England have revealed some weaknesses in the approach that is now taken....Also, it must be said that many design problems tackled by pupils seem to be in a vacuum and lack a relationship with the broader aspects of technology in society. There are exceptions to this, but the overall pattern certainly warrants this critical remark (p. 41).

Doing design activities for the sake of them; in a vacuum as deVries puts it, so that certain generic "capabilities" can be measured, seems a pale reflection of the full potential implied in the original Sloyd conception. The emphasis on design, because of its high cognitive content, may provide a science-like subject, but my view is that neither subject (technology, nor science) is well served by over-emphasizing those aspects at the expense of many others wherein lies the real richness.

Making as we saw in the silt example, is not a design process -- it is socially embedded in a way of life. It would be absurd to give students an applied distillation problem to design, and think that that captured the essence of the process as it occurs; that somehow students were learning technological capability. This "design brief" for salt arises in an isolated context as do egg drops in science "olympics". The need for salt in Africa isn't an isolated problem. It is part of a way of life.

So I have problems with the attempt to turn the making arts into science through design. Technology teaches us that context is important. That lesson should run from technology to science; it is science which needs to catch up with technology as an educationally valid base for experience. I say this of course, with this view of technology at the core of education that I have advanced.

Technology needs nothing more from science in schools than what it gets outside of schools: knowledge which may or may not be useful in the complex world of culture. Clearly many technologies depend on science for initiating and improving machines, but the part of technology to which science contributes is far from the whole. Again it simply reduces the potential of technology as a central part of education to emphasize only those aspects which align with science, or with information processing protocols.

Technological Capability and the Research Agenda

The concern about the breadth of technology as a school subject finally brings me to the question of technological capability itself. Kimbell (1994) says that the nature of technological capability is well understood:

> Capability is, in principle, the same at any age. It involves understanding the task and responding to it by making proposals; it involves understanding materials, tools and processes; it involves making products and evaluating them critically against the needs of the user. It involves all of these things for 6-year-olds and 12-year-olds and 16-year olds (p. 72).

Now this is a common view of capability -- one, I would say that it is influenced by the design process: an aspect of the whole most easily assessed; a view which speaks only to a limited educational goal. However, if we take the idea of capability as a goal of general education then a much broader conception is needed which takes into account the cultural centrality of technology and what students need to know about that. I would like to outline elements of this larger view, but I have not the space to develop any of these in detail:

1. Culture Studies.

How is our life influenced by technological systems? How did these systems come to be? Role of women, labour, capitol. Historical and sociological ability. Analysis. Argument. Writing.

2. Technology and Making.

What are technologies? How do technological problems arise? Where does science fit in? Real problems facing students? The criteria which governs things well made? Making things well.

3. Technology and Practical Action.

How do citizens affect technology? How are technologies controlled? Taking action. What virtues are required for practical action? Doing good.

Much could be added and categories changed, but the list would remain comprehensive. This list, from an assessment point of view, is a nightmare, of course. But why should assessment drive our definition of the role of technology in education?

The urgent challenge for technology education is to broaden the subject to comprise the dimensions we have discussed above. The values dimension is particularly problematic and important. Barnett (1994) draws our attention, for example, to the limits in the concept of 'fitness for purpose' as a governing idea in technology education. As he says:

> The values embodied in the notion of 'fitness for purpose' are purely technical values. The fitness of the purpose is not an issue. This stance reflects the traditional pragmatic self-image of the professional engineer; engineers solve problems that have been defined as problems by other people. Engineers, absorbed in meeting 'technical challenges' espouse technical values and leave broader value judgements to others (p. 57).
>
> It is only within a framework which highlights questions of value that the complex and potentially contradictory nature of the notion of a 'quality product' can be explored. An approach which is value-purblind will seek to ignore these contradictions, but once words such as 'quality', are deployed with the intention that they should mean something more than 'well-crafted' (like in the good old days), then it is difficult to force the genie of values back into the bottle of 'fitness for purpose' (p. 57).

But how can technology teachers be expected to take on critical analysis tasks that few other teachers seem able to deal with? This is a major challenge for change. Policies debate in technology education abound, but research on how teachers cope is not so common. Even when research is officially encouraged (Waetjen, 1991), there emphasis is on efficiency; how teachers should behave in order to bring about certain outcomes: effectiveness research. Indeed this research agenda parallels that of the design brief: make something that works. But this leaves aside the question: what ought to be done? And what is being done and can be done? This kind of research requires that the viewpoint of the technology teacher be heard and through that tradition of practice be appreciated (Olson, 1992; Sockett, 1992).

Skepticism about the adequacy of the current conceptions of technological capability comes from classroom research. As McCormick et al., (1994) point out:

> The lack of support in the literature for a general problem-solving capability, and in particular the importance of the specific context of any problem, means that technology educators must re-examine some of their assumptions. These assumptions, about what processes pupils learn and how they use conceptual knowledge, are not usually based upon close observation of pupil behaviour in the classroom. Although our research is at an early stage, it is evident that the caution counselled in the literature from other domains is justified (p. 31).

At this level of technological capability these authors point to rather specific problems: for example, the way conceptual and procedural knowledge (know-that and know-how) are linked. These are the two dimension of making which we discussed in reference to Aristotle above and what are unified in craft. Students may not see the design theory elements embedded in the process of making things. They may only focus on the actual challenge of getting something made - based on the know-how. They may not know that it is all about a certain kind of process. This tension raises issues about the way design has been treated as a separate entity and given rather heavy conceptual work to do in the technology curriculum:

> Finally it is important to realise that understanding Bernoulli's principle does not ensure that someone can make a kite fly. The converse is also true: kites were being flown thousands of years before the scientific knowledge was understood. The 'craft' knowledge built out of experience, and related to many different and complex kites, has found its way into the design of bridles and tails. Only some of this craft knowledge could be derived from the 'scientific' knowledge, and it is unlikely that the level of understanding of it by pupils would ever allow them to modify original designed to make them fly (McCormick, et al., 1994, p. 24).

The question arises: does this way of defining making adequately reflect the actual process or is it a way of emphasizing concepts at the expense of know-how since the latter is much harder to codify.

It is also clear from classroom research that technology teachers intend to do more than teach problem-solving capabilities. As Kozolanka and Olson (1994) point out, teachers have an image of worklife in mind when they are working with their students. Teachers establish work microcosims which are suffused with values, and the values, like them or not, are connected to virtues that teachers think these students ought to have both as civilians and as workers. This is no narrow vocational socialization. All teachers have images of civility in mind which cut across specialized roles to encompass the whole person; all school subjects are taught with these images in mind. As they point out:

> We began this inquiry as an exploration of how technology and science teachers responded to the social concerns that students bring them. We are led to ask: are these teachers really doing that? We were surprised to find that students and teachers were not concerned with recycling and citizen action. The teachers were concerned about the student's own unformed social and intellectual habits. They wanted to develop these habits in productive ways. They talked about the virtues of patience, taking pains, not stopping until it's done, producing quality work, being civil, organized, systematic and methodical. They were concerned that their students become good people (p. 224).

So although there is skepticism that teachers can tackle values questions, from talking to teachers and from what we know about education as a process, we can see that they teach a particular value context in any event; more or less made explicitly. It isn't a question of any value context, but which ones. Only research can reveal what values are actually taught. And there are dangers for the way technology education is perceived if it eschews responsibility for making value contexts explicit. As Barnett (1994) points out:

> If the subject labelled Technology is to be largely focused on practical aspects of designing and making, then it cannot possibly bear the sole weight of responsibility for enabling students to make sense of technology. To achieve the latter aim, other subject areas must take technology seriously. However, an arrangement by which responsibility for practical capability rested with Technology, and for critical awareness with subjects such as Social Studies, History or Religious Education i.e. where values had been driven into exile from out of Technology, would be undesirable. This would tend to confirm

Technology as a ghetto for ingenious, specialist tinkerers, and the Humanities as the natural home for anti-technologists (p. 62).

There are further questions for research about the way in which teachers interpret and implement curriculum policies. Teachers have their own curricular and pedagogical traditions which may well give rise to points of conflict with official policies (Olson, 1992). For example, in the Netherlands, technology has been introduced as a basic subject in the curriculum. The objective of the technology classes is to acquire skills in using and processing materials by means of machines and tools and to solve technical problems. In order to promote problem solving the teacher deliberately restricts his or her teaching and counselling role to a minimum and invite s pupils to solve the construction problem as independently as possible.

The method is an agreed upon policy guiding content and approach, which leads the teacher into open zones where pupil ideas, rather than content specifics, are at work. The lack of clear ideas about how to proceed gives rise to risks which teachers must take to open up topics for discussion. Such activities flow from the problem solving and real world aspects of the school plan. Thus teaching the subject entails departure from teacher-centered handicraft work to more pupil-centered open-ended tasks and less specifically defined learning outcomes.

McCormick et al. (1994) found that teachers asked to embrace a design perspective did not wholly agree. Some felt that knowledge of materials was being slighted:

> I really don't think that sitting down with a brief and analysis and doing lots of research is necessarily the best way to come up with a good idea". For her, 'firsthand experience with materials' was an essential aspect of design: "I want them to get into the workshops as often as possible and actually use the materials and have as broad a range of materials as hand as possible. I'd like them to combine as many materials as possible...but they've also got to value the materials too" (p. 10).

The emphasis the teacher places on the exploration of materials was a consequence of the high value she placed on creativity in design. It was precisely this quality that she felt was threatened by the early introduction of a design brief or specification.

Other dimensions of research and examples could be discussed did space permit, but the importance of knowing about school traditions and practices, and how technology actually goes on in schools is vital to the evolution of the subject. One aspect of research that ought to be underscored and which will round out this paper, is that of the cross-cultural.

The Cross-cultural dimension

Volume 5 of the UNESCO series on sciences and technology provides examples of how technology education is construed across cultures. This rich multi-cultural view raises a very central question with which I want to end. If technology is constitutive of culture everywhere, and cultures vary, ought we to expect a uniform programme for technology education world-wide? Often promoting high-technology capability is held up as a defining goal for technology. But high-technology is increasingly suspect. Do we want nuclear power stations world wide? or high tech medicine? Or other techno-visions? What is to be gained by tying technology education to these visions?

Technology has other, humbler work to do besides emulating what we take as visions of modernity; it has to lead us back into where we live and how to live better. People live differently in different places. We need to be reminded of appropriate technologies and appropriate technological education that surely will be culture specific and what we will see is diversity in approach and method. The diversity will be a way of affirming what Franklin (1990) called technology as "coping" which she contrasts with technology as planning:

> Berit Ås, the well known Norwegian sociologist and feminist, has described this different in strategies. She sees traditional planning as part of the strategy of maximizing gain, and coping as central to schemes for minimizing disaster. A crucial distinction here is the place of context. Attempts to minimize disaster require recognition and a profound understanding of context. Context is not considered as stable and invariant; on the contrary, every response induces a counter-response which changes the situation so that the next steps and decisions are taken within an altered context. Traditional planning, on the other hand, assumes a stable context and predictable responses. Planning protocols for prescriptive activities, whether they're industrial, administrative, or educational, can be transferred from one application to another without regard to context (p. 83).

The challenges to technology in our lives are challenges to education as well. Educators, I think, cannot escape the turmoil which surrounds technological society. These critiques of society have implications for technology education in the central role it plays in schooling. As Taylor (1991) says:

> The agent, seeking significance in life, trying to define him- or herself meaningfully, has to exist in a horizon of important questions....[W]hat is self-defeating in contemporary culture....[is] self-fulfilment in opposition to the demands of society, or nature, [and

> shutting out] history and the bonds of solidarity. These self-centered "narcissistic" forms are indeed shallow and trivialized; they are "flattened and narrowed," .... But this is not because they belong to the culture of authenticity. Rather it is because they fly in the face of its requirements. To shut out demands emanating beyond the self is precisely to suppress the conditions of significance, and hence to court trivialization. To the extent that people are seeking a moral ideal here, this self-immuring is self-stultifying; it destroys the condition in which the ideal can be realized (p. 40).

Taylor gives us firm ground for advancing technological education. Instrumental reason, the fruit of which are technological systems and artifacts are valuable when seen in the context of the relief of human suffering and the supporting of the welfare of people. Technology is valuable for doing good things and he notes that this ameliorative view of science and technology has a long history:

> He [Francis Bacon] proposed in their [sciences as they existed] stead a model of science whose criterion of truth would be instrumental efficacy. You have discovered something when you can intervene to change things. Modern science is in essential continuity in this respect with Bacon. But what is important about Bacon is that he reminds us that the thrust behind this new science was not epistemological but also moral (p. 104).

We have to understand what human welfare is? This is the moral horizon for technology which cannot be set aside; neither in the world, nor in education. We have to think about what is good for us as people living in this or that society and how technological capability serves that, and how technology education can re-create that capability: both to make good things and to know what the good things are that technology can enhance. To do otherwise is to court disaster. We have the means to destroy the planet. This is what I think of when I contemplate what is happening in my own country where machines are used to harvest nature. It is an uneven fight. Trees in the west and fish in the east are sucked up by machines as if there were no tomorrow. Somehow technology education has to help students see the dangers of such machines and systems out of control and imagine what might be the alternative. That is the challenge we face as educators.

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