**Green issues in the technology curriculum**

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Developing a greener technology curriculum

Mike Lloyd
O2

Abstract
Despite social, economic and political pressures, green issues play a small role in the technology curriculum in schools. This paper puts forward O2's vision for the future of technology education. Questions about the current practice of technology education in schools are raised and proposals are made for developing the technology curriculum to take advantage of the growing importance of environmental factors.

The environment question is widely perceived as a threat; but is this really the case? Changes in the wealth creation process that are less damaging to our ecology are already beginning to happen and this is making the environment, as an education issue, impossible to ignore.

In this paper a number of proposals are presented. Firstly, children should be educated to consume intelligently and for sustainable futures. Secondly, the technology cycle, or design loop, should be extended to include "Impacts". Thirdly, design methodologies for sustainable futures should be taught - some examples are proposed and described. A spirit of "respect and responsibility" for the environment also needs to be engendered in young people, but before this can happen a more human centred approach to education needs to be developed. An education system on a more human scale pioneered in the USA is described. "Eco-technology" education is in its infancy, but some case studies from secondary and higher education are given.

We live on a small planet with finite resources and a growing population and we all have our parts to play in developing sustainable futures. The final proposal in this paper calls on all those involved in education, and technology education in particular, to meet the greatest challenge of this age.

The environment question - threat or opportunity?
An old Chinese CURSE says - "may you live in interesting times". Interesting times indeed, but we live in times that present us with enormous opportunities for positive change.

The environment is clearly THE issue of the 90's. The Earth Summit in Rio last year saw more world leaders assemble over the environment than over any other issue in the history of mankind. With increasingly stringent legislation, rising disposal costs and consumer demands for a cleaner environment and greener products, the environment is becoming increasingly difficult to ignore. Michael Heseltine MP recently said that "environmental controls should be seen as an opportunity, not a threat." O2 believes that working with the environment creatively and intelligently will bring about positive social and economic change. There is no more important place to start this process than in developing the technology curriculum.

Seeing the wood through the trees
The starting point for the development of any curriculum should be "what kind of world will our students live in?" It is our informed anticipation of future change that should determine what our students learn. Let us begin with a look at some changes that are currently affecting Western society:
The environment - we live on a small planet with finite resources and a rapidly rising population. The effects of mankind's activities on the planet, on society and on individuals are becoming more profound as well as increasingly well understood and communicated.

The emergence of "Software Society" - living in the symbol drenched worlds of cyberspace, multi and hypermedia.

New Ways of creating wealth - multi jobbing, information processing, the return of cottage industries and the growth in leisure services.

Societies and economies are fragmenting, "de-massifying" and de-centralising into smaller and smaller niche markets.

The net affect of these changes is that education will have to become increasingly flexible and responsive to change.

New spirit for a rapidly changing world

The main opportunity for education is to nurture a spirit in people and from this springs the means and motivation to solve the problems of the age. Favoured spirits in the past have been the "pioneering spirit", the "competitive spirit" and more recently the "spirit of enterprise" and "self reliance". It is a spirit of "respect and responsibility" for the environment that is most important now.

What do we need to teach?

Many people believe that the "eco-technology" path leads no further than wind generators and the geodesic domes of Drop City. In the eco battles now raging, however, high technology is one of our best weapons and the serious "eco-technologist" embraces the most advanced technologies available.

Whilst it is important to show what adverse effects technology can have, it is more important to show how it has the capacity to improve quality of life in an ecologically responsible way.

Technology education should involve teaching children where the things we use come from and go to, in terms of materials, industrial processes and thinking processes. This involves developing the following concepts:

Educating an intelligent consumer

All of our students are, and will be, affected by technology, so it is essential that we teach children to control the ways in which technology affects their lives. All of our students will also become consumers of technology and one way in which people are able to exercise control is through purchasing decisions.

There is, therefore, an opportunity to teach children how to make informed and intelligent choices about which technologies to use in the goods and services they are likely to encounter, throughout their lives.

Children should develop an informed concern about the environment. They also need to develop a spirit of educated enquiry about the lifecycles and impacts of the goods and services they will use. They need to be taught how to ask deep and probing questions about products, services and work, and their effects on the environment.

O2 has for a long time been working with the concept of "the questioning network" - the realisation that everything is affected by everything else, and that we are able to answer questions about environmental impact only with more questions. A holistic approach to education, as suggested by Schumacher, would be helpful in developing the kind of understanding of relationships necessary for a more ecological approach to life.

Extending the technology cycle to include "Impact"

A generally accepted model of technological activity has been:

\[
\text{Input — Process — Output} \quad / \quad \text{(assessment & evaluation)}
\]

Taking environmental factors into account means extending the cycle to include "Impact":

\[
\text{Input — Process — Output — IMPACT} \quad / \quad \text{(assessment & evaluation)}
\]

Teaching design methodologies for sustainable futures

Design is an important ingredient in the greener technology curriculum, as it makes students aware of the decision and thought processes that go on behind the products and services they use. Marc de Vries, University of Technology at Eindhoven, points out that students should be made aware that their design activity is only the starting point of the whole lifecycle of the product.
Students should also be taught design principles for sustainable technologies; below are some practical examples that have been developed by O2 for the 1991 “O2, New Ways” exhibition:

Design for real needs
For decades now advertisers have been creating needs that didn’t previously exist. Technology education should be about meeting real needs and sustainably improving the quality of life.

Design for manufacture from renewable and recycled materials
Recycled and reclaimed materials are being increasingly used. O2 design concepts show that recycled plastics can be used for street furniture, containers, tables, chairs, lighting etc. Novel uses are being found for many wastes - hospital waste in Los Angeles, for example, is being mixed with a ceramic and then glazed to form building blocks.

Longevity
This principle includes design for easy maintenance and the easy change of worn out parts. The bristles on a dish washing brush usually clog up and flatten out after a while. Normally the whole brush is thrown away; the handle, however, remains useful. The appropriate solution is to design the head of the brush so it detaches from the handle, enabling the user to keep the handle for use with a new set of bristles.

Optimum use of energy and resources
As a principle, products should be designed to use the minimum amounts of materials in their manufacture, and minimum amounts of energy in their use.

Multi-function
Where possible, a product should perform more than one function. A vice that rotates through a horizontal axis and does the jobs of metalworking, woodworking and softjaw vices saves on materials and energy. In Russia, Scud missile launchers have been converted into cranes for civil engineering, demonstrating the twin principles of multi-functionality and longevity.

Optimum disposal
Environmentally responsible disposal is context dependent and therefore difficult to make generalisations about. It is better, however, to design for reuse than for recycling. If one is, nevertheless, to design for recycling, products should be made from as few materials as possible and should be made easy to dismantle.

Appropriate material and process choices
Material choice, like optimum disposal, is context dependent. Selecting materials that are environmentally appropriate is complex. Members of O2 have, however, developed software for classroom use that allows context defined materials impact assessment.

Design and technology education - a catalyst for sustainable futures
O2 believes that the nature of design itself, especially in the commercial world, is changing. Design, we think, is becoming a creative catalyst for other professions and disciplines. The parameters of design are also expanding rapidly and an interdisciplinary approach is developing.

William Dugger, Virginia Polytechnic Institute and State University, talks of technology education as the “webbing” used to integrate subjects. In a school offering holistic education, technology could be used as a “window” onto other subjects and design, the creative catalyst for learning how to build sustainable futures.

How should children learn to design and consume for sustainable futures?
Carl Nielsen, University of Technology, Sydney, recently asked:

“What’s the point of worrying about our learning and teaching strategies, unless our students have both the motivation and the capacity to learn what we can teach them?”

There is a need to develop a more human centred approach to learning technology in secondary schools, before a greener technology curriculum can be expected to have an effect. Some practical steps have been taken in the USA to counter the “FACTORY” or “PROCESSING” organising principles widely used in secondary education.

A modular approach to technology education pioneered in the US at sites in Kansas, Colorado and Pittsburgh, has created an effective learning environment on a human scale. Advantages of this approach include interdisciplinary learning, optimal use of facilities, cost effectiveness and marked increases in motivation in students and staff.

Some case studies
Ecologically responsible technology education is in its infancy. Below, however, are some examples of eco-technology projects:
1) Product lifecycle analysis

During this project students took apart every day household electrical items and looked at where the materials came from, how they were produced etc. They also looked at what parts were most likely to fail in use, or wear out, and thought about how the products could be designed to allow for easy repair. Students looked carefully into how the product would be disposed of and suggested alternatives to this.

2) Future transportation

Students were asked to describe the vehicle they thought that they would be driving when they reached the age of 40. Green issues played a central role in deciding not only how vehicles were powered, but what kind of road systems would be used.

Solutions included, predictably perhaps, greater use of bicycles and pedestrianised areas, and the use of smaller vehicles for individuals getting to and from work. Less predictable, was the suggestion of the use of elevated or suspended monorails to take the place of roads.

3) Design for social participation in environmental improvement

Students were asked to design ways to extend the use of the every day bus stop. Solutions included bus shelters performing a range of functions from public entertainment and information services, to providing facilities for the proper disposal of dog dirt and recyclable material.
4) Ecological issues as a context to learning
At Goldsmiths' College, University of London, the “Total Design” course has been raising interesting questions about design, and O2 recently organised a project on poverty there. The brief was to formulate design solutions that would help deal with particular aspects of poverty and the environmental destruction it causes.

Solutions included a poster designed by an Ethiopian student to try to help her compatriots make simple crockery. Another student worked with the Child Poverty Action Group to find ways of using design to help alleviate child poverty in Latin America. The solution she came up with involved children being given waste cardboard and skills such as cutting, forming, laminating and lacquering, which allowed them to make products such as food trays. In this example of successful green design and technology education, the system counts more than the product - a basic “eco-technology” principle.

Some practical proposals
We must be clear that integrating ecological thinking into our work and lives will have a positive environmental effect. The environment is one issue that affects us all and we all, regardless of our position in the education system, have a role to play.

Teachers need to have the freedom and the tools to give the environment a much higher profile in their programmes of study. Politicians and education policy makers will need to give the environment as high a profile as industry and commerce currently seem to have. National Curricula, the world over, will need to integrate ecological thinking into their fabric. Pupils and students will have to develop the basics - not dropping litter and turning off lights etc.

Conclusion
Mankind has always used technology to overcome problems and take advantage of opportunities. It is only in recent times, and in Western cultures, that the relationship between mankind and the environment has featured less prominently in what is taught to our young.

O2 does not take the Malthusian view that mankind will self destruct. It is important, nevertheless, that we do not take for granted that planet saving technological solutions will just appear - someone, somewhere has to make it happen and we all have our parts to play.

The great ecological thinker, Schumacher, said that education is the greatest resource we have. It is the hope and belief of O2 that a more human era in education will emerge sooner rather than later, and that long term vision is not blurred by short term issues. There are few things that we can be certain of in education, but we can be sure that the environment is one issue that won’t go way.

The UK technology national curriculum
At the moment it seems that the most important issue in technology education in the UK is the National Curriculum. There are, of course, many problems with the Technology National Curriculum, but from an ecological perspective the biggest problem is that it draws attention away from green issues. The biggest trap that curriculum developers can fall into is using the National Curriculum as a starting point for determining what children should learn in class. The National Curriculum, however, should be seen as a foundation from which a sustainable technology curriculum can be grown.

References
1. Greig, Pike and Selby, Earthrights, Kogan Page, 1987
2. Department of Trade and Industry, Environment Initiative - “Minimising Waste”.
3. O2 is a diverse international network of design professionals seeking to integrate ecological thinking into their work. O2 have staged major exhibitions in Milan and Tokyo and recently released a handbook for designers. O2 members are involved in projects ranging from developing environmental training packages for British Rail to designing golf courses on ecological principles and have worked with companies such as Philips, IKEA and Montedison. A key area of O2 activity is education, with members involved in secondary and higher sectors developing the curriculum along ecological lines.
5. Smith, D, Poudre R-1 Technology Education Curriculum Guide


10. The author acknowledges the work of the Technology Education Program at Delta County Joint School District #50.