

Electronics in Design and Technology

Paul Barnes

In this article, which first appeared in *Electronics Education* last autumn, Paul Barnes, director of the Southern Science and Technology Forum at the University of Southampton and co-founder of NEMEC, laments the lack of a systems approach as electronics moves to its new home in the technology curriculum

The migration of electronics in schools from science to technology is being endorsed by its exclusion from science syllabuses and inclusion in technology, more particularly in the proposals of the secretaries of state published in December 1992.

While changes to those proposals are inevitable — the final orders are not expected until later in 1994, the greater prominence given to electronics must be welcomed. The task seems now to be to make an educationally worthwhile curriculum into which the orders will fit.

One of the weaknesses of the current proposals is the lack of direction to construct the whole area of control and electronics on a systems basis. This may have been due to an inadequate appreciation of the developments that have taken place in electronics systems teaching over the past 15 years and an over-reliance on the 'mix and match' approach of electronics in existing design and technology courses.

The only two Level 7 Programme of Study descriptors in the proposals* are: 'In designing and making pupils should be taught:

that integrated circuits (ICs) provide dedicated circuit functions such as light flashing and require the correct connection of external components'

and

'to use logic gates in their products: e.g. *the use of the AND gate in a simple combination lock*'

which on the surface looks as if we are asking teachers to work at the level of 'here's a jolly useful chip — let's find a use for it'!

At Level 9, the sole 'electronics' descriptor is:

'that circuits can be regulated by clock pulses and to select a suitable pulse generator for a product application'.

Clearly there is a potential for lost opportunity if these are not revised.

There are clear advantages of using the systems approach, where widely available manufactured kits are used as 'development tools' allowing genuine decisions to be made within manageable parameters determined by

the teacher. The crucial development from the designed and tested system to realisation of the artefact built on printed circuit board can be enhanced by cheap software. Only control systems developed in this way can meet the wider demand of the new proposals to interface with pneumatic, hydraulic or mechanical systems (or, for that matter, with computer systems and high-level software).

At Key Stage 4 the suggested split between pupils concentrating on *either* the electrical and electronic (and computer?) end of the control system *or* the mechanical and pneumatic/hydraulic end is sensible, given the constraint of time, but emphasises the need to treat the electronics, as well as the whole, as a system.

Existing schemes for electronics within design and technology have met with resistance from many teachers because they do not see an opportunity for the pupils to engage in meaningful design. From the prescriptive presentation in many textbooks and syllabuses, it is not difficult to appreciate their point: electronic devices are often presented as unexplained elements within a wider project. If the revised technology orders continue down that blind alley, then a great opportunity will have been lost.

Taking the systems approach reaffirms the importance of design at a number of levels: the macro level of defining and refining the whole *purpose* of the system, the intermediate levels of specifying output and inputs, choosing actuators and sensors, and the processing required, and the micros levels of making real choices between a given range of subsystems, design compromises, signal matching and power requirements. This is all real engineering design, which is effectively carried out using the development systems originally specified by the IEE and now widely available.

The system design process precedes any use of components and circuit details. Clearly, design principles are reinforced when pupils are then required to make managed choices between two or three alternative realisations of the subsystems — not all of which need to be electronic. Substitution in the development system, subsystem by subsystem, using the chosen components allows the pupil and teacher to evaluate each stage.

* DES/WO, *Technology for ages 5 to 16* (1992), Proposals of the Secretary of State for Education and the Secretary of State for Wales.

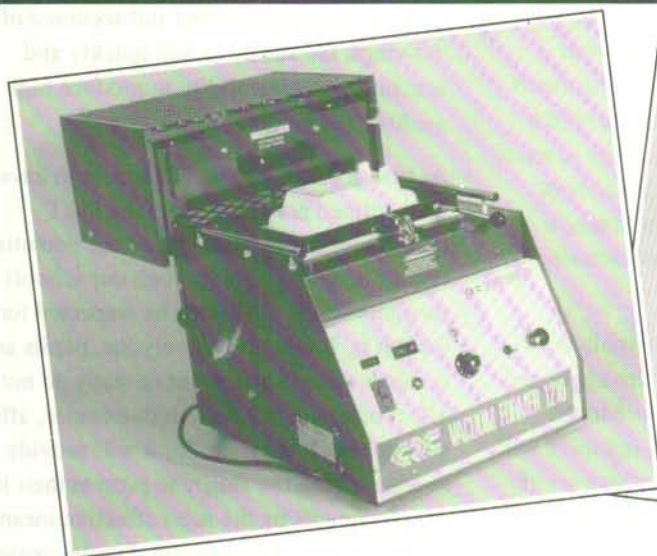
Cheap software can help the design of printed circuits, even to linking a given library of standard subsystems, and pupils can exhibit surprising skill at layout of components. Ultra-violet mask techniques are not essential — first-class results can be achieved with a bottle of nail varnish!

The other great advantage of this approach is to rescue the teacher from the nightmare of faultfinding on projects if each subsystem is clearly identified, with its input and output characteristics.

This process is as applicable to the KS3 project using two or three subsystems as it is to GCSE or post-16 work. Had it been used in the writing of the 1993 KS3 Design and Technology Control SAT, then that exercise could have made a real contribution to the education of pupils.

It seems that we are having a mismatch problem in the curriculum. There are significant numbers of science teachers who have been successfully teaching electronics systems at GCSE and A level, in some ways outstripping their colleagues in design and technology departments who have been poorly served by current course material and syllabuses. Many science teachers have already moved across, with electronics, to design and technology (as I did 20 years ago!) and found a new lease of life. Given a change of emphasis towards systems in the revised technology curriculum and some imaginative syllabuses, all the developments of the past two decades do not have to be scrapped, and many of those teachers (and pupils) lamenting the demise of electronics as we know it can work towards making it an entitlement for all within technology.

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