Integrated Design Studies at Bishop Wordsworth's School
New approaches in curriculum and resources

Austin Underwood
Bishop Wordworth's School, Salisbury

31

Identify your problem, analyse it, formulate your design brief, realise your design and evaluate it; or if you will, state your aim, carry out the necessary investigations, propose your solutions, optimise, implement your design and test.

Whether you next change the environment, improve your solution if necessary or pose further problems for investigation, might indeed necessitate its own problem identification for those proposing to change their teaching techniques. Call it the Design Process if you will or the Process of Technology, or if you like Caldwell Cook type terminology, simply 'problem solving'.

One thing agreed upon by all of the contributors to the continuing debate in Design Education, is that the last five years have seen an impetus in the change of approach to teaching methods in that part of Education which I naturally regard as being one of the essential parts of a full educational curriculum. Careful, or I shall add the word 'development' and perhaps start a whole new train of debate – or would it now be a dialogue (meaningful of course)?

I hardly dare mention a title for the area of which I speak, or something akin to the chorus of a Greek tragedy will begin with asserting 'It is Crafts', 'That is Art', 'It is Technology', 'This is Applied Science' ... and a thunderous echo, 'It is Design' ... Voice of educationalist offstage, 'Excuse me, but have you read Bloom's Taxonomy ... ?.'

Many years ago there lived a man called Euclid, and he too identified problems, such as 'To make (or was it demonstrate?) the shortest distance between two points'.

By clear definition, unmuddled terms, purposeful enquiry, aesthetic response, sound judgement and the minimum of motor skill, he invented and drew the straight line. Comparing his solution with his design brief for evaluation, he decided he could not improve on it, and so on repeating his design process, at one time we wrote QEF. Or was it QED? Anyway, we used Latin instead of our native tongue because Latin (like Design), was taught to help us think clearly.

Apparently, despite the achievements of those who were once schoolchildren, among those who have left school hitherto, there has been too much faciendum and not enough demonstrandum. When after the faciendum the evaluation test failed, such phrases as 'putting it down to experience' were used to encourage understanding by those who weren't listening the first time. Too much reliance was placed, it seems, on golden rules such as 'measure twice and cut once' in actually teaching motor skills.

The computer ended all that, however, and gave us things like the TSR2, with cocoons to stop prolonged negative feedback from the evaluation stages or in case the solution was no longer required by the time it was optimised.

On the other hand, divergency in the other direction showed that given enough space, free time and materials, you could construct almost anything – 'open-ended project' in fact. Like Metropolis. A kind of anti-computer process that defied anyone to identify the problems, yet alone synthesise it.

Where then is all the hard thought and work that has been put into Design Education/Educational Technology, leading? The continuing search for better methods in the learning process, and a more creative and realistic curriculum with more purposeful and enquiring pupil activity, are prerequisites of education in our rapidly changing world.

In that area, the search for a title will go on, and in the adoption of that title, traditionally accepted and entrenched boundaries will no doubt be affronted. I hope that too much energy will not be used on the periphery of such valuable work in arguing about titles, or in trying to apply new alternative titles to what are in effect,

the same thing — designing band-wagons in fact, on which the designers jump with alacrity.

When I qualified to begin teaching (and no-one ever becomes completely qualified to teach a particular speciality that is closely connected with the changing outside world, as a more acutely specialised pupil can often remind any teacher), the title was Handicraft. Although trained as a scientist, I later concentrated on an area that I found both attractive, coming as I did from a family of craftsmen, and I felt provided the necessary exacting intellectual demands of thought and understanding in applying the scientific method to 3D situations. Everything related in a very real way to other 'subjects', and indeed to outside society as a whole.

At the end of my training, in addition to my Teaching Diploma, I thus became possessor of an additional piece of paper headed Handicraft Teacher's Certificate. On a collateral School of Art course, we must have concentrated too much on motor and mentor skills instead of solving design problems (or so I am now led to believe after reading one College of Art lecturer). For we then felt that the time spent in, for example, investigations to produce the required volume on the History of Architecture, might have been better employed in trying to develop our skills as painters or engravers (College of Art lecturers in those days being invariably themselves artists of some distinction in painting, sculpture, engraving, drawing or some other branch of the arts).

I mention this in passing because last year I attended the Lanchester Polytechnic course to obtain my Diploma in School Project Work (Applied Science and Engineering) — and what a thoroughly excellent course it is — and although in some ways it was entirely different from my qualifying course, I found it absolutely complementary to that course and thoroughly compatible with it.

Similarly, I see nothing incompatible either between the Design Process, or the Process of Technology if you will, and the acquisition of motor skills depending on a knowledge of materials technology. Neither do I find the difficulties some seem to experience in deciding how much emphasis should be placed upon each, and neither do I believe, do the great majority of those who are similarly engaged in this work. For there is not one without the other.

Without getting too deeply involved in the argument about the chicken and the egg, or about theory without practice, there can be no completed design without realisation and evaluation. Without design realisation, the design process is sterile. There can further, be no design realisation without the use of motor skills, and no motor skills without a knowledge of materials and technology. Craftsmanship in fact.

Design and realization

If problem-solving is the educational means to an end, how can it be called Design without successful 3D creativity? Above all, how can educationalists claim the great value of 3D activities if they do not recognise the place of technological skills in its assessment?

Which brings me to saying something about Design and Technology at Bishop Wordsworth's School, Salisbury, where the work gains a great deal from the interest of our Headmaster, Mr Robert C R Blackledge who has actively encouraged the development of Technical Projects in the school and our participation in the outside activities of the Southern Science and Technology Forum, and from a co-operative staff.

If one had to state the general aims of our department, they would run something like this:

1. In all aspects of the work, to try to develop the intellectual education of the child, over and above the traditional acqui-

sition of skills (and disciplined thought), and to relate this work to the technological society in which he lives and to his own school and home experience.

2. To develop a critical awareness of the relationship of shape, size and function of natural and man-made forms, and an aesthetic appreciation in these forms, of surface texture and colour.

3. To communicate clearly through drawings and written notes, and to record accurately, essential data.

4. To allow the child to investigate and experience the possibilities of working and creating in a variety of materials, and the relationship of tools (machines) and technology with these materials.

5. To produce solutions to design problems and briefs and to carry through successfully the design process to realisation and evaluation.

It may be rightfully concluded from the foregoing, that at Bishop Wordsworth's School, we regard design realisation and evaluation as the assessment of the success of any design process, and that without it we believe there is no proven success. No chicken without the egg in fact.

To say, as some design educational purists do, that the aims of a Crafts Department and a Design Department are essentially different, is to ignore the reason for design at its simplest level – to *produce* something which is needed (for a given purpose) and that has not existed before (as part of the environment).

Moreover, in most circumstances, there will be restraints or additional specifications such as aesthetic qualities. Both Design and Crafts are therefore involved, and usually much more. Is so much debate about names really important? Are not some names used as escape routes from educational definition, rather than as they should be, to clarify educational purpose?

Do you foster the awareness of the pupil, or develop his understanding by asking him to work towards the apparent solution of a problem without previous evidence of testing the suitability of materials, the structural soundness of shapes, or the scientific viability of processes involved in the solution? Can there be an egg without the chicken?

This is where technology rears its head. Unlike the professional designer, the child cannot call in the boffins before getting back to the drawing board and the production process can begin. He has to be both designer and creator, with a commensurate knowledge of materials and skills.

With principal aims made clear, there are two maxims that I believe a teacher should have at the back of his or her mind (post-and pre-Bloor):

1. A child does not thank you for not showing him the best (right?) way to do a simple task at a particular moment, neither do you impair his ability to reason by doing so. In some cases, experimenting can be a waste of time and materials and can dispirit the child. I suspect that sometimes too it can be an easy way of not getting on to the next and more difficult stage of design realisation ('We didn't get there, but we learnt a lot on the way'). Confirmed when one discovers that the teacher didn't know, or hadn't the necessary skill either. Call it Learning Together.

2. Nothing discourages a child more than feeling that all he has proved to himself is that he can't do it and it won't work. A suggested short-cut somewhere along the line (the spectre in some educationalists' minds of 'the transmission of a given volume of knowledge') might helped him over a hurdle – that is, of course, given that the teacher himself had the knowledge, If not, call it Open-ended Project.

Some of the greatest designers in the sciences owed their early hurdle-jumping to that which some purists of design education advise us to eschew. All right, so we're not producing Einsteins, Rutherfords and Haldanes. But let us not be too averse to

imparting knowledge and skills without which design is incomplete.

Design in our curriculum

Returning to the place of Design and Technology in the curriculum at Bishop Wordsworth's School, every boy in the school in the first three forms has time-tabled a double period each week.

In Form 1, pupils investigate the design of forms, their shape, texture, structure and function, and explore the working of materials — mainly wood at this stage — with simple tools, and have some sketching experience.

In Form II we begin (unashamedly!) with 'all together' work in basic mensuration, marking out, cutting, shaping, drilling and finishing, from simple working drawings of small objects whose production includes all of these processes. This occupies about a third of their time in the half year which they spend in each of our two workshops.

May I hasten to add that our 'all together' working has never included graded exercises, filing 'by numbers', or the slavish construction of joints. We have always preceded this part of our work by a general discussion on the design of the artefact, the nature of materials and the tools that work them.

In the other approximately two-thirds of one half year, the pupils design and make something in wood. In the same part of the other half of the year, they choose a basic design brief from a number of suggestions, such as a device for weighing up to 1 kgm, or a device for converting wind power to rotary motion.

This exercise in design is planned to avoid the restrictions of a limited field that would be presented by a more exacting brief for a simpler object (a holder for a particular purpose for example), and also to open up possibilities in the field of technology. As wide a field of information resources as possible in the very restricted space of the workshop is provided. A valuable asset in this work is the Wiltshire County Library's School Library Service, which provides an excellent scheme of a packaged selection of books and film strips for a particular topic (eg, wind power, ships, bridges).

Each pupil works with a design sheet on which he defines his aim and the design brief, and by sketches and notes works out his suggested solutions. The design sheet poses questions on proposed materials and the reasons for their use. Group working at this stage is not permitted and partnerships are discouraged. It is the individual boy we are attempting to encourage to think, make decisions and carry them out. It is difficult to break up a sleeping partnership once it has begun. Intense and animated discussion always takes place between the boys during the course of their work, however, and is an indication of the sometimes ebullient thought process taking place.

Material supplies for this work must be as diverse as the information resources in the variety and form of materials offered. This is where good relationships with friendly firms and parents and other departments of the school, especially science, stand us in good stead. So do our regular visits to the Southern Science and Technology Forum's Stores, to be mentioned again later. Among the principal raw materials are expanded polystyrene; tinplate; assorted sizes of steel and bronze welding rod; small aluminium, non-ferrous and ferrous sections stripped from surplus equipment (domestic and scientific); elastic bands; rubber (old inner tubes); a great assortment of nuts and bolts (mostly from stripped equipment), together with access to the traditional stock of wood and metal. A wide selection of adhesives and fixing methods is also provided.

We try to get to the testing and evaluation stage by the end of the year. This puts quite a time restriction on the design brief and we find this a useful training asset in avoiding unfinished work in the future.

During that part of the year in which they undertake their basic design project, individual boys will use, and others learn of by watching demonstrations, a number of basic processes – use of the hot-wire cutter for expanded polystyrene and foam rubber, soft-soldering, blow-moulding (the blow-moulder, as the hot-wire cutter and most of this kind of equipment, has been made as a technical project in the workshop), and simple turning for example. These are some of the usual skills used in the design realisation stage of the various projects. The more involved successful designs are, however, only finished by extra time put in by the pupils outside their normal Design and Technology period.

Work in Form III has for some years begun a period of working in the project method which continues throughout the school. Boys have a free choice of workshop in which they will work. To this extent there still has to be an underlying bias of their interest in particular materials. This is dictated only by buildings, and we are rightfully envious of schools such as Pocklington, where a really free interchange of rooms and workshops is possible and this bias can be removed.

We have two workshops – one a single breeze-block walled 1943 ex-wartime ATC building, the other a wooden Army-type hut of late 1920s vintage. A third similar hut is used for larger project work and GRP. All have seen their best days and are serving well beyond their superannuated life.

Throughout the three years that really begin with this choice, we try to keep knowledge and skills abreast of ability to think out solutions to problems by investigation, reasoning and understanding. Again, this is because we believe that there is no proven success of the design process without realisation and evaluation.

Whether for example, among his work the pupil is engaged in a design project in copper enamelling where, without knowledge of the chemistry of oxides and fluxing and a 'feel' for kiln temperature and fusion, a first-rate design can be ruined; bridge-construction where basic principles need first to be investigated if not already known, or a transistor circuit where principles and precautions must be known before the design can begin, there is an underlying need for knowledge and skill on the part of the designer.

When pupils first come into Form III, they are given a resumé of the areas in which they may undertake their design project, and they can suggest others. Design briefs arise from further exploration of working techniques in the materials of their choice, or an investigational project which may be in plastics, GPR wood (including turning, carving and other processes in addition to frame and carcase working), metal (including forgework, hammered metalwork and silversmithing), jewellery, glasswork, lapidary, enamelling, resin-casting, structures and materials testing, applied science topics, electronics, or any other topic chosen for an investigational project. In this may be included projects in such things as an aspect of intermediate technology or industrial archaeology.

In Forms IV and V, the project nature of the work is developed, and while we still run 'O' level courses for those who wish it, we also have our own CSE Mode 3 Technological Studies, whose syllabus ranges approximately over the areas described in the last paragraph, and we are working towards a CSE Mode 3 Design and Technology.

In these upper forms, Design and Technology becomes one of the activities of a double period blocked across the whole year with such other studies as Art, Practical Biology and Music. Some of these are part of a further consortium as it were, of Technical Projects, having two things in common – we share a Technical Projects pool of money currently running at £250 per annum for

Art, Design and Technology, Physics and Applied Biology projects, and we meet occasionally to discuss organisation of our activities in the school.

The Technical Projects group of the school lead on to the VI form where one afternoon a week is set aside for activities that the name-givers might as properly call Project Technology or School Technology as School Project Work, and which include boys working towards the annual Esso Science and Technology Competition under the auspices of the Southern Science and Technology Forum, sometimes in a two-year project. With a parallel course in Electronics at the local College of Technology, topics at this stage are as diverse as designing a digital frequency meter or a computer memory unit (in the College of Technology course), a photographic dark-room, a harmonograph, items of jewellery or a vacuum-forming machine.

It is at Form III level and above, that the need for programmed learning is now being really felt, where classes of up to 18 are working in up to a dozen different topics at one time – with one member of the staff. To date we have relied on duplicated information sheets and on providing reference files with collated information.

The ideal, given the financial resources, would be something like a modified Millfield system, using tape cassettes with back-screen projection slides or film loops mounted over, say, two or three bench positions. We already use photographs with the instruction sheets (not everyone can afford CCTV!). A programmed learning system using an auto-stop tape system is planned as a future venture for a Form V or Form VI technical project to provide relevant information and data.

Because so much of this work calls for the ability to search for information, we include methods of information searching in the early stages of the work. We explain, for example, how to use a reference book, an index, a library, specialist sources of information such as the British Technological Index, or how to write to a firm or organisation asking for help or information (a draft letter for this purpose forms the subject of one of the information sheets). A talk by the librarian of the local College of Technology is part of the course, and senior students are encouraged to become members of the College library.

Two of our present 'A' level Design students are at present in close touch with the local Chief Fire Officer and the Fire Prevention Officer in their major project on designing a fire warning system for a warehouse. Another is in touch with the managing director of a local firm manufacturing aids for the handicapped, to gain information on his project to design a wheelchair for the disabled in the home. Yet another cycled in a round trip of nearly 200 miles to look at a factory turning out underwater swimming gear which is the subject of his 'A' level project.

From their inception (and now we see the conclusion of several) we have followed projects of the Schools Council, the work at Keele, Lanchester, Loughborough (and now Trent), Guildford and other centres.

One of the most useful and stimulating regional organisations that has influenced our work has been the Southern Science and Technology Forum that has become an excellent co-ordinating and information disseminating body between schools. The Annual Esso-sponsored Science and Technology Exhibition at Southampton in which we participate, brings a freshness of ideas and activity of Middle, Secondary, Grammar and Comprehensive schools alike. The Forum Stores at Southampton is a valuable source of surplus components without which we could not have afforded some of our project work. Parents and firms, too, help us in channelling to us disused equipment from which useful components for technical projects are derived.

1. Third-year pupils at the testing stage of their bridge designs, using a test rig built by fourth-year students as part of a materials testing rig, reselts of test on which are used in determing materials to be suggested for final realisation of design. Comparisons in design are made by dial guage readings. Other tests are made by strain gauges.

2. Second-year pupils in Design and Technology taking part in the first evaluation of their design brief in which they have a free choice of basic topics — in this case devices for converting wind to rotary motion. Wind source in this case is a vacuum cleaner as a blower, tested at varying angles and distances.

37 We have called the department Design and Technology because we believe its work is properly described by both these terms. Having endeavoured to develop understanding by enquiry and problem-solving we hope that we have at the same time allowed the child to acquire sufficient knowledge of materials technology and skills to form a sound judgement at the testing and evaluation stage, which, after all, like the eating of the pudding, is the ultimate proof.

1 Photograph: Austin Underwood.

Photograph: Austin Underwood. **2**