The social agenda of education for sustainable development within design & technology: the case of the Sustainable Design Award

James Pitt · Fred Lubben

Abstract   The paper explores the adoption of the social dimensions of sustainability in technological design tasks. It uses a lens which contrasts education for sustainability as 'a frame of mind' with an attempt to bridge a 'value-action gap'. This lens is used to analyse the effectiveness of the Sustainable Design Award, an intervention in post-16 technology education in three countries to encourage students and teachers to strengthen design for sustainability in their work. In each country, the intervention project provided varying combinations of teacher professional development, provision of learning resources, in school student support, lobbying of key curriculum policy makers and a student Award. Three types of teacher are identified by reference to their motivation for introducing sustainability into their teaching of design. These teacher types are linked to a hierarchy of teachers' understanding of the social dimension of sustainability. The consequences for continuous professional development are examined. The findings are then used to critique the value of the lens.

Keywords   Sustainability · Social dimension · Sustainable Design Award ·
Teachers' views · Impact research · Teacher training ·
Continuous professional development

Introduction

This paper develops a framework for Education for Sustainable Development (ESD) that includes a 'concentric' view of Sustainable Development (SD). This framework differentiates between ESD as policy to bridge a 'value-action gap' and ESD as a 'frame of mind'. It is used to evaluate an intervention aimed at including sustainability, particularly

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the social dimension, in design tasks in the subject Design & Technology (D&T) in England and Wales, and in the Netherlands. It is hoped that the findings will suggest effective strategies for improving teachers' understanding of, and confidence in, including the social dimension of sustainability in design tasks, depending on the teacher's motivation. The usefulness of the proposed framework for Education for Sustainable Development will be reviewed.

Sustainability and sustainable development

The concept of sustainable development is both problematic and highly contested. The original Brundtland definition as *"… development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (WCED 1987) still provides a rough and ready handle that makes sense to many people. Even if this begs definition of the term 'development' it does invite us to look beyond narrow environmentalism towards wider, social and economic considerations.

Sustainable development, or sustainability, is now seen to be pervasive and multi-dimensional. Harrison et al. (2002) emphasise that sustainable development can not be practised as the remediation of a number of mismanaged situations (e.g. rubbish dumps, poisoning of a stream, child labour exploitation) but that sustainable development relies on "continuous principled vigilance" (p. 118) to uphold a combination of social values. The Earth Charter (UNESCO 2007) is based on 16 principles that are grouped into four broad headings of

1. Respect and care for the community of life
2. Ecological integrity
3. Social and economic justice
4. Democracy, non-violence and peace

When these are unpacked they include ecological, economic, social, cultural and personal dimensions. More commonly, sustainability is described as having three dimensions–environmental, social and economic. For the purposes of this paper we will include under 'social' anything that is cultural and personal.

These three dimensions of sustainability–environmental, social, economic—are often represented by interlocking circles as shown in the left hand diagram in Fig. 1—see for example the image on the website of the Department of Children, Schools and Families in England (DCSF 2007a). Webster (2004) is critical of this view, suggesting that this leads to a fragmented and indeed false perspective in which economic growth can be allowed to continue unchecked. He points out that whether we like it or not, the planet is a finite ecosystem. Elshof (2005) notes that sustainability has to address the imbalance between "our technosphere and the capabilities of the biosphere to regenerate and sustain the life support systems upon which we all depend" (p. 174). Thus, Webster (2004) proposes a concentric image of sustainable development arguing that the ecosphere encapsulates all human activity and breaking the boundaries will risk catastrophe. Environmental policies and the protection of biodiversity are human constructs. Within this, considerations to improve the society determine human decisions with an emphasis on "improving the quality of life, since it cannot be a society of more and more, it will be a society of better and better –and fairer" (p. 40). The economy is seen to provide for societal development with "the economy as a means of servicing human needs rather than people and resources servicing the economy" (p. 41). This image is presented in the right hand diagram in Fig. 1.
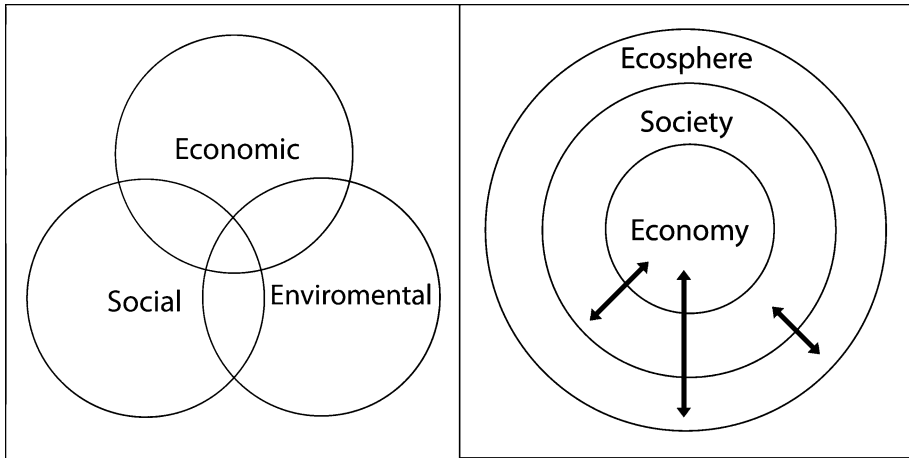
Fig. 1 Relationships between environmental, social and economic dimensions of sustainable development [adapted from Webster, 2004, p. 40]

Education for sustainable development

The advances in the formulation of sustainable development have influenced how Education for Sustainable Development (ESD) has changed over the last two decades. In a wide-ranging review, Huckle (2006) describes how the construction of ESD has changed, at least in the view of UNESCO. No longer seen as an extension of environmental education, ESD was, by the time of the Earth Summit in 2002, seen as a catalyst for change and as a way of addressing the changes in values and behaviours that must take place if the planet is to have a sustainable future. It is concerned with exploring the basis of making real decisions relating to the economy, environment and community well-being and the inter-relationship between these, both now and in the long-term (Huckle 2006 pp. 10/11). As noted by Tungaraza and Sutherland (2005), such links between the economy, environment and society set ambitious requirements for technology education—"a commitment to critical analysis whilst fostering creativity and innovation" (p. 190).

ESD as part of 'policy' or a 'frame of mind'?

Bonnett (2002) distinguishes between ESD as teaching to promote 'sustainable policy' and ESD as teaching to adopt a sustainable 'frame of mind'. The policy, or value-action gap, approach is constructed within a didactic paradigm. In a technology education environment this approach might play out as follows. In this approach teachers may inform students about resource depletion, use and abuse of energy, pollution, poverty, human rights and so on. They invite students to make design decisions (in their projects) that have the minimum negative impact on the environment, economy or social relations. Teachers highlight examples of specific sustainable decisions, and 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. Teachers further hope that once students' eyes are opened as to how things can be made better

through D&T, they will make 'better' choices as designers and consumers, in their lives beyond school. It is assumed that changed knowledge will lead to changed behaviour. However, Dakers (2005) claims that this "hegemonic behaviourist approach", where the teacher provides the standards and values to be applied for desirable design behaviour, will only produce uncritical practitioners replicating and refining existing behaviour.

An alternative approach is to think about sustainability and hence ESD as a 'frame of mind'. This starts 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 the rest of nature, including in product or systems design.
- Therefore, both the content of what we teach in D&T and the way in which we teach D&T (and other subjects) should be informed by these differences in values and beliefs.

Bonnett (2002) comments that this will, inevitably, lead to argument. He proposes that if we encourage students to look at "the underlying, dominant motives that are at play in society" rather than "symptoms masquerading as causes" (p. 19) this will be discomforting but in the long run more productive. He suggests we need to examine meaning and how it is constructed rather than seeking the uncritical implementation of sustainable development policy.

A pedagogy of sustainability

This raises the question: are we concerned with education *about* sustainable development, or education *for* sustainable development? Both of these approaches to ESD fall within Bonnett's *policy approach*:

1. Education *about* sustainability may be seen as familiarisation with aspects of environmental science and management. It is essentially environmental education. The assumption is that increased knowledge will contribute to sustainable policy changes.
2. Education *for* sustainability can be seen as teaching towards changes in values and behaviour: it attempts to bridge the value-action gap to increase sustainable decision making.

Huckle (2006) argues that only in the latter case there are implications for pedagogy which may meet with resistance. He suggests that

> As an aspect of policy 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, ESD is limited by modernist assumptions. Instrumental rationality means that such ESD is too ready to overlook the semantic, ethical and epistemological issues that lie at the heart of the sustainability debate; and too reluctant to examine the real causes of unsustainable development that lie within modern institutions and ideas. (p. 5)

By contrast, ESD within a 'frame of mind' paradigm encourages students and their teachers to examine their own and others' interpretations of nature and different ways of relating to nature and one-another that encourage the joint development of human and

non-human nature. The use of such a paradigm will certainly require a change in pedagogy. It looks to an analysis of arguments and the motivation behind adoption of different points of view. By engaging students in arguments and exposing underlying values it becomes possible to identify the beliefs on which values rest. The 'frame of mind' paradigm is linked more closely to education for critical technological literacy (Petrina 2000) involving constructive criticism of modern ideas, gadgets, structures and institutions. The starting point can be analysis of conflicts. Stirling (2001) calls for a paradigm shift in education if sustainability is to be promoted by acknowledging the social construction of nature, environmental issues and identities. The diversity of people's environmental knowledge needs to be recognised as a basis for ESD as does the existing social knowledge directing people's everyday lives. Given that D&T as a subject involves students making real decisions about real products, that these decisions require making value judgements about competing demands, and that these decisions might affect them personally, there are clear possibilities for developing ESD as a frame of mind within the subject.

What are the social issues in technology education?

This paper focuses on the social dimension of sustainability in technology education. In a study of the issues Canadian technological studies teachers associated most strongly with sustainability Elshof (2005) finds that sustainability issues related to 'social justice and equity' are seen as less important, and within this category global issues such as population growth, pollution, human rights and fair labour practices rank highest. These may be considered distant issues over which students and teachers have little control, and there-fore, not worth including in sustainable design teaching. This interpretation is reinforced by the fact that the same teachers saw political leaders, not themselves or the community as a whole, as the main agents for change towards achieving sustainability. Similar sentiments amongst UK teachers have led to interventions highlighting the opportunities for including a range of sustainable issues in D&T design tasks, including the social dimension of SD.

Since 1997 the NGO *Practical Action* (formerly known as *Intermediate Technology* or *ITDG*) has been refining a checklist of what the social dimension looks like (Practical Action 2007a). It includes issues such as whether a product is really needed and how appropriate it is, the impacts on health, cultural diversity, traditional skills and 'sociability', how it relates to human rights, and impacts on future generations. Clearly social, environmental and economic issues are not mutually exclusive: factors such as availability of jobs and the types of job available can be categorised as both social and economic with environmental impacts! The full checklist of social issues is given in the appendix, and checklists of economic and environmental issues as they relate to design decisions can be found on the website of Practical Action (2007b). In this paper we examine how these issues have been adopted by teachers engaged with the Sustainable Design Award (SDA) project in England, Wales and The Netherlands.

The curriculum context

ESD is gradually emerging in the school curriculum for England: indeed in the latest version it is written into the Key Stage 3 programmes of study for geography, science, D&T and citizenship (QCA 2007a). For the 16 + curriculum a set of mandatory criteria form the basis of the exam specifications written by the awarding bodies (exam boards). In

the new criteria for AS/A-level that the QCA published in 2006, against which specifications for 2008 onwards have been written, the words 'sustainable' and 'sustainability' are now inserted in four places QCA (2007b). According to a personal communication from the QCA these insertions were a direct result of the SDA. The criteria for D&T already in force at the period reviewed required that students recognise the social, moral, spiritual and cultural values in design and technological activity, and that they should develop critical evaluation skills in technical, aesthetic, ethical, economic, environmental, social and cultural contexts.

In England the Department for Schools, Children and Families is actively promoting a policy for sustainable schools. It asks that schools move towards becoming more sustainable in their behaviour (*Campus*), in how they relate to the outside world (*Community*) and in their teaching and learning *(Curriculum)* (DCSF 2007b). However, in the 3 years under consideration there were only minimal references to sustainable development in official curriculum documents. It was something that teachers could introduce if they wished, but it was not mandatory.

The situation in Wales was slightly different in that the Welsh Assembly was actively promoting its sustainability agenda since 2002. It published guidance on education for sustainable development and global citizenship (based on its *Sustainable Development Action Plan*) and this was sent to every school (Welsh Assembly Government 2002). The Welsh inspection agency, Estyn, was charged with looking to see how this was being interpreted in schools. However, sustainability did not feature significantly in curriculum documents, and again it was up to individual teachers or schools to decide what they actually did.

In the Netherlands sustainability was included as conceptual learning outcomes within the various science curricula. Only with the start of the SDA project did sustainability also emerge as an emphasis in assessed technical design tasks within these science subjects.

Description of the SDA intervention

The goal of the *Sustainable Design Award* (SDA) project was to raise awareness and understanding amongst young people within the England, Wales and The Netherlands of appropriate technology, its role in sustainable development and its potential contribution to poverty reduction. The project did not set out explicitly to develop a 'frame of mind' approach to education for sustainability. In fact, the aspects of sustainability were illustrated, as usual, by the overlapping circles for social, economic and environmental dimensions. The main emphasis was on developing the perception that sustainability goes beyond environmental concerns.

In England and Wales, the project targeted students taking an 'A' level course in Design & Technology (D&T). The SDA project intended to offer teachers support with dealing with "issues of environmental, economic and social sustainability especially in relation to product analysis and major projects" (Practical Action 2007b) included in each year. It was linked to an Award or certificate that could be given to individual students who demonstrated good practise in sustainable design.

In The Netherlands, the SDA project activities were targeted at upper secondary school students taking science subjects such as General Sciences, Physics, Chemistry or Biology. The SDA project provided the basis for the inclusion of a technological design as an assessed piece of work within the school-based assessment in these subjects. Since the project targeted science students in The Netherlands, Dutch data will only be used for the purposes of this paper as illustrative of issues emerging from the English and Welsh data.

The *Sustainable Design Award* project was implemented by Practical Action (PA) in England, the Centre for Alternative Technology (CAT) in Wales. The equivalent *Ontwerpen Voor Duurzaamheid* project was implemented by the Amstel Instituut (AI) at the Universiteit van Amsterdam in The Netherlands.

In England and Wales the project provided printed and web-based resources, training days or weekends, and email and telephone support for both teachers and students. The resources included a wide variety of design contexts within which students could develop design briefs: some were generic (e.g. apply the principles of reduce, reuse, and recycle in the redesign of any product), others much more specific and relating directly to issues of sustainable development, for instance: "In Sri Lanka rainy seasons are becoming less predictable. Therefore, capitalising on rainwater when it does fall is increasingly important. Investigate different methods of collecting or filtering rainwater and design and make a filtration or collection system suitable for the dry areas of Sri Lanka" (Practical Action 2007c).

In England the main focus was on training teachers and over the period 2003/07 more than 500 teachers attended SDA courses, as did about 600 students. Normally these courses took place over one or two days, out of school. In Wales project staff gave greater emphasis to working directly with students in schools running half-day or full-day sessions, or by having students come to the Centre for Alternative Technology itself. They too trained about 600 students in the same period, and about 100 teachers (Lubben and Pitt 2007).

This study is interested in evaluating to what extent the SDA project has been effective in promoting the social dimension of SD within D&T, and what views of ESD have been adopted by participating teachers and key experts. Consequently, the research questions for the study are:

(i). What were the motives for English and Welsh teachers of A-level D&T to get involved in the SDA project?
(ii). In what ways has the project increased participating teachers' understanding of, confidence in, integrating the social dimension of sustainable development in their D&T teaching?
(iii). What were factors perceived to be contributing to these changes?
(iv). At the end of the project what are teachers' views on the nature of SD especially with regards to the social dimension?

Methods

Data were collected in two ways. The main body of data was collected through 20–30 min semi-structured interviews with 12, 8 and 10 teachers in England, Wales and the Netherlands, respectively. In addition, relevant curriculum documents were analysed for references to sustainable development.

The purposive sample selection (Cohen et al. 2002) attempted to involve teachers with different levels of adoption of sustainability. However, no attempt was made to obtain a random or representative sample, as the intention was to identify issues related to the project's impact. In the event we have not been able to include any rejecters of the project.

The interviews were electronically recorded and notes were made of significant issues raised, but the interviews were not transcribed verbatim.

The analysis used interpretive methods (Strauss and Corbin 1998) by reading repeatedly through interview notes and documents, identifying common patterns. The data were also

interrogated for references to any of the three dimensions of sustainable development, and of indicators of the two approaches to ESD identified by Bonnett (2002), i.e. the preparation for bridging the value-action gap or for sustainability as a frame of mind.

The reliability of the analysis was increased by the independent analysis and subsequent comparison by two researchers of 20% of the interview data. The trustworthiness of the findings was increased by the triangulation of data from different sources. Initially, data from the three country contexts were analysed separately, in order to form a comparative framework.

Findings

Teachers' motives for engaging in the SDA project

Three groups of teachers emerge from the data, based on their motives for getting involved in the SDA project: the *SD devotees*, the *SD seekers* and the *SD surfers*.

SD devotees

More than half of the teachers (six English and five Welsh) reported that they were passionate about and committed to SD already before their involvement in the SDA project, as illustrated in the two quotations below.

> In my training (B.Sc Engineering, Design and Appropriate Technology) I was steeped in the ideas of sustainable development. Even before getting involved with SDA, I was always sympathetic, and tried to include it in my teaching. But SDA provided an instant tool. It is easy to stand up and talk about sustainability—that's what I did—but it is difficult to think of short clear tasks that fire students' imagination.
> I have always been passionate about conservation, and I guess before the SDA project I was just making it up, I mean, getting SD in to my class. Now it is more systematic, I know how it all fits together, the different aspects of sustainability.

For these teachers, the SDA project provided the vehicle for integrating SD coherently in their D&T teaching.

SD seekers

One in five of the teachers (four English) were looking for more joined-up thinking for their D&T teaching. Although the search was not specifically for SD, the SDA project approach provided a cohesive framework for D&T teaching.

> As a start I got a one-day training 5 years ago, as preparation for 16 + classes for the first time: I was not trained for this level of D&T. I came home very enthusiastic after that day, and adopted the approach for my entire teaching.

This cluster of teachers also adopted the SDA approach as a new mindset underpinning their overall approach to teaching D&T.

SD surfers

A quarter of the teachers (two English and three Welsh) got involved in the project mainly for the Award as an add-on to non-SD teaching. This approach to the SD Award as 'just-

another-award' is not always successful. Teachers discontinue entering students for the SD Award, do not adopt an SD curriculum but consider entering students for alternative schemes such as the Design and Innovation Award for Young Engineers or the Gold Duke of Edinburgh Award.

At this point we note that the project was not only able to provide teaching activities for teachers, who were convinced about the relevance of SD to their D&T teaching. In England, the project was also able to attract teachers without SD priorities, but with a need for a coherent scheme for D&T teaching. This only occurred in England possibly because the Welsh efforts focused largely on the inclusion of the SDA activities in an existing network of teachers and schools—for example one teacher in Wales said that they had been working with the implementer already for years and that they provided great support—whereas the teacher recruitment in England was much more open ("I saw the SDA workshop advertised in a flyer and I got permission from the school to go for it").

Changes in teachers' understanding and confidence

The size of any change

The data on reported changes in teachers' understanding of, and confidence in, integrating the social dimension of SD in their teaching are reported together as there is a considerable overlap. Reported changes are weighted as follows:

No change = 0
Some change = 1
Definite change = 2
Huge change = 3

We will summarise if and to what extent teachers reported any change, including frequencies, in order to explore any relationships between teacher type and adoption of change. For each teacher the weights for change in understanding and confidence were summed and the results are presented in Table 1 in two bands, the scores from 0 to 2 representing little or no change, and the scores of 3–6 for considerable change.

Table 1 shows that nine out of the twenty teachers in the sample reported considerable changes in their understanding of, and confidence in, integrating the social dimension of SD in their D&T teaching. This included most of the *seekers*, and half of the *devotees*. A slightly larger group of eleven teachers considered that little change, if any, resulted from the project involvement. Some of the *devotees* in this group reported they already had a

Table 1 Perceived change in understanding of and confidence in teaching the social dimension of sustainability

Summed total of perceived change in understanding/ confidence	Frequency			Teacher identification
	English teachers (*n* = 12)	Welsh teachers (*n* = 8)	Total (*n* = 20)	
No or little change (weights 0–2)	4	7	11	Surfers (5), Seeker (1), Devotees (5)
Considerable change (weights 3–6)	8	1	9	Seekers (3), Devotee (6)

good understanding of and confidence to integrate the social dimension of SD in their teaching. Others report change but not in terms of the adoption of the social dimension of SD saying, for instance, that "the SDA project helped me move from the view that sustainability is purely about recycling, since I now understand that it [a sustainable design] needs to address a user's need, through working with the business contacts provided by SDA". The *surfer* teachers had no intention to change.

The table also shows that changes in understanding of, and confidence in, integrating the social dimension of SD in D&T teaching were mainly reported by English teachers.

The nature of change in understanding and confidence

A group of five teachers reported integrating SD more coherently in the curriculum. They use terms like "implementing SD broader across the whole curriculum", it being "more methodically and rigorously integrated" and the ability to "fit all the aspects of sustainability together coherently".

Again five teachers illustrate the change as a development of the *curriculum content*. This curriculum content change is expressed in three ways. Firstly, a central place is accorded to the social and moral impact of product design. Secondly, a principled decision is taken to not only teach SD but also practise a sustainable development approach across the department. This group includes two *devotee* teachers who report little change in their understanding and confidence, but clearly changed their actions. Lastly a change in school policy towards the inclusion of the social dimension of SD is being reported.

Several teachers, mainly *seekers*, illustrate the changes by mentioning new teaching activities they introduced, including the Ecodesign web and the use of Product Pairs, comparing for instance a tin of ordinary Coke versus organic cola, or Fair Trade chocolate against ordinary chocolate bars.

Only one teacher referred to a specific change in confidence, by suggesting a reduction in anxiety of integrating SD in the curriculum:

> SD is hugely complex, and there are lots of ways of looking at things. SDA provided ways of looking at it. We used to be fearful of having only simple approaches and tools to deal with quite complex matters. Now we have a skeleton on which we can hang things that we require.

Reasons for changes in understanding and confidence

Four reasons, each voiced by several teachers, are provided for the change in understanding of, and confidence in, integrating the social dimension of SD in D&T teaching. Change most commonly is attributed to the project's provision of teaching strategies. The "spectacular, visual resources such as the Ecoweb" and the starter activities were frequently mentioned. Secondly, changes were supported by talking to experienced and knowledgeable experts and peers. This is particularly a stimulus for changed behaviour for teachers who reported otherwise little change in their understanding and confidence. Thirdly, practise of the teaching strategies during the CPD programme and direct transfer into class resulted in an increase in understanding and confidence. Lastly, success and "the public recognition of projects done by your own students provides a considerable confidence booster".

Teachers' views on the nature of sustainability

At the end of the SDA project teachers were asked to describe their interpretation of sustainability. The responses were analysed in terms of the representations of the environmental, social and economic dimensions of sustainability, and of the presence of Bonnett's two perspectives: sustainability as a bridge for the value-action gap, or as a 'frame of mind'. Often the responses defined sustainability in the context of D&T teaching of sustainability, in itself an indication that the respondent does not adopt an overarching frame of mind view.

From the responses six levels of understanding emerged, the last three directly related to the social dimension of sustainability. Although these do not correspond precisely with teacher type (*surfer, seeker, devotee*) there is a relationship which we explore below.

At the first level some teachers emphasised a sustainability-free perception of good design projects, as illustrated below by a teacher from a high achieving private school.

> That is a difficult one. (long pause) Sustainability should incorporate the design of products taking account of its environmental, social and moral implications—not only taking care of the client's need but also thinking about what will happen to these CD racks beyond that. The reality is that we are very proud of a project where we produce a CD rack, and we sell 3,000 copies of it, without thinking what will happen to these racks in the long-term.

Several of the teachers who do not include sustainability in their teaching, suggest a more explicit curriculum prescription such as: "sustainable development is a valuable thing but it is not going anywhere at the moment—having marks allocated for this would make a big difference".

The second level shows a strong awareness of the environmental dimensions of sustainability. Sometimes this is combined with lip-service to the other dimensions as quoted from the curriculum documents (as in the quote above), but the examples and detailed definitions betray the environmental preference, as illustrated in the second quote below.

> I think sustainability is about reducing waste, re-using products and recycling; also about reducing the use of energy.
> The social/moral is now central to designs. For instance, these days students do an exercise on recycling which would not happen 5 years ago. I am seen as a green teacher, environmentally aware.

The environmental interpretation of sustainability is not only implemented in their D&T teaching, but also in "helping the school with drawing up policy on energy reduction" and "submitting proposals for the use of sustainable building materials".

The third level of understanding emphasises perceptions of sustainability related to clients, often an economic aspect. One of the requirements of sustainable design is to avoid, in the words of one of the teachers, "coming up with non-products, spurious sort of things that do not need to exist". Some teachers with this understanding report that the required close collaboration with a concrete client may lead to some tensions, as the client may not be interested in sustainable features of the product:

> People like to buy glossy and shiny things. In the real world things are not always done in a sustainable way. Sustainable solutions often do not look so professional.

The fourth level of understanding reflects a partial commitment to the social dimension of sustainability. The teachers in this cluster show awareness of the social dimension and

wish to include it in their teaching. The SDA project promotes the inclusion of some overseas contexts to provide access to the cultural, indigenous technology and human right aspects of sustainability. However, several teachers comment that these design contexts are too far removed from students' own experiences. In these cases teachers have problems in remedying 'a patronising attitude in students'; several teachers find this is not their role or forte.

> For the foreign contexts, my problem now becomes the way the student visualises the problems that exist in developing countries. They tend to think in caricatures. I'm quite adamant in not using terminology like '3rd world', but 'developing countries', to emphasise the variety of circumstances. But still, several students continue imagining the situation using the views portrayed by TV. They are not real, they are stereotypical. It takes a lot of work to make students without any relevant experience come away from those stereotypes.

The pre-condition of connecting foreign design contexts with students' own experiences is equally emphasised by teachers using these contexts satisfactorily. They refer to the usefulness of the presence of students with a family background from developing countries, access to staff who have worked in these contexts, and linking schemes with schools in such countries. All of these increase the immediacy of the foreign SDA design contexts.

The fifth level of understanding is the complete commitment to the social dimension of sustainability, usually in addition to the environmental and economic dimensions. The two quotations below illustrate the philosophical aspect and the teaching aspect of this theme.

> You can make the definition of sustainability as wide as you want. For me it hinges on the notion of stewardship. We hold the stewardship of the earth, as a community. Especially young people should feel that. You can link the stewardship idea to any project design. We are living in a Catholic community. We may have it easier than some other schools, because students here are comfortable talking about ethical and social aspects, about responsibilities.
>
> I push the line of where are the materials from: the origin of the materials, their life cycle, the effect of the product on society. I use the three headings in the curriculum: ethics and values, economics and … there is another one. Initially I found it hard to teach about the moral and social aspects of a project design. This is a requirement at GCSE and A-level with our [examination] board. SDA has shown me that I can just ask them [the students] to write a piece about a product, any product, a lamp for instance.

All of the previous levels (apart from the first one) fall within the approach to education for sustainability as a bridge for the value-action gap. The sixth level is the adoption of sustainability as a frame of mind. This holistic approach is exemplified by the following quotations:

> Sustainability is a broad context, a mindset, an approach. It is a way of appreciating how we live on the planet. It can operate at a number of levels, e.g. from where a piece of hardwood comes from to whether a certain teaching style is sustainable. It is a mindset rather than anything else.
>
> I teach sustainability as holistically as possible, through the idea of being friendly— to the environment, to society and to other people. Other people can be local or distant. Everyone understands being friendly to the environment, but they struggle with social and economic impacts. So I ask them to think about designing and

manufacturing, and consider what might be the harmful impacts on other humans—then discuss who this harmful impact might be on, such as a miner in Korea or a manufacturer in SE Asia, or someone close suffering from pollution.

There is some resistance to this interpretation of sustainability as an over-arching frame of mind approach. One Welsh teacher refers to the promoters of SD in the following way:

The project is basically good but we need to engage more people in the [teaching] community. The people [promoting this] clearly have a conscience but it does not always go down that well. But for someone who knows the average teenager—dealing with waste and recycling does not always go down that well with every student. The average teenager lives in a shiny electronic, high energy world. Trying to persuade them that this is … It has to be done, but we have to give a lot more thought to how we get this over. It's like Jamie Oliver [TV celebrity cook campaigning for better school meals] and his healthy eating. We all know it is good for the students but will they do it?

Similarly, a curriculum designer in The Netherlands compares the frame of mind approach to joining a religion, as illustrated below.

If schools want to do something with sustainable development they are easily overwhelmed by all the aspects they get themselves involved in. They have to buy into a belief, sort of. And that increases the threshold for actually using the [SDA] materials and their approach. You find that teachers are absolutely not interested in such major changes, and as a result SDA is excluded entirely. The SDA is a movement. It is possibly because of the people who are conveying the message. SDA is presented as if you need to do it with the whole school that you have to look at all your activities in the SD light. Like you would have Sports Academies, you would also have SD Academies, and that can be overwhelming.

The perception of sustainability as a "movement" reportedly makes several teachers hesitant to consider sustainability seriously for inclusion in their teaching, even as a bridge for closing the value-action gap.

Table 2 below summarises how the six levels of understanding of sustainability relate to the different components in the framework for ESD, and to the type of teacher. Note that, within the latter there are different types called Type A, Type B etc.

Table 2 shows that, two-third of the teachers (13) include the social dimension in their understanding of ESD, i.e. at level 4–6. The table also suggests a link between the type of teacher and their understanding of education for sustainable development after 3–4 years involvement, although there is no one-to-one mapping. Teachers attracted to the SDA project because of the actual Award (the surfers) either have a vague notion that teaching sustainability is just 'a good thing' (type A) or consider it only in an environmental or economic but not a social light (types B and C). They define sustainability mainly in terms of encouraging re-using and re-cycling of materials, the reduction of waste in the production process, and the reduction of the use of energy. These teachers note that sustainable designs require a close match between the specifications and the users' needs, but that the users often are disinterested in sustainably designed products, since they may look less professional.

Most teachers who searched for an underpinning framework for their D&T teaching (the seekers) also wish to include the social dimension of sustainability in their design teaching

Table 2 Relationship between levels of understanding of sustainability, the components of the ESD framework and type of teachers

Type of teacher	Components of the framework for education for sustainable development					Level of understanding of sustainability	Frequency ($n = 20$)
	Bridging the value-action gap				Frame of mind		
	Unclear dimension	Environmental dimension	Economic dimension	Social dimension			
Surfer A	+					Level 1	2
Surfer B		+				Level 2	1
Surfer C			+			Level 3	2
Seeker A		++				Level 2	1
Seeker B		++	++	+		Level 4	3
Devotee A		++				Level 2	1
Devotee B		++	++	+		Level 4	3
Devotee C		++	++	++		Level 5	3
Devotee D		++	++	++	++	Level 6	4

+ = weak understanding, ++ = strong understanding

(seeker type B). However, this cluster of teachers considers 'foreign' design contexts irrelevant for their students.

The same views are held by some of the teachers who were already committed to SD before their participation in the SDA project (devotee type B). However, most of the devotees emphasise the social dimension strongly in their perceptions of sustainability, emphasising its pervasive application in the teaching of design (devotee Types C and D). They refer to sustainability encapsulating "global issues, reflecting on where we are and drawing on information from other countries", and how "designers are a controlling factor in the way we manage earth's resources".

Four of the 11 devotee teachers (three English, one Welsh) have not only fully adopted the social dimension of sustainability, but also they see education for sustainability as the promotion of a frame of mind, rather than the bridging of a value-action gap, in Bonnett's sense (devotee Type D). These we call the 'critical devotees'.

Discussion

Uptake of the social dimension

After participation in the SDA project, two out of three teachers in the sample include the social dimension in their understanding of sustainability. This success is particularly remarkable with the majority of the seekers, i.e. teachers not specifically looking for a scheme supporting SD. Their interest was caught by the coherence of the teaching scheme and the quality of the resources. The success in the promotion of the social dimension of sustainability is tempered by the fact that half of adopters indicate that they find the inclusion of foreign design contexts problematic, and several suggest feeling uncertain in

promoting mature multi-cultural attitudes and respect. As a consequence, they are reluctant to include three important aspects of the social dimension, i.e. cultural diversity, fostering traditional wisdom and the enhancement of human rights.

It is clear from the evidence that the social dimension of sustainability, including a 'frame of mind' approach, is only adopted by devotees. This is not surprising when one considers Harland and Kinder (1997) and their analysis of effective in-service strategies; one of the main criteria is the presence of congruence of values between teachers and trainers.

The majority of the teachers who do not adopt the social dimension of sustainability are surfers. This finding seems to imply that the strategy of attracting teachers on the basis of the opportunity for their students to enter the Award does not lead to a complete adoption of all dimensions of sustainability.

The social dimension of sustainability has been taken up more in England than in Wales. This may be explained by the project delivery methods. Although project materials for both countries did not emphasise education for sustainable development as a frame of mind, in England the teachers were trained outside their schools over one or two days, and there was plenty of opportunity for discussion and debate. In contrast, in Wales the focus was on working with students in school. The different adoption rates of the frame of mind approach between the two countries might also be related to teachers' perceptions of the deliverer. If Welsh teachers perceive the deliverer as an environmental organisation they might not hear other messages; indeed the strap-line to the deliverer's mission statement speaks in terms of showing practical solutions to environmental problems. The deliverer in England, by contrast, presents itself as a sustainable development NGO with a broad conceptualisation of sustainability in which the social dimension is all-pervasive. A third factor could be that in Wales an existing network was being served (contacts with many of the schools originated from before the SDA project) whereas in England an open community was being served.

A hierarchy of teachers' understanding of sustainability

The data suggest a hierarchy in terms of teachers' awareness of the social dimension within sustainability and their approach to incorporating it into their teaching.

At the lower levels (1–3) teachers see sustainable development in a very fractured way, and are not thinking about the social aspect of sustainable development at all. This is not to say that they are not interested in relating social issues in their teaching: every competent teacher of design will demand that their students consider user needs and satisfaction. But this can be done without regard for the needs of future generations.

At level 4 teachers, aware that there are three dimensions of sustainability, encourage the students also to consider economic and social dimensions when making design decisions. The dimensions are seen as separate but overlapping, as in the left hand diagram in Fig. 1 (the overlapping circles in Webster's chart in Fig. 1). Teachers provide checklists for design decisions in all three areas. Assessment considers decisions for the three areas separately. This is a form of value-action gap education.

At level 5, teachers have an emerging awareness of the inter-connectedness of environmental, economic and social dimensions of sustainable development and an increasingly global perspective. A strong awareness of the social dimension is a prerequisite in making sense of the others. The teachers still focuses attention on economic, environmental and social criteria of sustainability, but they also invite students to consider how these inter-relate. This correlates with the view of sustainable development represented by the concentric circles in Webster's chart in Fig. 1. Furthermore these teachers

recognise that almost every policy to do with sustainability is both contestable and contested; they are willing to encourage debate. This appears to be a threshold or gateway.

At level 6, teachers recognise the social dimension as the overarching framework within which sustainable design discourse needs to be conducted. They realise that sustainability needs to be a frame of mind that underpins or challenges all their teaching and indeed behaviour. In the classroom they put emphasis on both values and beliefs, base their pedagogy on making these explicit, and relate this to action. They are no longer teaching *about* sustainable development, nor engaging in education *for* sustainable development in the value-action sense identified by Bonnett (2002). Rather it is education *through* sustainable development.

Recommendations

Implications for in-service and pre-service teacher training

We would argue that both the typology of teachers and hierarchy of levels identified above could provide useful tools in the planning and delivery of teacher training, both at pre-service and in-service levels. These tools could be used as diagnostic instruments to identify where teachers are, and then interventions could be targeted so as to help people move onto the next level.

The uncommitted teachers (surfers) need clear guidance as to how sustainability can be related to curriculum requirements. This argues for working on policy makers to ensure that such requirements are explicitly stated in programmes of study. The teachers will then 'need' teaching materials that are easy to use in order to 'deliver' the knowledge to support sustainable development policy: they will be teaching *about* sustainable development.

Teachers who are searching for a coherent philosophy for teaching D&T (the seekers) find a training and resources package such as the SDA both stimulating and supportive. But they need further support in two areas: in identifying and dealing with clients with a coinciding sustainability agenda, and in finding ways of bringing the cultural, traditional and human rights aspects of the social dimension into the lives of their students. If this support is unsuccessful they will fall back on the environmental aspects of sustainability.

Those teachers already committed to sustainability (the devotees) are supported by the SDA package, but it is important that CPD providers make it clear that the social dimension is essential and that it can provide an overarching perspective. Some of these teachers reach some sort of a threshold in terms of their personal commitment.

We would argue that the concept of a gateway that teachers can choose to pass through as they progress from a value-action deficit approach of education *for* sustainability to a more critical education *through* sustainability could be a significant tool in planning CPD. But in order to make this transition into becoming a 'critical devotee'—to pass through the gateway into a 'frame of mind' approach—Pitt (2006) identifies three conditions. These include the fact that the approach should permeate all designing, making and product analysis; the encouragement of discussion and articulation of teachers' and students' values and beliefs; and the constant links made between what is being learnt and personal choices in terms of life styles.

The importance of raising values issues

The importance of grappling with deeper values issues is underlined by a number of authors such as Pavlova (2005a) in her cogent attack on a narrowly (and 'incoherent')

technocratic view of technological knowledge. Analysing how technology education should respond to social change she calls for the involvement of students in *inter alia* "democratic debates on the future outlines of technological development; development of their social and ecological sensitivities" and argues that students and their teachers need to challenge both the way people are manipulated through advertising and cultivation of their desires, and consumer-oriented design. In discussing *how* to deal with values in technology education, Pavlova (2005b) distinguishes between the cognitive, affective and behavioural components of values and argues that moral values "have to provide a frame for all technological activities and should be at the top of the values hierarchy among technology teachers" (pp. 144/5). De Vries (2005) also argues that the teaching of technological knowledge must incorporate ethics and ways of dealing with a value dilemma.

When addressing the ways that values may be introduced into technology teaching through a frame of mind approach, Dakers (2005) distinguishes between values imposed from above and those which are co-constructed through analysis of conflict; this could apply as much to teacher education as to student learning. The insights of Paulo Freire concerning 'banking education' and problem-posing education are also pertinent here. In his seminal text *The Pedagogy of the Oppressed* he says

> Whereas banking education anaesthetizes and inhibits creative power, problem-posing education involves a constant unveiling of reality. The former attempts to maintain the *submersion* of consciousness; the latter strives for the *emergence* of consciousness and *critical intervention* in reality. (Freire 1970 p. 54)

This accords closely with Bonnett's distinction between teaching to a given understanding of sustainable development, and encouraging students and their teachers to 'reveal the underlying dominant motives that are at play in society; motives that are inherent in our most fundamental ways of thinking about ourselves and our world' (Bonnett 2002 p. 19).

Many of the SDA resources or tools require that values issues are raised. There are starter activities such as Product Pairs and Belief Circles (Practical Action 2007d) and design tools such as the Design Abacus (Practical Action 2007e). But most of these resources are based on the interlocking circles model of dimensions of sustainability. This tends to keep teachers at Level 4, locking them into value-action gap pedagogy of education *for* sustainable development. It would appear that a more constructive approach would be to base initial teacher education, in-service education, curriculum and resource development on Webster's concentric circles construction (Webster 2004) and to encourage debate and the analysis of conflict. This will help teachers to identify the gateway into a 'frame of mind' approach, allowing for education *through* sustainable development.

Conclusion

Is the 'value-action gap' versus 'frame of mind' lens useful in analysing and planning successful ESD?

The 'value-action gap' versus 'frame of mind' distinction has provided a useful descriptive framework both for analysing teachers' responses and in diagnosing what is going on. It can be helpful for teachers in seeing how to include the social dimension into their teaching, and for teacher educators. It can be used for planning pre-service teacher training, in-service teacher training (CPD) and classroom interventions, curriculum development and resources development.

Education *about* sustainable development or *for* sustainable development can be planned on a value-action gap model that sees the environmental, social and economic dimensions of sustainability as Webster's overlapping circles, which can be used to identify appropriate content of these dimensions and for raising values issues. However, we would argue that a more fruitful pedagogy in terms of change is to think in terms of education *through* sustainable development, which falls naturally within a frame of mind perspective and links with the concentric circles. It is only then that the social dimension can be fully appreciated.

Appendix

Practical action's list of social issues for design & technology students

Headings	Comments and questions
Product not really needed (bad) *(over whole life cycle)* Genuinely useful product (good)	Some products are not really needed. Perhaps we might be better off without them, as making, using and disposing of them at the end of life all contribute to pollution and using up of limited resources. But some products genuinely improve the quality of life for the users. How would you rate this product?
Not appropriate for the culture of the users (bad) *(over whole life cycle)* Appropriate for the culture of the users (good)	Some products might be good in one society or culture, but not so good in a different one. For example, a solar lantern (a light charged up by sunlight) is good for Kenyan families that have no access to mains electricity but experience strong sunshine. It would not so be appropriate for use in England where we have mains electricity and dull days. But what about a wind-up torch? At the end of its life, the product might be waste in one country or a reusable or recyclable resource in another. Is the product culturally appropriate for where it will be used?
Traditional wisdom and technologies disappear (bad) *(over whole life cycle)* Conserves traditional wisdom and technologies (good)	New products can sweep the market, and in the process traditional ways of doing things are lost, sometimes forever. This makes the world less sustainable. For example, more and more supermarkets sell ready-made meals: will this mean that we lose the skills of home cooking? On the other hand new or improved products can build on 'the wisdom of the centuries'. A better product is produced, but traditional skills and know-how are not lost. Thinking about the whole life cycle, how would you rate this product?
Diminishes cultural diversity (bad) *(over whole life cycle)* Promotes cultural diversity (good)	Every culture has its own way of doing things. This is reflected in the clothes we wear, the food we eat, what we like to do in leisure time and so on. In England—a multicultural society—there are many different cultures. There are also cultural differences between generations. For example, teenagers dress differently from their parents, and use text-messaging more on mobile phones. Thinking about the whole life cycle, how far does the product promote cultural diversity?
Diminishes conviviality (bad) *(over whole life cycle)* Promotes conviviality (good)	Humans are social beings. On the whole we like to be with other people (but not all the time!) and do things together. Some products encourage this—such as the mobile phone, musical instruments or clubs. Through books we can share the ideas or knowledge of others. But some products tend to make us more isolated. Thinking about the whole life cycle, how would you rate the product on a conviviality scale?

Appendix   continued

Headings	Comments and questions
Limits opportunities for future generations (bad)	A successful product will meet the needs of people today. But how far is this done at the expense of future generations? Will it limit their choices?
(over whole life cycle)	
Increases opportunities for future generations	
Limits basic rights and freedoms (bad)	Every person has a right to basic freedoms—enough to eat, safety, care (especially the young and old), a place to live. These are enshrined in the United Nations' Universal Declaration of Human Rights. This includes also the right to education and, for adults, a job, fair pay, the right to vote and so on. How far does this product support such rights? For example, is it fair-traded?
(over whole life cycle)	
Enhances basic rights and freedoms (good)	

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