CAL — the most appropriate use of IT in D&T?

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Computer-Aided Learning (CAL) has a poor reputation with many but, as Tony Hodgson argues, IT is the new CAL and needs to be seen as such

The use of information technology (IT) in design and technology has recently been highlighted in two significant ways. Firstly, a DFE invitation conference to consider the use of information technology in the teaching of design and technology in schools was held in November 1993. One of the objectives was to consider how future GEST funding might best be used to promote the effective use of IT in design and technology.

Secondly, the Dearing report on the National Curriculum and its assessment was published in January 1994[1]. The report proposes the exclusion of IT from technology: 'In technology the proposed reduction [of attainment targets] is from four to two [excluding information technology]'.

The exclusion of IT is based on advice from the National Curriculum Council (NCC)[2] who also recommended that: '. . . IT should be specified separately from design and technology in the National Curriculum and that pupils' attainment in the two should be reported separately'.

This is not as significant as it may seem since it refers to the manner in which *assessment* of IT capability is undertaken, rather than the means by which that capability is *developed*. It has never been the sole responsibility of design and technology teachers to develop, or assess, a pupil's IT capability. The Dearing report simply clarifies the position stated in the original orders for technology and the *Non-Statutory Guidance* which supported the orders:

> information technology capability will be abbreviated to IT. It is included . . . as a cross curricular skill and should be taught as an integral part of most foundation subjects in primary and secondary schools.[3]

All teachers have a responsibility to consider how IT may be used to enhance learning and teaching in their subject, and how they might contribute to the development of IT capability. Design and technology teachers will be able to benefit from GEST funding support which will be available during 1994/95, but will this help them to develop pupils' design and technology through the use of IT, or just develop specific areas of IT capability?

The DFE conference on IT in design and technology received a paper from myself and a number of colleagues who hoped to clarify the potential of IT. We identified a number of categories for the use of IT and discussed some of the issues concerned with effective implementation:

> For design and technology teachers, the challenge continues to focus upon the utilisation of IT within design tasks . . . One way towards meeting this challenge is to consider the potential of IT in a number of specific categories of activity relating to design and technology: graphics, modelling, manufacture, control and information use.[4]

These categories highlight the use of specific IT applications which are particularly appropriate to design and technology. They suggest a predominantly emancipatory role in which IT supports designing and making being used as a tool to enable project work to be completed more quickly and more accurately. Software applications specifically developed for this use have been available for many years, but have not always been fully exploited by teachers of design and technology. There are many reasons for this, including a lack of funding for resources, a lack of effective teacher training programmes and a lack of appropriate software. It is likely that GEST funding and similar initiatives will help to address the lack of resources and INSET, but a lack of appropriate software continues to be a barrier to effective use of IT in design and technology.

I fully support, and actively promote, the use of IT as a tool to enhance designing and making in schools. However, for many pupils and their teachers, the time taken to become familiar with a software package can outweigh the advantages which may follow its use. Although the printed output from a graphics or CAD package is clean and crisp, and a CNC milled piece of plastic is accurate to 0.01mm, do they really indicate a greater understanding of design and technology? Will access to a wider range of information through IT networks help pupils to research more effectively, and will the use of a spreadsheet to calculate structural loads help them to design a better structure?

The answer, of course, depends on many other factors, some of which are determined by the teacher and the pupil. These include, for example, the teaching and learning strategies employed, the context of their use and the way in which the software has been integrated with the teaching programme.

Many schools have made effective use of IT to enhance the quality of pupils' design 'outcomes' and to enable them to produce parts of a product which they would otherwise only be able to design and sketch. This undoubtedly develops IT capability, but what of *design and technological* capability? A pupil's capability in design and technology must be overtly developed. Simply asking pupils to identify design needs and develop design solutions may well help them to practise that capability but it is not, on its own, an effective strategy for its development. The NCC appears to support this view by suggesting that pupils should:

> . . . undertake focused practical tasks in which they develop and practise particular skills and knowledge; these tasks will focus on the development and application of specific designing or making skills . . .[2]

It is important that IT should be used to develop specific design and technology capability, moving beyond the application of IT for its own sake or simply emulating the use of IT in industry and commerce. IT which seeks to develop specific capability may be described as Computer Aided Learning (CAL) and in certain circumstances IT-based 'tools' may also be described as CAL. However, this term is usually reserved for software applications which simulate, instruct or reveal information, and which have been designed with an educational purpose in mind. Such software has a rarely recognised potential to support the development of design and technology capability and includes, for example:

- providing information or instruction at the point of need — the nature of individual project work is such that pupils may require information or skills which lie outside the core content of that specified in the National Curriculum. Traditionally, the acquisition of this information has been difficult to manage, but CAL applications can provide an effective means of supporting individual or small groups of pupils whose needs are not relevant to the whole class.
- simulating technological activity and so moving more rapidly to an effective design outcome — the computer has a great capacity to simulate cause and effect, particularly when this interaction can be defined mathematically. The simulation of a change in structural load or the operation of an electronic logic circuit can be a powerful aid to understanding the design principles involved and their application to real products.
- assessing pupil capability and assisting the management of learning resources — many schools aim to support more individual learning routes through the use of resource based or flexible learning approaches. The outcome of formative assessment helps to determine the most appropriate learning route for pupils. CAL applications are able to carry out such assessment, provide immediate feedback and analyse the results for individual pupils. For some of the National Curriculum Attainment Targets it might also be used to provide a guide to the level of attainment reached by each pupil in the class.
- bringing real design contexts and situations into the classroom — whilst there can be no substitute for the real experiences provided by visits and meetings outside school, it is often impractical to take pupils into an industrial environment or design context which provides the air of realism required in designing and making activities. Modern multimedia systems provide a viable alternative to the visit, supporting video descriptions with relevant data and interactive questioning.

Unfortunately, CAL has not always enjoyed a good reputation. Many associate it with the programmed learning machines which characterised early CAL applications. These were little more than 'drill and skill' applications used to assist rote learning and didactic teaching approaches. In a move away from such teaching strategies and towards more experiential learning, CAL was often rejected as inappropriate. However, it is worth remembering that recent criticism of design and technology in schools has highlighted a lack of basic skills, and there may be an effective role for CAL to support the development of such skills, particularly to assist revision and reinforcement.

There has, however, been a great deal of CAL development since the early programmed learning applications. It is now possible for pupils to browse through micro worlds of information and simulations, to be directed to

specific learning materials by tutor input or expert system, and to model their designs with integrated computer tools. More powerful computers are becoming commonplace in our schools and they are able to support the multimedia software which integrates images, video, sound, text and assessment. The development of appropriate learning materials has been enabled by the use of sophisticated authoring tools which teachers can use to modify software so that it better suits the needs of pupils in their class.

Whilst potential for the introduction of CAL has been identified, and the means to develop suitable software applications now exists, there are still a number of barriers to its effective implementation in schools. A number of issues need to be considered before CAL applications can be designed and recognised as a natural resource in the classroom:

- Who should have control of the way in which a CAL package is used? In some situations the teacher will want to provide a tight structure to the learning provided, in others the learners will take control of the materials and learning style for themselves. Alternatively, the computer can provide control of the pace, style and material which is provided by the CAL package. Varying this 'locus of control' is one of the ways in which CAL software can be made to be particularly effective.
- What is the nature of interaction between learner, teacher and computer? Teachers will naturally ask different questions of a whole class than of individuals. Pupils may question other pupils more readily than their teachers, and some prefer to work individually rather than in groups. The different ways in which questions, and feedback to the answers, colour the interaction between learner and computer lie at the centre of effective CAL resources. Can, or should, a computer be able to emulate the range of teaching and learning styles already employed in design and technology?
- Will teachers be able to influence or modify the CAL application? It is unusual for teachers of design and technology to adopt just one textbook or use a colleague's design worksheet without amending it. Most will 'mix and match' from a range of resources and prefer to write their own worksheets and materials so that they better fit their own teaching model. The same approach is difficult to achieve with CAL resources, but may be a facility which must be provided before such resources receive wide acclaim.

As an enthusiasm for multimedia technology gathers pace and a new generation of CAL packages emerge, many of the issues surrounding their effective implementation will clarify through trial and error. Continued research and development will also support their use in school.

As a greater understanding of how pupils and teachers can best employ CAL resources develops, it will be possible to explore ways of developing design and technology capability which will only be possible with computers. It will be possible, for example, to help pupils move more easily from 2D to 3-D visualisation, or perhaps to design entirely in 3D and develop 2-D views only because they are required for manufacturing purposes. Traditional notions of progression in capability and real design situations will be challenged. The greatest potential of IT will be achieved when emancipatory software such as graphics, CAD and CAM applications are combined with CAL theories of learner interaction and the locus of control.

The first objective for implementing IT in design and technology must be to meaningfully employ the software tools which help to overcome barriers to learning. Indeed, this should already be happening. The second objective must be to develop CAL applications which move beyond the development of IT capability and actively develop design and technology capability. This is the real potential of IT in design and technology.

References

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