

Design & Technology Forum

CAD/CAM

Bill Nicholl, Lecturer in Design and Technology Education, University of Cambridge, Stephen Stott, Schools and Industrial Programmes Co-ordinator for the Technology Enhancement Programme (TEP) and David Prest, National Endowment for Science Technology and the Arts (NESTA) fellow and Design and Technology Adviser for Cornwall LEA discuss their views on the creative use of CAD and CAM in the processes of Design and Technology.

The three who met recently at the DATA National CAD/CAM conference, were struck by their similar views on how Design and Technology should be taught in schools and the need for sensitivity and care when integrating CAD and CAM into the sometimes fragile processes of Design and Technology. The guiding principle to which all three passionately adhere is that CAD and CAM must be seen as a means to a creative end rather than be considered an end in itself. Bill, Stephen and David believe that it is the responsibility of the Design and Technology teacher to encourage pupils to gain and consider knowledge and understanding in six key areas when tackling any Design and Technology activity.

Dave describes the six areas as:

1. The design strategy to be used (all three strongly believe that there are many ways of tackling a design problem rather than following the 'design process' slavishly and often boringly advocated in many Design and Technology text books)
2. How the pupils will clarify and communicate their ideas through drawing, modelling, talking and writing
3. Aesthetic and sensory consideration
4. Scientific and technological aspects
5. The use of appropriate materials and processes
6. The relevant social, economic, historical and moral issues and influences

This holistic view of the Design and Technology requirements, which encourages pupils to make value judgments based on real knowledge and

understanding, has been at the heart of the professional lives of all three. As Bill says about his experience at Elliot School in London where he worked until July 2000:

"Pupils at Elliot were, and still are, encouraged to sketch, experiment with materials and processes



- modelling using simple materials such as paper, card, foam, scissors, tape and paper fasteners. Pupils' research included the study of the visual elements and principles, for example line, colour, texture, balance and harmony. Other stimulus came from nature, architecture, art and design movements, individual designers and the lifestyles of people. The ability to think, express ideas on paper or through discussion together with analytical and evaluative skills are vital to the design process."

So where does CAD/CAM fit into a modern Design and Technology curriculum? First and foremost, the three believe that CAD and CAM should be viewed as just another set of resources available to the designer to express and manufacture creative ideas. Stephen says, "For many students, CAD helps to overcome the frustration they experience in not being able to express their ideas using pencil and paper with sufficient artistic clarity, so that others can understand and share their proposals. CAD packages enable pupils to create virtual images that accurately represent their designs as a fully rendered illustration. The only constraint on a CAD solution is the student's ability to understand and use the software. Sometimes the opposite is true, where pupils are competent users of CAD but forget about the other elements that make up a total design. CAD and CAM should not be allowed to dominate our subject but when used appropriately they are vital components in

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the designer's toolbox.'

However, they also believe CAD and CAM make a significant and unique contribution in the following three areas:

- ▶ Communicating, modelling, developing and adapting ideas – CAD packages such as Techsoft 2D Design, Pro/DESKTOP and ArtCAM enable pupils to create virtual reality images, which closely represent the images that are developed in the pupils' imagination.
- ▶ 3D thinking is encouraged by the use of packages such as Pro/DESKTOP, which enable pupils to work directly in a 3D environment and to model graphically complex 3D shapes and interfaces, again unrestricted by their personal sketching skills.
- ▶ Manufacturing quality and precision is greatly enhanced when the CAD image is interfaced with a CAM device such as a stencil cutter, router, milling machine or lathe.

Bill, Stephen and Dave have developed an approach to enable students studying Design and Technology PGCE at Cambridge to deliver CAD/CAM to pupils at Key Stage 3 and beyond.

The designs shown here were created using simple geometric shapes and fundamental CAD modelling techniques. All of the proposals were manufactured from 2mm thick styrene using the TEP milling machine, which



was developed to give schools a low cost solution to achieving CAM in the classroom. This group of products illustrates how three-dimensional outcomes can be achieved using a structural approach that takes advantage of the close tolerance fits available through the accuracy of CAD/CAM. Many of the designs were inspired by different architectural styles

of the 20th century.

The designs for the desk lamps (pictured below) show how large-scale engineering principles can be applied to small-scale industrial design products. The forces and loads that ensure a tower crane remains stable



are equally evident in the design of the desk lamp shown here. This represents an opportunity to develop a design from an aesthetic and functional platform and to include applied maths and physics in the design process. TEP are investigating the opportunity to develop design using a cross curricular approach and would expect to produce support materials to enable Design and Technology to work more closely with other curriculum areas such as Mathematics, Science and Art.

With all this in mind, Bill, Stephen and David



are developing and documenting an approach to Design and Technology which places creativity and innovation at its heart.

David says, "The strategy is based on the exciting and challenging aim for Design and Technology expressed in the importance of the Design and Technology statement found at the beginning

of the National Curriculum 2000 Design and Technology document. We have interpreted the programme of study for Design and Technology Resistant Materials work at Key Stage 3 into clear and unambiguous statements using the six headings outlined

earlier in this article. Activities such as these illustrated in this article are then planned in a progressive way against this matrix of knowledge, skills and understanding."

A planning sheet is used to record the key learning objectives for each unit of work.

Bill, Stephen and David believe that the photographs of outcomes illustrated in this article indicate that when pupils are given stimulating design briefs, are taught relevant knowledge, skills and understanding in the six areas discussed and have access to appropriate CAD and CAM facilities, innovative, exciting and creative outcomes are the result.



① **Bill would be pleased to hear from any school, individual teacher or organisation who would like to contribute to this exciting new venture.**

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