The Relationship between Design & Technology

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In the last few months, as I have been visiting schools, which is one of the privileges of this particular occupation, people have been voicing their anxieties about what they perceive as a potential snare facing them. It is that in some senses they could envisage CDT in the future dissolving into three: technological activity, design activity, and craft — something separate again. I would like to discuss that, and also speak about two other important issues. One is to offer some, I hope, provocative thoughts about the issue of progression in our subject; the other is to make a few remarks about technological language. I hope, in the plenary that follows, there will be an opportunity for you to challenge these things as some of them will be rather tentative.

Firstly, though, we need to be clear about what we mean in the CDT community about technological education for schools. In an audience as large as this one, there is plenty of expertise on which we can draw. So the first task is participation! In the next few moments, I would like you to mentally flag or write down the first couple of words which spring to your mind if you were about the characterise technology for young people in school.

(PAUSE)
(The following responses from members of the audience were then noted: MAKING THINGS WORK; UNDERSTANDING; SATISFYING HUMAN NEEDS; ENVIRONMENT; ANALYSIS; IDENTITY, DESIGNING PRODUCTS AND SYSTEMS; APPLICATION OF PRINCIPLES; UNEMPLOYMENT; INVENTING.)

May I suggest that among these are certain clusters of ideas. Firstly, there is an area to do with some of the social effects of technology, including environment, unemployment and whether technology can simultaneously create as well as destroy employment. Secondly, there are references to the processes by which technology actually develops, eg. making, applying, products, systems, designing, inventing. Thirdly, there are references to areas of conceptual understanding which might be useful to people who are involved in these processes. So, I think there are three groups of ideas which are not entirely incompatible with those expressed in this slide . . .

INTELLECTUAL PROCESS:
Inventing, Applying, Designing
EDUCATIONAL CONTENT IN SCHOOL: Control, Making, Machines and Systems
RELATED SUBJECT AREAS: eg. Environment, Social Consequences, (Personal and Social Development)

Technology is difficult to define and a description involves a series of complex ideas which are difficult to weave into a single short statement.

Firstly, in your comments, there were references to how and why technology *changes*. Why does it change? The comments suggested it was about satisfying human needs, such as providing electricity and fresh water supplies, furniture and means of transport, and so on. Secondly, the directions taken, that is the things we choose to do, or not to do, are expressions of the values and attitudes that we possess as members of a particular society. Thirdly, and in particular, are three principal means by which technology itself seems to develop. It seems to me that these need to be portrayed to young people:

1. Inventing
2. Applying
3. Designing

The risk of fragmentation in our subject area can be demonstrated to be groundless if we look a bit more closely at the mechanisms of technological change. The slides which I will show you in just a few moments will confirm that inventing does not stand alone. Inventing itself has to be followed by designing. It is designing that refines and develops the invention idea into a device that can be made that will work, and that is appropriate for its intended use. That takes a bit of getting used to; the idea that inventing is one sort of activity and designing is another. The two are very importantly connected. Secondly, as soon as something has been designed and produced, it can in fact be redesigned again and again to meet changing conditions. Thirdly, that if a person is consciously applying an idea or concept from an area of academic pursuit, again they are likely to be involved in designing in order to make an expression into a functional, useful product or system.

I would like to cement that view by referring to some slides. They show that technology, through transport, bridges and roads, services, consumer goods and commerce, permeates every part of our modern world. We do need to recognise and perhaps accept this. I suggest that to be a cultured person today means having some perception of technology, some *awareness, understanding* and *capability.*

In the outside world, designing and re-designing goes on year by year. In schools, however, its processes tend to be compressed. In teaching, we are likely to have small groups of individuals each attempting to design or re-design. So instead of having to undertake a product analysis which reveals active processes working over many years of development, a similar but greater intensity of experience is provided for children as a result of all pupils in a group seeing and debating the outcome of the work of each member of that group.

The River Thames flood defence barrier is a good example. Let us next look at the areas of inventing and applying. As a society, we value the ability to invent but we cannot demonstrate that people can be taught how to do it. However, through learning in appropriate areas people can probably be better placed to invent. Inventing is important to technology. It brings into being a new class of object or system, but to get from that fresh thought, which, when it is first revealed is very exciting to, say, a piece of huge civil and mechanical engineering construction, is really a different matter altogether. This is an important route through which applying comes into technology. If I start to ask 'Shall I make these river-bed piers out of concrete?', I will want to know such things as 'If I want to make the concrete stronger with reinforcing metal, what sort of metal shall I use? How far apart shall I put it? What diameter shall I make it? What shall I make it of? Shall I treat it against corrosion? What kind of concrete should I use? Should I control how the concrete sets? and so on'. You will

quickly begin to see that the kind of reasoning which brings answers to these sorts of detailed questions comes from different sorts of thinking compared with that involved in the original invention. So, there are various kinds of process which need to be taken into account, but the common feature in each of them if those three principal methods of technological change hold good, is that each of them depends upon *design* to bring it to fruition. And, therefore, it follows that to make technology and design separate is quite an irrational step to take. The two things must be linked firmly in any kind of educational programme.

My next point is that children can perform these processes. They can, for example, develop computer controlled buggies, desk top executive toys, electronic music devices, solar powered aids for thirld world countries, a nursery for piglets, a self-righting slalem pole, a bivouac tent, a device for manoeuvring heavy tyres in a truck depot, and devices for helping children learn music.

I have referred to three key words: *awareness, understanding,* and *capability.* For some time, CDT publications have been examining what we mean by technological capability in CDT. Firstly, *awareness* is an important area to which much of the education system contributes, particularly subjects like history and personal and social education, as well as CDT. Secondly, *understanding* of technology is developed in many places and CDT has a part to play alongside other subjects. Thirdly, the issue of technological *capability,* the ability to actually put into effect a scheme or some means to change circumstances and improve them, is what we mean by capability. But I have to say that if we stop and think about technological capability a bit more, it is not just one solitary activity. I want to argue that all of us, every day, in common life, whether we are involved in Design and Technology occupationally or not, need to possess some level of technological capability. The question then, is why? What do we mean by technological capability? I think this has several related parts.

To start with we, as citizens, need to be *capable as informed users of products and systems.* In other words, I suggest that to drive a car or operate a word processor, or programme a video recorder, or operate a dialysis machine, are each, in varied ways, the exercise of technological capability. Secondly, to be capable of repairing a lawn mower or food mixer, servicing an aircraft engine or typewriter, fixing a car, repairing and maintaining things in general, is also the exercise of technological capability albeit in a slightly different way. Thirdly, if you are designing and building things, you are exercising technological capability in an even fuller sense, because it is in this activity that you are likely to be inventing, applying and undertaking all the various steps in designing. So I am suggesting that these things are all aspects of capability, and are hierarchical. I would like you to challenge that,because there are some problems with the argument as it stands.

I think CDT has a vital part to play in providing technological capability for children. I think also that design and technology education in schools cannot be separated because it is through designing and making that children are enabled to invent, to apply concepts and ideas and given the opportunity of exercising all of those skills in the solution of problems which they, or, at an early stage of development, someone else, has defined.

Something which is very difficult at the moment, but related to capability, is the idea of *progression.* Progression as opposed to differentiation. By differentiation I mean: at a given age, what can the abler person do which the less able person cannot do? By progression I mean: what can the person at one age do which is qualitatively different from what the person at a different age can do? We are talking about an age related measure, describing things which older people can do which younger people cannot.

In technology and design, it is possible to find some of these abilities. Firstly, children from playschool age onwards want to build, to explore, to invent, to shape the world around them. That's pretty obvious! They do so often with constructional kits, very effectively, and will talk at length very clearly about their aims and objectives and how they are achieving them, and the difficulties they have to overcome.

In time, we find children begin to use other materials besides constructional kits, for example card and paper, to create models of their ideas in materials which we might begin to regard as more authentic, or appropriate and similar to materials adults might reasonably choose for their solutions. The means of construction become more exact and children begin to be capable of selecting the means of construction which are appropriate to a given goal. In other words, some of the empiricism disappears. I suggest, in fact, that children, and maybe all of us, do not actually shed those early abilities: we simply incorporate them and add to them others which we find more effective for different situations.

In primary schools, also, one of the great stengths is that development of technological work often springs very naturally from a wide range of interdisciplinary topic work. As children reach the top of their primary schools, they often make more exact models, increasingly to pre-planned drawings, or designs, which they have prepared. Working in teams becomes important, or maybe it has always been so.

With regard to the ability to model, what are the similarities between the five year old working with plastic constructional kits and the upper primary pupil using construction kits and surplus materials?

Some things are very different; some might in fact be fairly similar. We start to expect a niceness of construction in appropriate, durable materials; we expect the abilities to be applied across a broader field; we expect to get more exact control over what we construct, for example to progress into radio-control, and feedback, and we get computers to do some of it for us. Nearly always we expect the final prototype to be built to proper standards — we become irritated by lashups and want to see thoroughness and endurance in the product of device.

There are various areas in which children can clearly progress, and which we might use in trying to describe progression. There is a snag, however. I suspect there are some abilities which develop over time, and there may be some which do not. For example, the ability of children to identify with the needs of another group of individuals is a skill which I suspect developes with age, particuarly if they are trying to think about the needs of a remote group,

eg. if a group of 13 year olds are trying to think about a group of 5 year olds, or if a group in one country is trying to think about the needs of a group in another country.

I suspect that children become able, over time, to cope with increasingly open problems, that is problems which give less guidance or fewer clues about how one is to reach a solution. Similarly, I think we become capable of coping with increased complexity, and we improve our ability to communicate precisely through langauge, through drawing, through models.

I think we become able to judge and decide upon what methods of contruction is appropriate in a given situation: colour, texture and form, materials, sorts of components are all considered.

I certainly think that we begin, as time passes, to be more able to handle a wider variety of processes or appropriate resistant or conventional materials suitable for the kind of product being developed.

I think we are increasingly able to make conscious applications, to say 'Now I am going to think about tessellation (which I have studied in mathematics). Now I need to consider density which I have studied in science'. We are consciously more likely to be able, as time passes, to draw upon concepts that are being developed in various parts of the school curriculum.

Lastly, I think we become more fluent in technical language, and we need that language at every level, especially as citizens, because we are often in contact with the so-called experts to whom we need to make our wishes and decisions known. Everybody who has tried to explain their desire in an area where they are technically illiterate, realises the embarrassment caused. The ability to communicate adequately is a powerful disincentive to engage in such activity.

There are some snags, however. The first is that I begin to wonder if there are some abilities which are independent of time. Are some people able to reach a good solution without actually being able to set out a whole variety of others? That 'straight to the point' sort of thinking, the ability to explain without a set of steps or that their mind was working in a particular way, is something which is really difficult for us, especially to assess. We may have to live with that. Yet insight and originality permeates much that we do.

The importance of language is the third issue I would like to touch upon. It is illuminated very nicely by looking at work in some primary schools, because it is there that I think you will find opportunities are more often given for children to talk about what they are doing and to work collaboratively in small groups. The group-based topic can be a fine way of exercising technical vocabulary.

I would like to read a quotation from a story being used in a primary school in Nottinghamshire, in which some of the technical project work springs quite spontaneously out of the literature: an unexpected source for us, but nevertheless there.

It is possible for literature to be very powerful and strongly motivate children. Catherine Cookson's 'Our John Willy' is read by upper juniors. It is about two boys in a nineteenth century mining community. We pick up the lines where they are underground in a tunnel, and there is a roof fall. Listen for the references to technical terminology (in italics here).

> 'The sound was still reverberating along the *shaft* when there came to Davy's ears the known and ominous rumbling of a roof fall, the snapping of timbers, the groans of stone released from centuries of pressure, the wrenching, tumbling, terrifying cascade of rock falling from one level to another. 'Oh, my', he felt bad. He couldn't get his breath, then he knew the reason why: there was no air. Yet the roadway stretched back to the *ventilation shaft,* the one he had crawled up, the one he had lain under that awful night. It came to his fuddled thinking that there must have been another fall sometime previously. There were roof falls all the time in the old *workings.* The *pit props* were rotten. How long could he last out? He must lie flat, that's what the pitmen did when trapped. They lay flat. He groped his way back over the scattered rocks until he came to the *bogie rails* and slowly lay dow between them and as he lay, he began to sweat like he used to when working in a low wet coal *seam'.*

Now I hope that this little encapsulation has shown that very quickly we can play outselves into a situation which is very powerful and gripping and it motivates us to try and intervene. That is exactly what the class had to do: 10/11 year olds were asked to (1) design and make a cage which travels up and down mineshaft safely; this is a result also of visiting a mining museum nearby; (2) make a simple hydraulic system which will move a piece of mining apparatus; (3) you have got to move coal trucks up a slope and return empty wagons.

It seems to me that in this example, the children are engaged very powerfully in a situation and their language is being developed naturally out of the things they are doing, while technological project work is springing directly from it. Now if we capitalise upon that experience to build progression when childrn move into secondary schools, motivation that we can rely upon can be very strong indeed. Make no mistake, motivation of *all* children remains one of the most important challenges which face us in the CDT community. About 55% of the population of this country choose to do a broadly technological subject after the age of 14 years; that is about 48% boys and 6% girls. Now it seems to me that that is a very worrying issue and one which we need to tackle. Lastly, let's see this situation through the eyes of one of the people who has actually struggled through the meshes of the prejudice, the hurdles and the antagonisms which all too often, subtly yet powerfully, confront people wishing to go forward in this area.

> 'I knew technology was not going to be easy but I didn't bargain for the fact that I was going to be the only girl in a class of 9, and 20 for TVEI. For the first few lessons, I sat on my own and didn't mix with the boys at all. I felt lonely and awkward and then I realised that I had known them all for three years and got on very well with them'.

It seems to me that the development of technological language is one of the most important skills we need to tackle. This same young lady, in a school in Croydon, puts a pretty piognant message to us.

'Remember, Technology is part of our future, and the future doesn't belong to men alone'.

To summarise, I have tried to touch upon three important topics. Firstly, Design and Technology are inseparable; secondly, we need to define progression, and fairly soon; and thirdly, perhaps more than anything else, we need to do something about the access of girls into our area.

Postscript

Gordon Hainsworth
Chief Education Officer, Manchester.

I would like to say that it has been an absolute privilege to be here today; I do say that because I actually mean it. I was in a secondary school in Leeds from 1946 to 1952. It was a Grammar School, and we didn't do CDT you will be surprised to hear. We did Art, sort of. We did some science; and for four years I was under the expert ministrations of somebody called Chippy Ireland, and I tell you, today would have been a revelation to him too, because what we have had today is the description of an opportunity for learning, and an enthusiasm for learning which is totally new in my experience.

I am a failure. I am, in John Mattick's definition uncultured because I do not know about Technology, and today has made me feel the loss of that. I am not joking. I feel the loss of that from the experience I have had today, not just from the experience of listening to the people from the front, but I did get into one of the discussion groups for a while, and whilst there was more heat than light there, I quite enjoyed it. The fact is, that when I actually saw the work that children had been doing, in the exhibition, I realised what it was that we could do for all children.

It seems to me that the English education system is wasteful, not in money terms, but in terms of people. We waste people. Too many people fail. Your subject, your curriculum area, as defined today, seems to me to have potential to bear on that because all children like to succeed. All of them like to find out how. All of them like to plan, and talk together and work together, and it seems to me that a curricular approach that we have had identified today in the last session, and the problems identified by John Eggleston in the first session, particularly with the approach of the national curriculum, lead me to believe that you have the opportunity here to make a real contribution, to make a system that is currently wasteful a lot less wasteful.

Now I am not saying that that is going to be easy. All of you work in individual establishments. All of you are more or less isolated, and yet your strength is when you get together and work in networks and teams. I do not know whether the answer is DesTech, because I do not know anything about DesTech. One thing I do know is, that if what you have got to offer, the expertise and the enthusiasm, is to be properly harnessed, you have got to find some means of ensuring that you get together across schools, that you get together across LEAs, and that in networks you work with higher education establishments like this, and the Manchester LEA knows how good this establishment is, far more receptive than many others. You must get together with the higher education institutions and above all with the initial teacher training institutions, because that is where your future colleagues are. And if I could suggest that one or two of you from this group, after today, instead of going away and forgetting it, try to get together, whether it's under the umbrella of DesTech or anything else, and make sure you harness that ability, the conference will have been even more valuable than simply having a reasonably enjoyable and a very stimulating day out. I hope that some of you will take that on and think in terms of networks for this curriculum area, despite the 1265 hours!