THE NATURE OF RESEARCH INTO DESIGN AND DESIGN EDUCATION

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KEYNOTE ADDRESS TO DATER 91

This Keynote Address could perhaps have been titled:

"What kind of research is appropriate to the study of education through Design and Technology?"

or even:

"What should be the priorities of an International Design and Technology Educational Research and Curriculum Development Conference?"

Strictly speaking, I should be better able to answer such questions at the end of this Conference rather than at the beginning. Nevertheless, there is value in setting out principles in advance of the event. Over the next two and a half days, I am hoping that we will all hear answers, or tentative answers, to questions about Education and Design and Technology posed at all levels of generality and particularity. In order for each of us to put such contributions into context, it may be useful to remind ourselves where we have got, so far, in our understanding of the four key ideas in the title of the conference, that is: Design, Technology, Educational Research and Curriculum Development. In particular, we need to remember how the meanings of these terms are qualified when they are used in combination. This will help us to appreciate the continuing development of Design and Technology, not only as a curriculum subject, with an extensive body of practical knowledge to be taught and examined within specific timetable slots, but also as an educational discipline with theoretical underpinnings having implications for the whole curriculum.

Technology

Let me begin with the idea "Technology". And let me get down to absolute basics. One fundamental attribute of human beings - that is, one of the attributes that defines creatures as being human - is that they devise and make tools, and use these tools to adapt their environments. Another definitive attribute of human beings is, of course, their ability to invent and use language, but we will return to that later. It is essentially through their ability to make and use tools that men and women have been able to penetrate and explore their environments; to discover and employ the resources of the natural world; and to create the conditions under which there is time and resource to form, cultivate and express personal, social, cultural and aesthetic values. The activity of tool making and tool using has made possible, and continues to make possible, sculpture, architecture, agriculture, industry, music, writing, printing, computing, scientific experimentation, surgery, communication at a distance, and the recording, for later use, of knowledge, experience and expression. Mankind's collected knowledge about tools of every sort; about the way they work; and about where and how to use them, is what we call Technology. Technology, or knowing-how, in this very general sense, is related to, but different from, Science. Science is knowing what is the case, making informed judgements as to why things are the way they are, and predicting what is most likely to happen in given circumstances. Technology draws on this knowledge and on its own experience in order to make things happen in a desired way. If Science is a sine qua non of Technology, Technology is a sine qua non of the progress of a civilisation.

It is a pity that, for historical reasons that I do not have time to go into today, our social system, for more than two centuries, has undervalued Technology as a subject of study and banished it to the margins of education. There it remained until the 1970's, by which time the products of technology, and especially the products of Information Technology, had intruded so ubiquitously and dominantly in society that such marginalisation had become untenable. Most men and women in the modern world exercise at least some degree of skill in the use of technology in their everyday life, and many attain an advanced level of performance and understanding. Nonetheless, most schools and universities remained unexcited by the proposition that the acquisition of technological capability should be seen as a central objective of general education. Even in the 1970's, when the Big Bangs of the Information Technology revolution in business were headline news, and the retraining of workers in new technology was a national priority, it took a prodigious effort on the part of many doughty fighters to bring Design and Technology at last into the mainstream of the school curriculum.

Design

If Technology is "knowing-how", then Design is "envisaging-what". The capacity for envisaging a non-present reality, analysing it and modelling it externally, is the third great defining characteristic of humankind, along with tool making and language use. The ability of the human being to picture things in the mind's eye; the ability to comprehend the three dimensional configuration of something, even when it is seen from only one viewpoint; the ability to perceive order, pattern, connectivity and causation in complex things or systems; the ability to conceive of a construction or arrangement that will meet a need; the ability to invent, and to image in the mind's eye, something which does not yet exist, the ability to capture such a cognitive model, analyse it, and externalise it through drawings, models, notation or language so as to bring it to realisation or test: such abilities are common to all human beings, in at least some measure. We have seen that Technology rests heavily on Science, from which much of its operational data is drawn, and upon which are modelled many of the intellectual disciplines whereby Technology codifies and applies its experience. Design embodies an entirely different mental discipline. The distinctions are worth noting.

Science is a process. The science process seeks to isolate a phenomenon from the complexities of the situation in which it is embedded, and to abstract generalisable principles from observation and experiment. Much scientific activity is devoted to testing in new ways generalisations that have been made previously. The scientific process itself is subject to strict disciplines calculated to minimise the probability of error in both observations and in findings. On the other hand, there is no insistent demand that subjects for scientific enquiry should be confined to particular categories or that findings should be useful. Scientists are entitled to turn their minds to anything, so long as they do it scientifically.

Design, also, is a process. However, Design is directed towards meeting a particular need, producing a practicable result and embodying a set of technological, economic, marketing, aesthetic, ecological, cultural and ethical values determined by its functional, commercial and social context. If we are to sustain a claim that Design and Technology is a distinctive discipline, we must identify the descriptors that set it apart from other disciplines. We can say that Design is:

Useful,
Productive,
Intentional,
Integrative,
Inventive,
Expedient.

The distinguishing characteristics of the Design discipline
Fig 1

Design is described as useful to distinguish it from the expressive arts, many of which explicitly deny there is operational value to their expressions. Design is described as productive to distinguish it both from Science, which, as we have seen, is explanatory, and from Humanities, which are reflective, and to place Design in the world of action. Design is always seen as setting in train the production, and the introduction into the world, of some real thing or system. Design is described as intentional to distinguish it from serendipity, or discovery by chance, and to place it in the social and commercial world, where practitioners are obliged to make judgements on difficult and complex issues, and to take decisions in the face of imperfect information and the capricious turns of event that confront everyone in the practical world. Design is described as integrative to reflect the fact that a design has both to be complete and coherent internally, and to be well adapted to the environment in which it will be sold and used. A designer has the right and the duty to employ information drawn from any and every field of knowledge that happens to be relevant to the case in hand. In this sense, the body of knowledge in support of Design has to be regarded formally as unbounded. Design is described as inventive because it necessarily demands the introduction of something new. Whilst it is not completely unknown for a designer to be asked to produce a specification, drawings or data for an absolutely standard, unoriginal product, such a task would not normally merit the description "design". The inventiveness of Design is in many ways its most distinctive feature. The word "creativity" is often used in this context. The term "creativity", however, more properly describes a combination of inventiveness with productivity. Inventiveness itself has many facets. A design may be inventive in a functional sense, that is, it may perform an operation or supply a service that has not been offered before. It may be inventive in the operational sense, that is, it may perform its function in a new and more efficient or more convenient way. It may be inventive in the technical sense, that is, it may embody a mechanism or a construction that has not been proposed before. It may be inventive in the sense of offering aesthetic, stylish or marketing configurations that have not been seen before, Design i's described as expedient because design activities are justified by their results, rather than their reasons. In contrast to the overriding importance of orthodox methodology in the conduct of Science, the conduct of Design is validated by its efficacy rather than the rigour of its methods. Designers can, and do, on occasion, seize upon chance information, adopt capricious ideas and exercise untidy methods in the course of a project. None of this matters if it delivers a satisfactory result. The two procedures in design methodology that really do need to be conducted rigorously are the procedures for determining the precise design requirements and the procedures for determining the validity of the design result.

Almost the same descriptors can be applied to Technology. The only significant differences between Design and Technology are the relative weights to be attached to the various descriptors, and the range of the fields of knowledge that would be regarded as within their respective purviews. Technologists tend to set less store by inventiveness than do designers, and technologists may well look askance at the idea of expediency. In practice, however, technological activity exhibits both these qualities in various measures from time to time. In respect of fields of knowledge embraced, technologists tend to regard subjective areas of human concerns, such as aesthetics and marketing values, as being outside their areas of direct responsibility, whilst designers are obliged to take these into account.

Design and Technology in the Curriculum

For the purposes of general education, the National Curriculum Council has quite rightly linked the two ideas, Design and Technology, and has defined their combination as a single curriculum area. Rather ambiguously, the authors of the Non-Statutory Guidance notes published in March1990 describe Design and Technology as "likely to be taught as a separately timetabled subject in secondary schools", whilst in the same text they define it as "an activity which spans the curriculum, drawing on and linking a range of subjects", naming Art and Design, Business Education, CDT and Home Economics as subjects drawn upon. Information Technology is dealt with separately, and is seen largely as an instrumental contribution to learning skills and communication skills generally. Design and technological capability, as defined by the National Curriculum Council, is widely seen elsewhere as being analogous with literacy and numeracy. Cross curricular educational objectives such as literacy, numeracy and technological capability may be just as achievable - perhaps more readily achievable - through the pursuit of common attainment targets in parallel or alternative subjects as through a single subject that attempts to distil, as the Non-Statutory Guidance notes suggest, a variety of ideas and values extracted from a variety of subjects and delivered separately from them.

The parallel with literacy and numeracy is clear from the descriptions given in the Notes of technological capability. Given this parallel, one can note that it is seldom argued anywhere that literacy or numeracy are deliverable through single subjects. The alternative course is the setting of appropriate common attainment targets in parallel or alternative subjects, so that each pupil may develop the essential cross curricular capabilities through the learning media that best capture his or her interests and that best exploit the school's resources and the teachers' talents. Indeed, as I see it, logistically speaking, there is no way, other than by common attainment targets in parallel and alternative subjects, that education for design and technological capability can be delivered to the majority of the children in the majority of schools. Few, if any, schools can provide enough timetable slots in enough technology classrooms to accommodate the majority of the children on roll. Last summer's GCSE and A~level results in the subjects listed by the Non -Statutory Guidance notes give some idea of the relative sizes of the subject learning resources available today.

		GCSE A- level	Total
	Technology:	(161,513 + 8,274=)	169,787
	Art and Design:	(209,469 + 31,161=)	240,630
	Business Studies:	(82,918 + 15,082=)	98,000
	Home Economics: 471,367	(129,067 +3,660=)	132,737
	——— 641,154		
cf.	English Language:	(642,91 1 + 79,137=)	722,048
	Mathematics:	(570,818+ 75,006=)	645,824
	Science:	(633,762+ 93,206=)	726,968

Numbers of pupils sitting GCSE and A-level examinations in 1991

Fig 2

A total of (161,51 3+8,274=) 169,787 pupils sat one or other of the variously titled Design and Technology GCSE and A leve] examinations in 1991. By contrast, (209,469+31,161=) 240,630 pupils sat Art and Design, (82,918+15,082=) 98,000 sat Business Studies, and (129,067+3,660=) 132,737 sat Home Economics, a total of over 470,000 places in these subjects, designated as contributing to the Design and Technology curriculum area, 2,78 times as many as sat Technology itself. If we are seeking, as I think we must be determined to seek, to equate technological capability with literacy and numeracy in spanning the curriculum, we have to compare the 169,787 who sat Technology with the (642,911+79,137=) 722,048 who sat English language, the (570,818+ 75,006=) 645,824 who sat Mathematics and the (633,762+93,206=) 726,968 who sat the Sciences. Only by harnessing to common attainment targets the resources of all the subjects in the broad curriculum area, numbering perhaps 640,000 places altogether, can design and technological capability be delivered to numbers of pupils to compare with the other key National Curriculum areas.

Curriculum Development

We thus confront one of the most critical issues affecting the future of Design and Technology: Intersubject collaboration in curriculum development. Several educational research reports published in the 1970's argued that major curriculum change can only be brought about by research and curriculum development carried out by teachers in schools. Change agents brought in from outside seldom had lasting influence. However, A.V.Kelly, writing in the 1980's, noted that trying to encourage teachers to act as in-school change agents, and helping them to make curriculum changes stick, was much easier said than done. If and when an instance of curriculum change entails, as the National Curriculum Council's notes can be interpreted as entailing, the annexation by one subject of ideas and values cherished by others and/or the superimposition of common attainment targets on hitherto autonomous subject specialisms, then change agency is even more of an uphill task. Being an agent for change demands skill in three separate arts: educational research, curriculum development and advocacy. Intending change agents needed training in these arts. Moreover, getting the other teachers in the school to appreciate new ideas, assimilate new information and acquire new skills is, in fact, teacher development. Teacher development demands time, resources and commitment. The advancement of Design and Technology demands such resources more, perhaps, than any other.

Educational Research

One of the factors identified by Kelly as inhibiting school based educational research and curriculum change was the difficulties he and others had encountered in converting good teachers into good researchers. In fact, this is not a characteristic observable only in teachers. Most practitioners find it hard to set aside their practitioner values and skills in favour of researcher values and skills. Managers generally make poor researchers. So do airline pilots. So do film directors. Even doctors, despite their close reliance on the output of medical science, are not usually very good at research. It is not surprising that the same has to be said of teachers. There are absolutely fundamental differences in priorities and attitudes of mind between practitioners, who are obliged to take decisive and early action, whether they are in possession of perfect information or not, and researchers, who are obliged to remain sceptical indefinitely, even when the information before them appears to be unequivocal. Many practitioners are unaware of these differences, or are unwilling to acknowledge them, and blunder into research without the necessary mental set. Even where they recognise the need to acquire the necessary skills, teachers may be ill served by having the wrong mode 1 of research exposed to them. Much of the training offered in post experience courses in education is dominated by training in the methods of historical enquiry. For teachers of subjects in the Design and Technology area of the curriculum, such a model is even further removed than is the more familiar science model, from the mental set they have properly acquired in the practice of teaching.

The designerly approach

Fortunately, an alternative model is to hand. A designerly approach, rather than a scholarly or a scientific approach, can be made towards educational research and curriculum development, Design, in a certain sense, is research done backwards. Research starts with the particular, and moves towards the general. Design starts with the general and works towards the particular. Designers are told, or decide, at the outset, what their end product must be and do. They begin by conceiving of one or more broad configurations that seem likely to be, and to do, what is required. They then elaborate the structure of these configurations and develop the subsystems of one or more of the most promising proposals, then detail the construction of the whole, finally working back to the particular, the bits and pieces, upon whose correct construction depends the efficacy of the whole. At various stages, the validity of assumptions is checked and performances are measured. The same basic design process can be, and is being, applied to the development of all sorts of things and systems that have not hitherto been thought of as subjects for design. For example, providers of banking and other financial services now speak of their products (that is, charge cards, insurance policies, etc) as having been designed to meet the needs of given classes of the user, Curricula, courses, lessons and examinations are thus proper subjects for design. Happily, the National Curriculum Council's attainment targets provide ready made design requirement specifications. A designerly approach to curriculum or course design might be to ask:

"What sort of capability profile would a pupil need to exhibit in order to be seen to have attained the target in question?"

and then:

"What are the categories of knowledge, skill and values that contribute to such a profile?"

"What are the components of each category?"

"What kinds of learning experience are likely to imprint each of these components of knowledge, skill and value?"

"How can such learning experiences be provided?"

and so on, from the general to the particular, down to exercise design, performance assessment design and resource allocation. There is every reason for teachers of design and technology to use the techniques with which they are familiar to attain the objectives to which they are committed.

I opened this address with the question: "What kind of research is appropriate to the study of education through Design and Technology?"

My answer has been: "The designerly mode of enquiry is entirely appropriate to the study of education through Design and Technology. It is also less prone than are scholarly or scientific modes of enquiry to distortions arising from conflicts between the mental set of the practitioner and the mental set required of the researcher".

That is not to say that scholarly and scientific research methods do not have their proper place in educational research. I do say that scholarly and scientific methods need to be executed by people properly trained in their employment.

Design as learning

There is one important issue that I have not touched upon so far. In the 1970's and 1980's, cognitive psychologists working at the Department of Design Research, Royal College of Art, in collaboration with midcareer teachers studying in the Design Education Unit at the College, identified a close relationship between the mental activity of designing and the mental activity of learning. The design process is a special application of the learning process. This led the midcareer teachers in the Design Education Unit to explore two possibilities: that design activity might provide a suitable vehicle for learning in selected subjects in the curriculum, or that the enhanced learning capability apparently engendered by experience in the design subjects might facilitate learning in other subjects. Some evidence was produced in support of both propositions, but this research ceased when both departments were closed under the Royal College of Art's reorganisation programme in 1985. Both Professor Ken Baynes and Professor Phil Roberts were in turn Head of the Design Education Unit at the College before it closed, and have carried on the work elsewhere since then, The implications of the findings of these studies are important. First, this evidence supports the proposition that imaging capability is, indeed, a fundamental human characteristic, ranking with language use and tool making in defining the human being. Second, it supports the proposition that design and technological capability ranks properly with literacy, numeracy and science awareness as the key cross curricular areas in the National Curriculum. Third, it gives weight to the argument that education in design and technological capability can and should be delivered by the setting of Attainment Targets that are common to a range of contributory curriculum subjects.

This really gives my answer to the second question with which I opened this address: "What should be the priorities of an International Design and Technology Educational Research and Curriculum Development Conference?" In my view, such a Conference must have high on its agenda:

1 Contributions to the development of theoretical underpinnings for Design and Technology identifying it as a distinctive and fundamental discipline having implications for the whole curriculum.

2 Studies of the nature of design activity and the nature of technological activity, at professional and at school levels, respectively; and arising there from, the identification of the attainment targets for design and technological capability in schools, appropriate to pupils' various age and ability levels.

3 Studies in the logistics of engendering design and technological capability to the majority of the pupils in the majority of schools.

4 Contributions to the study of the implications of setting up common Attainment Targets for design and technological capability in parallel or alternative subjects across the curriculum, calculated to make it possible for each pupil to acquire design and technological capability through subject specialisms that best capture his or her interests and that best exploit the school's resources and the teachers' talents.

5 Studies in the types of learning experience that contribute most effectively to the development of various aspects of design and technological capability.

I shall listen with the greatest interest to the many presentations that are to be made in the course of the next two days. I will, of course, be trying to judge if and where these presentations will fit into scheme I have just outlined. No doubt I shall be kicking myself from time to time, and asking myself, "Why did I not appreciate that before now?”

We all have a lot to learn together in the next few days.