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The place of sustainability in design & technology education

Margarita Pavlova and James Pitt

Introduction

The need to address sustainability has suddenly appeared in agendas for educational policy around the globe. The emergence of the issue has been motivated by a number of reports that suggest that humankind is living beyond the carrying capacity of planet earth. Footprinting studies (a way of measuring the environmental impacts of different lifestyles) such as the “Living Planet Report” (WWF, 2006) indicate that we globally began to live beyond the Earth’s carrying capacity in 1987 (see image overleaf).

Recent studies by WWF (2006) and Jerrard Pierce (2005) demonstrate that industrialised countries have the greatest impact on this process. Jerrard Pierce’s cartogram (2005) shows graphically the relative contributions of different countries to global ecological footprints.

The “Ecological footprint by region...” graph (overleaf) gives comparable data by region for 2003. The overall area of the rectangle indicates the impact. Thus relatively few people in North America living at a high level of consumption have an impact significantly higher than the whole population of Africa. The charts for energy footprints and water withdrawal paint similar pictures - that people in the wealthy countries consume a disproportionate amount of resources (WWF, 2006).

The UK can be taken to represent the industrialised world. If everyone in the world were to live at the same level of consumption as people in the UK, there would be a need for three planets.



If people emerge from poverty and aspire to western lifestyles, can the planet earth sustain it? But what are the alternatives - continued poverty, huge reductions in population, or some other way of limiting damage to the planet?

Clearly the present trends are unsustainable. Almost every scientific academy in the world now says that there is a causal connection between high levels of consumption, greenhouse gases and climate change, which is already having a disproportionate impact on poorer people. Image 03 (overleaf) presents the model of the world by the 2050s where global warming and climate change has a disproportionate impact in the poorer countries. People in the industrialised world need to radically rethink how we live - our buildings, travel, diet, use of energy and in particular the type of technologies we use. Without a rethink of lifestyle a forecast for the wellbeing of the earth is not optimistic.

In October 2006 the government published the "Stern Review on the Economics of Climate Change". This report made clear that the situation facing the world is very serious. Here are some quotes from the executive summary.

- 'The scientific evidence is now overwhelming: climate change is a serious global threat, and it demands an urgent global response'.
- 'Climate change could have very serious effects

on growth and development'.

- 'The costs of stabilising the climate are significant but manageable; delay would be dangerous and much more costly'.
- 'Action on climate change is required across all countries, and it need not cap the aspirations for growth of rich or poor countries'.
- 'A range of options exists to cut emissions (of greenhouse gases); strong, deliberate policy action is required to motivate their take-up'.

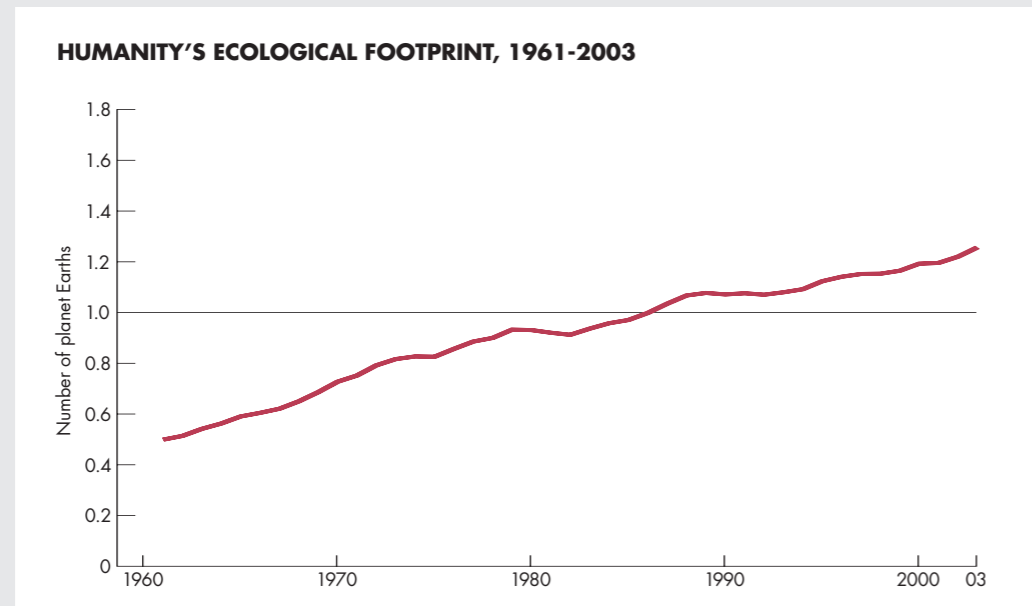
- 'Climate change demands an international response, based on a shared understanding of long-term goals and agreement on frameworks for action'.

The Stern Review's findings have been emphasised by the recent report of the Intergovernmental Panel on Climate Change (2007). It seems obvious that the way forward is through sustainable development but this is not straightforward as there is no one broadly accepted definition of the concept of sustainable development.

You can find out more about the Stern Review at this website: http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

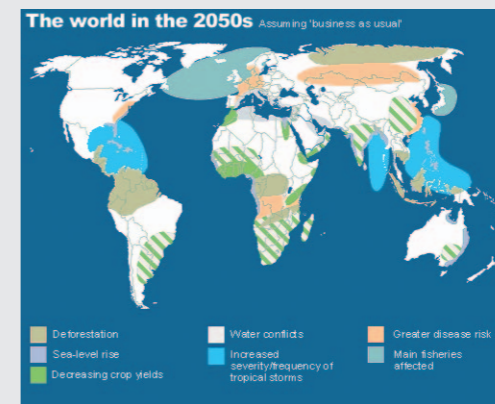
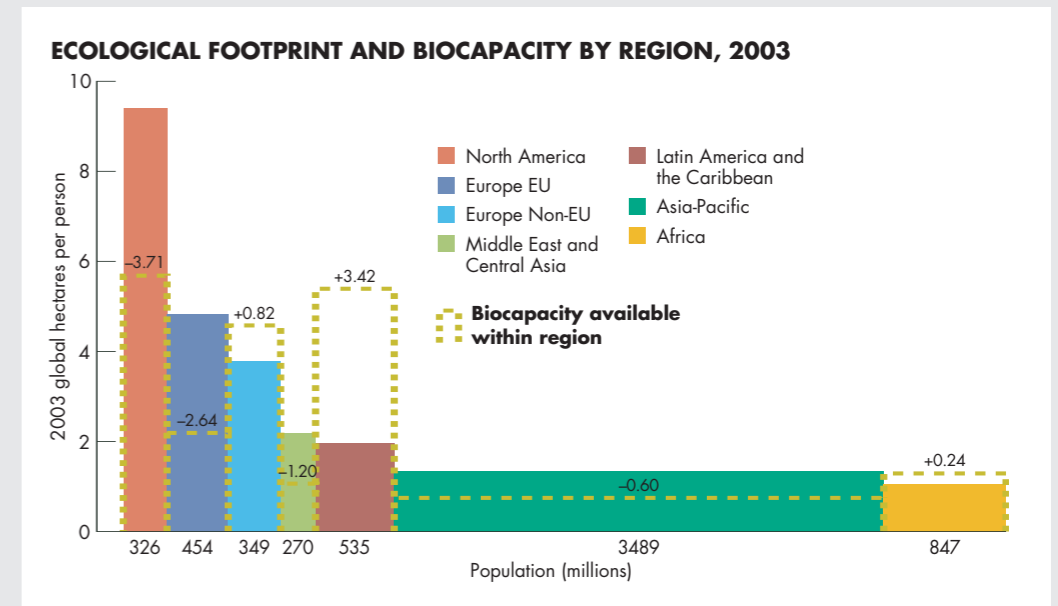
01

01 Humanity's world ecological footprint over time. © 2006, WWF (panda.org). Some rights reserved.)



02

02 Ecological footprint by region. © 2006, WWF (panda.org). Some rights reserved.)
03 Prospective relative impacts of climate change assuming 'business as normal'. © Guardian News & Media Ltd 2006)





To what extent do you think it is possible for design & technology lessons to provide space for students to rethink what is desirable and to challenge assumptions about what is needed?

What is meant by 'sustainable development'?

A widely used definition comes from the World Commission on Environment and Development (1987), in what is generally known as the “Bruntland Report”. Sustainable development is defined as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’. This has led to a well-known approach for analysing sustainability that includes social, economic and environmental dimensions without any prioritising. Although widely accepted, this approach has been recently criticised. “Forum for the Future” argues that in this form this approach is invalid. ‘A popular way of understanding sustainability is the concept of the triple bottom line of economic, environmental and social accountability. This idea proposes that an organisation’s licence to operate in society comes not just from satisfying stakeholders through improved profits (the economic bottom line), but by improving its environmental and social performance...

Whilst this concept is useful, we feel it is limited by giving equal weighting to each of the three bottom lines. We believe that environmental sustainability is pre-conditional, because without it the other bottom lines can't exist!
(Forum for the Future, 2006)

People in many developing countries might give greater emphasis to economic or social aspects of development. For Western societies, however, it is important to give the environmental bottom line particular significance. The model of sustainable development described here presupposes that the carrying capacity of the ecosystem (environmental limits) defines and envelops the extent of human action. The economy is tailored to work within this ecosystem’s capacity. The needs of communities to develop and maintain eco-efficient and sustainable technologies or ways of doing things have to work within the limits of natural ecosystems.

Sustainable development can be seen as change for the better in which social, cultural and economic needs are met without plundering non-renewable resources nor threatening eco-systems. Forum of the Future defines sustainable development as: ‘A dynamic process which enables all people to realise their potential and improve their quality of life in ways which simultaneously protect and enhance the Earth’s life support systems’.
(Forum for the Future, 2006)

Working within an essentially capitalist model of society, they extend the concept of capital to include natural, human, social, manufactured and financial capital and say: ‘Sustainable development is the best way to manage these capital assets in the long-term. It is a dynamic process through which organisations can begin to achieve a balance between their environmental, social and economic activities... In the sustainable society, four conditions must apply... The system conditions mean that nature is not subject to systematically increasing

1. concentrations of substances extracted from the earth’s crust - such as heavy metals.
2. concentrations of substances produced by society - such as plastic waste.
3. degradation by physical means - such as rising sea levels or desertification.
4. human needs are met worldwide...’

And, in that society...

This thinking is expanded by Jonathan Porritt (2005) in his book “Capitalism as if the earth matters”. He argues that (a) we have to live sustainably on Planet Earth, and that if we do not we are faced with ecological disaster; (b) that since capitalism will remain the dominant economic system for the time being, we have to work towards sustainability through a capitalist economy.

This view is challenged by other thinkers such as Arne Naess (1990), the author of the “Deep Ecology” concept which proposes a radical critique of capitalism. Two points made by Naess are:

1. All life has value in itself, independent of its usefulness to humans.
2. Basic ideological, political, economic and technological structures must change.



To what extent do you believe that ‘All life has value in itself, independent of its usefulness to humans’? What are the implications for designing and making?

However sustainable development is conceptualised, everyone agrees that education plays an essential role as we move towards more just and sustainable relationships and hence world order. In this chapter we are considering the contribution of design & technology towards education for sustainable development, which is usually called just ESD.

Recent developments in ESD

As governments, industry, NGOs and policy makers generally have become more aware of the urgency of sustainable development, educators have increasingly seen that there is a vital role in both formal and non-formal teaching and learning towards sustainability. UNESCO (2004) has dedicated 2005- 2014 as the “Decade of Education for Sustainable Development”.

Doorway	2. Energy and water
Curriculum	Schools can use the curriculum to cultivate the knowledge, values and skills needed to address energy and water stewardship - both at a local and a global level.
Campus	Schools can review their use of energy and water and establish policies for monitoring and reducing their use through good management and the deployment of appropriate technologies.
Community	Schools can use their communications, services, contracts and partnerships to promote awareness of sustainable energy and water use among their stakeholders.
Target	By 2020, the Government would like all schools to have minimised their carbon emissions by becoming good examples of energy efficiency, showcasing wind, solar, bio-fuel and other appropriate energy sources in their communities. Within the same time frame, the Government would like to see all schools minimising their use of freshwater by becoming good examples of sustainable water management, demonstrating freshwater conservation, rainwater use, and other water-saving measures in their communities.

04

04 Recommendations for the energy and water 'doorway'.



05

05 Where the Sakha people live.

Back in 1999 Faye Benedict developed a model of a systematic approach to sustainable environmental education. She proposed that for change to occur, teaching as an activity should take place in a multilevel system: teacher-student level, classroom level, school level, school system level, political level and outside world. She argued that teachers should consciously act at a range of levels, putting their efforts into a broad perspective. This is supported by focus group studies in England conducted by Cai Cheadle, Gillian Simmons and James Pitt in 2004. The Department for Education and Science in England acknowledged this need for multi-level intervention in 2006 when they published their sustainable schools policy as a framework for planning. The centrepiece of this approach is to think in terms of 'doorways'. Rather than impose yet another 'you ought to do this...' onto browbeaten teachers and school administrators, schools are being invited to examine all the different ways they can engage in more sustainable behaviour, under the headings of curriculum, campus and community.

There are 8 doorways into becoming a more sustainable school:

1. food and drink;
2. energy and water;
3. travel and traffic;
4. purchasing and waste;
5. buildings and grounds;
6. inclusion and participation;

7. local well-being;
8. global citizenship.

For each doorway there are recommendations for how the school should behave (campus) and how this can link to teaching and learning (curriculum). Schools can develop or use their relationships in the local community to become champions and living examples of sustainable development (community). The fifth row specifies targets.

The thinking is that it does not matter which doorway is emphasised within a school, as sooner or later they all link up. The energy and water doorway is reproduced above.

The strength of this approach is that it links teaching and learning to school policy and practice. There are huge opportunities in the first five themes for design & technology teachers.



What might go into the curriculum, campus, community and targets for

- food and drink?
- travel and traffic?
- purchasing and waste?
- buildings and grounds?

You can check out your answers against the

framework provided by the government at this url: http://www.teachernet.gov.uk/sustainableschools/framework/framework_detail.cfm

The relationship between humanity, technology and nature

Throughout history the relationship between humanity and nature has been among the most important existential and philosophical issues. In traditional, rural cultures the unity of humanity and nature was part of the overall perception of the world and up until now some indigenous cultures have preserved this view. For example the people of Sakha, one of the nations of the Far North of Russia, have a number of 'rules' related to respect and protection of spirits and nature:

*'Don't spoil fire.
Don't pollute water; keep it clean.
Don't dig up the earth.
Keep air clean.
Don't break stones into pieces.
Do not trample down the green grass.
Do not damage a tree.
Protect animals and birds.'*

(Shamaeva M.I, Semenova V.D & Sitnikova N.V, 1995, p. 69)

As humankind has developed, this holistic understanding of the world in terms of the

relationships between humanity and nature has changed, particularly in the West. The accumulation of technological knowledge has been aimed mainly towards the effective control of the physical world in terms of the exploitation of nature and its resources. The conceptual split between humans and nature that philosophers refer to as a 'Cartesian dualism' has established a dualism that is fundamental to the Western worldview: *'One key legacy is that we still separate or disassociate things that are related... Separation and fragmentation extended to almost everything including science, art, ecology and economics, people and nature. It is essentially a materialist worldview, which isolates and diminishes spiritual and sacred aspects of reality'* (Stephen Sterling, 1993, p. 75).

A strong belief that science and technology can expand human power has been predicated on an unaccountable use of natural resources. People saw this scientific-technological progress as an independent source of profit creation, on which economic growth depends. In the view of Jurgen Habermas the process of the 'scientization of technology' has gone hand in hand with research under government contracts in the military sector, at least since the end of the 19th century (Habermas, J 1968/ 1971, p. 104). Thus, technological development and an increase of the technocratic ideology with its strong belief in the unlimited development of technology have greatly contributed to environmental and social

problems. This in turn has impacted on the way that sustainable development is conceptualised.

G

What is your view on the extent to which technology can contribute towards the resolution of social problems that will lead to sustainable development? How might students be encouraged to go beyond the environmental dimensions of sustainable design, so that they also consider the social and economic impacts of a new product or technology?

Education for sustainable development as a 'frame of mind'

In reviewing different approaches to ESD, John Huckle (2005) distinguishes between two broad trends: (a) ESD as *policy*, and (b) ESD as a *frame of mind*.

(a) ESD as policy

One approach to design & technology might look like this. As teachers we inform students about resource depletion, use and abuse of energy, pollution, poverty and so on. We invite them to make design decisions (in their projects) that have the minimum

negative impact on the environment, economy or social relations. We encourage them to weigh up the three dimensions of sustainable development (social, environmental and economic) and to justify their design decisions by demonstrating an overall improvement when comparing what they have designed with the product it is replacing or need that it is meeting.

In each year or key stage we will ensure that there is a project which lends itself to raising issues of sustainability across the whole lifecycle of a product. We hope that what they learn in this project can be extrapolated and applied to other projects. We further hope that once their eyes are opened as to how things can be made better through design and technology, students will make 'better' choices as designers and consumers, in their lives outside and beyond school. As teachers and curriculum developers we aim to *'develop "positive" attitudes among our students, to realise sustainability indicators and deliver "relevant" knowledge as set down in policy documents'* (John Huckle, 2005).



To what extent does this describe what you have seen in school?

John Huckle questions this whole approach. Sustainability can be viewed as a policy designed to achieve a certain state of affairs, whilst covertly failing to question the

'attitude of mind that sanctions the continued exploitation and oppression of human and non-human nature'. Huckle implies that the viewing of sustainability as policy, and ESD as one aspect of this policy, does not and will not work. It is not enough to know that burning fossil fuels causes climate change. We have known this for a long time and we are still increasing the use of fossil fuels. We know that air travel is unsustainable and yet the UK government will not tax aviation fuel. New cheap airfares and routes are appearing all the time. We know that over 25% of traffic on motorways is generated by shifting food around the country yet we continue to buy from supermarkets rather than farmers' markets - and so on. We are shocked by images of poverty and exploitation yet continue to buy clothes without questioning their provenance. The question is, why do we not change our behaviour?

Many bodies view ESD as an aspect of overall sustainable development policy, one which is *'designed to close "value-action" gaps between people's knowledge and concern for sustainability issues and their lack of relevant action and support for relevant policy'* (John Huckle, 2005). Put the facts in front of people (this thinking goes) and they will change their behaviour.

Huckle argues that this is a simplistic view based on assumptions of cause and effect that simply do not hold true. The so-called 'facts' are not agreed, or at the very least are open to very different interpretations or meanings.

We are not always rational in our decision-making. Our value systems (seldom made explicit) influence the way we perceive the world and think. There is no consensus about what needs to be done. And treating ESD as one aspect of policy allows teachers and schools to compartmentalise it in a way that dissociates anything that children might learn from what they actually do.

(b) ESD as a 'frame of mind'

An alternative approach is to think about sustainability and hence ESD as a frame of mind starting from very different assumptions:

- There is no consensus as to what is meant by 'sustainable development'.
- Different people have different views and interpretations about the bio-physical world and social relations. These both inform and are influenced by each person's underlying values and beliefs.
- These values and beliefs need to be made explicit as we explore the concept of sustainability as a way of relating to nature.
- Therefore both the content of what we teach and the way in which we teach should be informed by these different views.

John Huckle (2005) quotes Michael Bonnett (2002):

'If we are to enable pupils to address the issues raised by sustainable development rather than preoccupy them with what are essentially symptoms masquerading as causes, we must engage them in those kinds of enquiry which reveal the underlying dominant motives that are in play in society;

motives which are inherent in our most fundamental ways of thinking about ourselves and the world. That such a metaphysical investigation will be discomfiting for many seems unavoidable, but it promises to be more productive in the long term than proceeding on the basis of easy assumptions about the goals of sustainable development as though it were a policy whose chief problems are of implementation rather than meaning'.

Q1

To what extent do you think it is the role of design & technology alone in the curriculum to engage in ESD? Discuss with colleagues who teach geography and science what their views are and find out to what extent they adopt a frame of mind approach.

Implications of ESD for teaching and learning in design & technology

In order to consider how ESD might influence teaching and learning in design & technology we must first position design & technology within the overall education endeavour. The recent QCA initiative to review the secondary curriculum states that the aim of the curriculum is for all young people to become:

- 'Successful learners who enjoy learning,

make progress and achieve'

- 'Confident individuals who are able to live safe, healthy and fulfilling lives'
- 'Responsible citizens who make a positive contribution to society'

See <http://curriculum.qca.org.uk/subjects> (accessed on 17.10.07) for more detail.

This looks uncontentious until particular phrases are unpacked. For example, what is meant by making 'a positive contribution to society'? If this is seen solely in terms of making an economic contribution, then the role of design & technology becomes the narrow one of fitting young people for employment within occupations that require the particular knowledge, understanding and skill that can be learned in a vocational manifestation of the subject. The place of ESD here is limited at best and will probably not involve a frame of mind approach. If, however, making a positive contribution to society is seen in much wider terms as developing an ecologically-oriented and critical world outlook, then design & technology is well positioned to respond to ESD with the opportunity to adopt a frame of mind approach.

Q1

For the two views of making a positive contribution to society put in order of priority the following statements about the purpose

of design & technology education:

1. It should prepare students with technical skills so that they can get jobs;
2. It should enable students to uncover and analyse the moral decisions that underlie the development and production of a product;
3. It should be a central part of helping students to see what changes need to be made if they are to live more sustainably;
4. It should give students generic competencies such as thinking, problem-solving and team-working;
5. It should prepare students with life skills such as cooking and making things so that they are technically competent as adults.

Product life cycle analysis is a key concept in discerning the impact of a product or technology on the environment and, with the use of appropriate tools, the wider impact on society and economic activity. It can be

used to good effect in the curriculum as part of a frame of mind approach to ESD. Product life cycle analysis is sometimes referred to as cradle-to-grave analysis. For any given product this analysis requires a consideration of the following:

- The raw materials and their sources;
- How these materials are processed;
- How the processed materials are manufactured to give rise to the product;
- How the product is distributed and sold;
- How the product is used;
- What happens to the product at the end of its useful life.

At most stages there will be transport involved. Sometimes the materials, manufacture and disposal will have the biggest impact, as in the case of a battery-powered torch. By contrast the impact of an electric kettle will be largely in its use: the oil or gas burned and resulting CO₂ emissions in electricity generation will have an impact some thousands of times higher than that of bringing the product into being and disposing of it.

So pupils can be taught to use product life cycle analysis when considering existing products, in speculating on the impact of the products they design and make should they be put into production and also those products that they develop to the 'concept only' stage. If done regularly, the sophistication with which the process is carried out can lead to the unpacking of different views and



interpretations of the relationships between nature and humanity. In this way the gradual movement from ESD as policy to ESD as a frame of mind can occur.

The approach can be extended by considering winners and losers at each stage of the product's life. In the development, use and disposal of any product there will be those who benefit and those who become worse off. The winning and losing can take place at individual and community level and involve both economic and social impacts. In many cases these impacts are related. For example, the building of nuclear power stations in England has massive environmental implications stretching far into the future, but for the communities of coal miners who became unemployed because nuclear power was the government's preferred option to coal-fired generation of electricity, the result was economic decline and social malaise through the disintegration of their communities.



Choose one or more of the following products and carry out product life cycle analysis. Use this analysis to identify the environmental impact of the product.

- Fair trade coffee from Africa.
- Scissors manufactured in China.
- A computer manufactured

in Taiwan.

- Clothing manufactured in India.

Use a winners and losers analysis for some of the stages in the cycle to extend this analysis to include social and economic impacts.

To what extent do you think it possible to engage pupils in design & technology classes with this approach?

You can find out more about a structured approach to winners and losers at this url: http://www.secondarydandt.org/resources/ks3/frk3_000000013.asp

Analysis undertaken by Margarita Pavlova (2006a, 2005) demonstrates that to deal with ESD via design & technology is a very complex task. Two popular approaches identified in the literature towards SD - 'technological fix' and 'value change' (Robinson, 2004) were analysed by Margarita to explore which one might work better for design & technology. After she conducted the analysis of both approaches using philosophy of technology and sociology of consumerism, she concluded that neither approach would work on its own.

To appreciate the value of the 'technological fix' approach Margarita has critically analysed the concept of technology within the broader philosophy of technology. Margarita Pavlova (2006b) demonstrates that technology on its own cannot fix all the problems of the modern world and concludes that it is even dangerous to believe that. She raises the question as to whether it is always possible to use technology ethically. For example cloning technologies provide a lot of possibilities, but legislation in some countries prevents scientists from carrying out any experiments on humans due to a number of ethical issues. However, some scientists have been using this technology on human cells. Although most technologies have positive features that can be used for sustainable development of the world, their major aim is the optimal performance. Henry Skolimowski (1966, p. 375) describes this as:

'...maximizing output (the information or modifications obtained) and minimizing input (the energy expended in the process). Thus, these are the main aims for developing technology. The nature of technology could be described as "to produce more and more diversified objects with more and more interesting features, in a more and more efficient way" '.



To what extent do you agree with Margarita Pavlova that a technological fix could not be seen as the only way to achieve sustainability?

Margarita Pavlova (2005) uses the sociology of consumerism to analyse how a *value change* approach to ESD could be positioned in a consumer society, the society where aesthetics, not ethics, is the prevailing paradigm. People, Margarita argues, are preoccupied with the appearance of the products. In particular aesthetics plays an increasingly important role in influencing youth's identity. At the same time ethics has a diminishing role, even though ESD is thought of as an ethically-based approach to education. Similar to the 'technological fix' approach, a 'value change' approach cannot be seen as the only one to be used in the classroom. However, another important aspect emerged from this analysis - the importance of aesthetics. If we accept this, an important role for aesthetics should be design for sustainability, or to put it the other way, education for sustainability should pay more attention to aesthetics. There is a need to understand the relationships of interdependence of the ethical and aesthetical components of sustainability, as well as the relationships with social and economic aspects of product design.

It is important to note that aesthetics today is conceived in broad terms. As Ralph Alan Smith and Alan Simpson (1991, p. 18) express it, aesthetics *'...tends not to concentrate exclusively on the concept of beauty; aesthetics is the attempt to understand our experiences of and the concepts we use to talk about objects that we find perceptually interesting and attractive'.*



Fruit from a local farm, picked and put on display at a farmers market is unlikely to look as uniform or unblemished as fruit on display at a supermarket. It is also unlikely to be available in such a wide variety, being restricted to what can be grown seasonally in the locality. But the range of choice and blemish-free uniformity comes at a price, air miles and a process of selection with the rejected fruit probably going to waste. Appreciating the beauty of the locally grown requires underpinning of more than a little life cycle analysis! This close relationship between aesthetics and ethics can be used for the development and use of the concept of aesthetics for sustainability with students. Through their product design they can influence consumer choices in modern society in a positive way.



To what extent do you think it will be possible to educate pupils in an aesthetics of sustainability? Try to develop some useful examples.

Conclusions

We believe that in the teaching and learning of design & technology it is vital to avoid the implicit suggestion that sustainability is just another thing to think about.

There is a danger, however, that students (many of whom are products of a materialistic, individualistic, hedonistic, high-consumption-and-bigger-the-consequences, instant gratification society) will be bored out of their heads by overt moralising. The key (following John Huckle) is to see ESD as discourse analysis. Let us examine what people are actually thinking and feeling and saying to each other about design decisions and ask, why do they think that? What are their (and our) presuppositions and preconceptions? Let teachers confess their own duplicity and share this with their students in dialogue. Perhaps one consequence of adopting a frame of mind approach is that teachers must be prepared to deal with conflict - not comfortable, but possible.

Further reading

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Useful websites

For a fuller elaboration of different approaches to the concept of sustainable development, useful starting points are:

<http://www.biothinking.com/>

UNECE: <http://www.unece.org/env/esd/events.htm>

UNESCO: http://portal.unesco.org/education/en/ev.php-URL_ID=19648&URL_DO=DO_TOPIC&URL_SECTION=201.html

UNESCO-UNEVOC: http://portal.unesco.org/education/en/ev.php-URL_ID=31336&URL_DO=DO_TOPIC&URL_SECTION=201.html

http://en.wikipedia.org/wiki/Sustainable_development

<http://www.gdrc.org/sustdev/definitions.html>

http://www.forumforthefuture.org.uk/aboutus/sd_page170.aspx. Go to 'Tools for Sustainable Development' for more detail.

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