Manufacturing By Design

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NCET recently published a set of CAD software and curriculum materials, available to schools free of charge; Nick Capstick describes the thinking behind this new initiative

In today's manufacturing, designing the right product to meet customers' needs, and manufacturing it to the highest possible standard in the shortest possible time is the key to success in increasingly competitive markets. Highly sophisticated computer-aided design, CAD, is at the heart of this process for much of manufacturing industry.

Manufacturing by Design introduces young people to this crucial component in modern manufacturing. As well as addressing the specific need for teaching resources for the National Curriculum, it is hoped that these materials will assist teachers and pupils to forge closer links between activities in the classroom and the actions of industry. Specific design projects in the pack include designing the layout of a factory floor, calculating the volume of detergent containers, testing the mechanism of a toothpaste dispenser and designing electronic circuits for a satellite communications system.

This is a joint initiative between the CBI and NCET to produce curriculum materials to support an industrial CAD application entitled DesignView. This software is a 2-D parametric package which offers features which will take CAD beyond the current capability of most schools. In addition, the pack also offers resource materials including a teacher's guide, carefully graded pupil tasks and tutorials based on specific design issues, and a series of case studies which set CAD clearly in the context of manufacturing industries. The supported self-study materials offer carefully structured progression for teachers and students which should meet the needs of a wide range of users, while the resource pack offers a number of possible areas where students could take a design within the context of manufacturing industry.

The software and curriculum materials are available to all schools who wish to apply and in order to give maximum exposure to the quality work which we hope this initiative will generate, there are plans to hold a number of regional celebrations. Selected work from each of the participating schools will be exhibited to the public in a prominent regional centre in the summer of 1994.

Following registration the DesignView software will be licensed to the school for one year. If the school wishes to keep the software beyond that point they will need to fulfil one requirement: they will need to supply NCET with a short portfolio of pupils' work which has a clear connection with their use of CAD. On receipt of this work, NCET will send an acknowledgement and arrange with the licence holders to forward to the school a permanent licence agreement.

So why is CAD so important to the emerging school curriculum ? And why should schools get involved in this project? Well, it seems to me that if schools are to keep abreast with new technologies in this audio-visual age then it is essential that CAD is put in its rightful place within the curriculum.

The Development of CAD in Schools

The Historical Perspective

Computer Aided Design (CAD) is often associated with engineering working drawings which communicate precise information to aid the production of an artefact. These are often referred to as drafting applications. CAD within D&T has far more to offer and is far more diverse, however, offering students the opportunity for evaluation or analysis within most media areas and design activities. Even the most sophisticated packages can be used in a simple way to improve the quality of working drawings or to encourage free experimentation in design. The advantages of CAD over more traditional drafting methods are numerous and include the quality, speed and accuracy of drawings, the ability to edit quickly and accurately and the ability to produce high quality hard copy.

At first glance CAD would appear to have a well defined position within the D&T curriculum but it is only when the potential impact on all passing through our schools is recognised that CAD will be respected for what it is. It will affect everyone, pupils and teachers alike. Some areas of study do not affect others; CAD will, in due course, affect all subjects. It must do, for it will provide everyone with the ability to present their ideas and arguments by the most effective means known — visual expression. For this reason alone we are seeing the introduction of a major force of communication in education.

A Subject in Revolution

It is common knowledge that at the moment the N C Technology Orders are in a state of flux to say the least. The range of short and

long courses is enormous and the possible combination patterns vast. The new orders are currently being revised and restructured with the number of attainment targets in the D&T component being reduced from four to two. These will be known as Designing and Making with a weighting of 40:60 in favour of Making. It is not, however just the curriculum area of Design and Technology (or Technology and Design as it is called in Northern Ireland) which is in a state of revolution but the entire taught curriculum which could be transformed by the power of CAD. In fact it may even be worth examining a parallel example.

Word-processing and DTP

Also by courtesy of the microcomputer and having made a rapid cross-curricular impact is word processing. Not so long ago, some pupils studied the specific skill of typing and presentation of the written word; only those students studying the subject learnt the skills. Now keyboard skills are learnt almost by default as pupils prepare their reports on word-processing systems which include spelling check routines; hard copy is then printed on machines which enable ideas to be well produced and unhindered by poor writing and bad spelling. A supplementary but very important aspect of the introduction of word processing is the way in which work can be easily checked, ideas revised or even presented in a more appealing way. A student working on a long, handwritten report was always very loth to re-read and correct his or her work. This is no longer the case.

The next phase has already begun with the rapid growth of desktop publishing software. Here, graphics and text are integrated to produce hard copy of a quality comparable with any professional printer. Consider the creative child with poor handwriting who could not spell and whose creative progress must have been hindered with the insistence of grammatical correction! What price word processing with spell checkers and syntax correction? At the end of the day it must be the ideas that count and the ability to express them and put them into effect. With the new found capacity to produce effective graphics and incorporate them into meaningful text, there must be potential for a rapid improvement in human communication.

What does CAD entail?

What I have just been talking about may seem slightly futuristic but will almost certainly happen. But where does CAD sit now in the school curriculum? CAD is growing and developing within the D&T department. It is worth asking why, if this is such a powerful communication tool, it appears to be based almost exclusively in one department. Historically anyone studying the old curriculum area of CDT had the simple task of wishing to make something and of developing skills to enable this to take place. This initial requirement has developed into aspects of the D&T curriculum which relate to 'Design and Realisation' and 'Design and Communication'. Both rely heavily on graphics for the presentation, analysis, development and construction of ideas. With the need to produce graphics which can be manipulated and repeated, CAD has a place in this environment. Furthermore now that modern technology has released the constraints of single colour copiers the subject is ready to move on to more diverse productions freed from the constraints of codes employed to overcome lack of colour work (codes like different line styles, hatching and symbols etc.). Look at any old technical print and see the use of colour. Don't we all prefer the colour movie to black and white?

The D&T department is therefore the natural home at the moment (and it is important to stress that it may only be for the moment), for CAD. This is especially so when it is linked to CNC machinery and production follows directly on from design. Increasingly however, in a variety of other curriculum areas there is a requirement to communicate ideas to others. At the moment this is often done along traditional graphics lines with colour work, photographs, stills, and dramatic and eye-catching presentations. CAD can do all of this and more, for it now includes the ability to look at animation, video work, 3-D modelling and many other aspects of visual presentation.

Introduction of CAD into the curriculum

CAD is now being experienced — possibly for the first time — by all pupil age groups and teachers. Consequently everyone is learning the basics at the same time; this will change and will develop into the normal structure. Teachers will be proficient and students will gain in experience progressively. Every year

will have goals to be met and will continue to bring an increase in the understanding of the breadth and scope of CAD. The important question is, how is this to be achieved and what are the goals to be set? These are urgent questions that need to be answered so that important decisions can be made concerning implementation. Already a number of needs can be identified. It may be worth listing them so that they form the basis of decision making:

- All pupils need to be exposed to CAD principles, irrespective of particular talent or subject persuasion.
- A structure for gradual development needs to be decided so that :
  - — evolution in understanding is enabled
  - — all pupils have a basic awareness which can be called upon, irrespective of subject study
  - — schools can be equipped to cater for need at various levels
  - — testing of progress is understood and undertaken
  - — teachers are adequate for the task. (*It should be noted that at present the 'happy amateur' is still forcing the pace; soon all teachers, irrespective of persuasion, will be required to have a level of knowledge.*)
- A proper INSET programme must be instituted so that teachers are trained, ready for the task ahead.
- The elements which constitute CAD need to be identified so that they can be incorporated into the curriculum at the appropriate stage.
- A structure must be decided so that both the student who needs to use CAD at an awareness level and the student who needs to use CAD at an advanced level, can be accommodated. Who knows, this may even require a new examination syllabus!

The first task therefore is to identify who needs what type of instruction and training. This is complicated because at present most are learning the subject at the same time but at varying speeds with varied degrees of success. It is possible however, to identify a number of categories:

- At the present time all pupils from KS1 up need not only computer literacy but also CAD experience according to their age and, in the case of KS4, their subject of study.
- In the near future, the requirement will change as the need for training and education in computer literacy at the later age range diminishes. However, by then some progress will have to be made in identifying those aspects of other subjects which provide complementary building blocks in the understanding of CAD, such as absolute and relative co-ordinate theory, and polar and Cartesian co-ordinates, aspects which may possibly be areas which teachers of mathematics could develop in support of CAD. Similarly, art departments may be required to develop work in colour or composition.

  Teachers, being adults, present special training problems when learning to use a new technology. Positive mental blocks have to be overcome in many cases. The trouble is compounded when both pupil and teacher are learning how to use kit at the same time. Often the pupil will be more confident with the equipment and this may result in the teacher being reticent to show his or her inadequacies. The consequence is that the equipment is under-used or not used at all. That again is one of the advantages of *Manufacturing by Design*, as it has been designed to ensure that teachers will gain rapid progress in the use of the software. In time natural evolution will ensure that staff become proficient — if a rigorous policy of in-service training is adopted; new teachers, having gained their experience in school or at university, will ensure that eventually the loop is complete. The challenge therefore is in the immediate future, and it needs to be planned.

In order to support schools in the endeavours the CBI has set up a help line and appointed a project officer to manage day-to-day enquiries. He is John Harris and he can be contacted on 071-240 2754. All enquiries should now be directed to him.