CAD/CAM – Now we've got it, what do we do with it?

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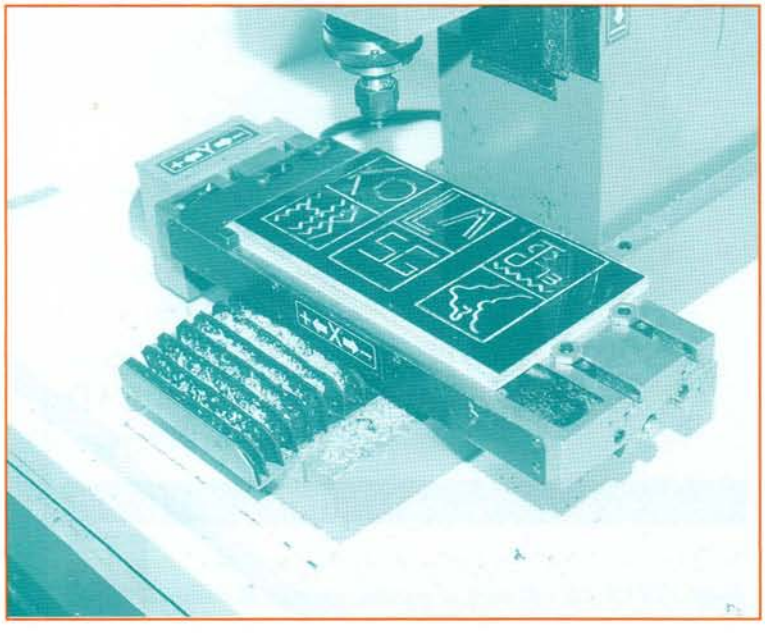
This article sets out to explain how staff at Sawston Village College went about familiarising themselves with new CAD/CAM equipment. Hopefully, it contains some advice which may be helpful to those who may be considering the purchase of hardware and shows how activities may be planned and introduced to pupils in the first year. Some evaluation has been carried out and staff hope that observations and comments will help to shape further development within the units which have already been started and with pupils as they progress through the school.

There seem to me to be two very specific challenges associated with the introduction of CAD/CAM work within a school. Firstly, how do you get the money for the equipment, and secondly, what do you do with the 'machine' when you've got it? With the expense involved, it is likely that only one machine could be purchased and this brings with it a whole range of resource management problems. Having only one of any machine can cause problems for teachers and could prevent many departments from even considering the initial challenge of how to get the money. Junior school teachers have always seemed to me to be the masters of such situations – just one or two computers and a room full of 30 lively children requires some major management systems.



Group of six Year 7 stencils after machining

Being a Technology College meant that some of the finance problems may have been a little easier. I will not say whether I think it is right that some schools should have access to additional finance but I do believe that those schools which are more fortunate should experiment and pass on what has been tried or learnt to others. The challenge which we set ourselves was that, if we were going to get a CNC machine, planned projects must involve all pupils within a year group and for us that meant 240 pupils at a time.

Selecting 'the machine' is a decision which is perhaps something not to consider for too long. I don't mean that you shouldn't gather facts, see machines in action or get recommendations but there will be a range of views and it is likely that after you've made up your mind, someone else will come up with something new or improved or an enhanced version of something else – that's technology, I guess. My only advice would be, decide what you feel is best and go with it. Once the invoice is signed, how you use it is the important issue.

A delivery date was arranged and we painted a bench for it to go on, rather like having royalty to visit – it seemed the right thing to do. Although it was delivered on the back of quite a large van, once installed onto its 'new' bench it didn't look very big. Big that is, when compared with the size of a new or second-hand car which you could buy with the same amount of money. Although it is a perfectly formed piece of machinery, perhaps it is non-design and technology staff, in particular, who should not be told the full sum involved. They are less likely to appreciate the details and more likely to equate the money with mountains of new text books, heaps of pens and pencils or even a new car for themselves.

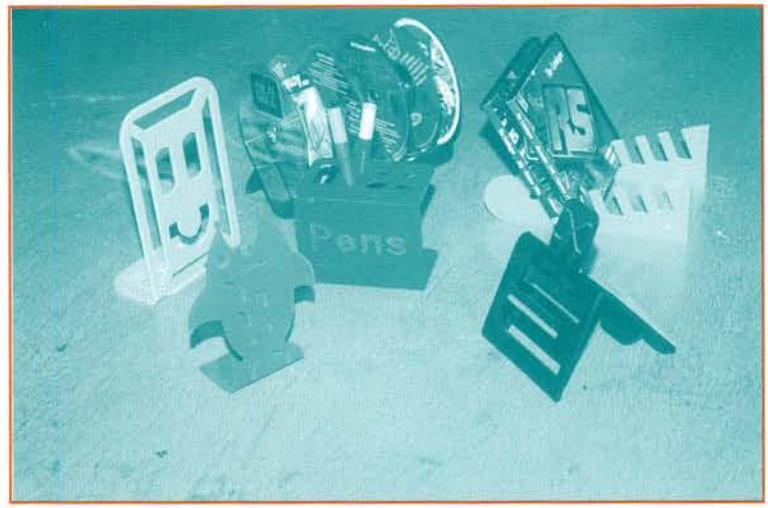
Two staff attended the supplier's training day and returned full of CNC experience, ability and ideas. We had left ourselves some time over the summer to experiment and to come up with projects. Example projects were included by the supplier but we decided not to use these wholly but rather as a basis for our own ideas. I believe the process of developing the work helped us to understand what would be needed and

also allowed us to get project ideas which fitted in with our other planned units of work.

We chose Years 7 and 9 to be involved with the machine. We felt that this would have greatest impact on the school and within two years all Key Stage 3 pupils would have used it. We would also have pupils moving up to GCSE courses with experience and hopefully they would be thinking about how it could be used in a more individual way.

Our Year 7 project developed into work involving the making of a personalised stencil. It started with graphics work and looking at letter styles, then moved onto looking at logos. Pupils then developed their own ideas based on their own initials. We then introduced the design software, showed them what could be done and let them experiment with some of the features. We had thought that the concept of leaving parts of the letters intact so that areas of the stencil did not fall apart would be difficult to get across but the pupils surprised us – once shown there were few problems to correct.

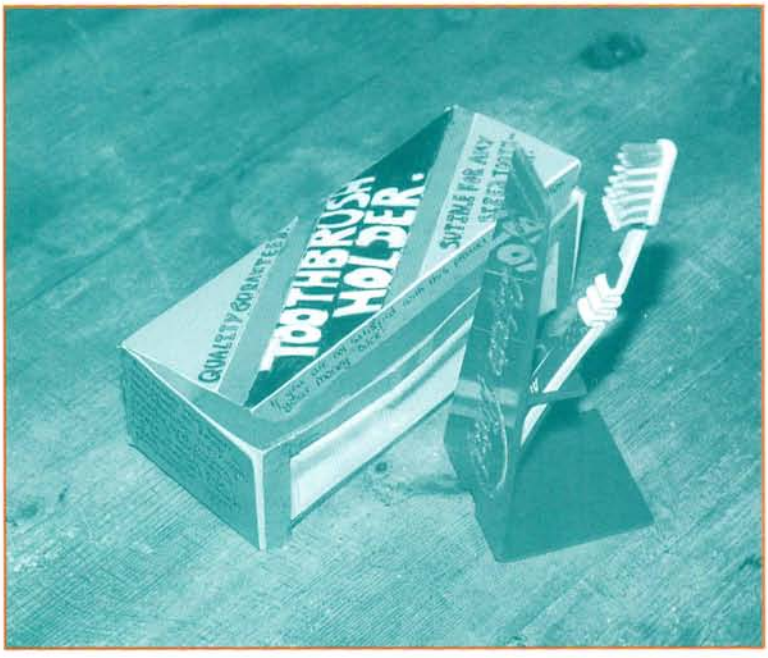
Pupils completed their designs and moved onto computers. We let them work in pairs and found that most could produce two designs within the lesson. Each pupil's work was individually saved and later the teacher put them into groups of six and saved them in machine code ready for machining. Each class would have 4 sets of 6 stencils and each set would take about 30 minutes to machine. We made 2 stencils for each pupil, one for them to use and one to go inside the package. Because we could not guarantee that all stencils would be machined before the following lesson, the project required pupils to do a number of other pieces of work, not dependent on having the stencil. Earlier lettering work was applied in the making of a small package, including some bubble package vacuum forming. Pupils also had to draw a detailed view of the CNC machine and complete an illustrated flow chart to show the progress of the whole project. Whilst not all pupils may have seen their own stencil being made they would get to see a demonstration on how the machine is set up and all would see it cutting a similar stencil.



A range of Year 9 'Keeping things tidy' products

Whilst this unit is very 'focused' and quite limited it now plays an important part within the overall scheme for Year 7. It quite specifically sets out to develop pupils' designing skills by looking at lettering, symbols, shape and colour [PoS Designing skills]. It gives all pupils a considerable amount of IT work [PoS Designing skills and working individually and in groups]. Whilst there are few making skills involved pupils do look at making products in quantity as well as evaluating the product at the design stage and after it has been made. To some extent, there are also issues involving the programmes of study for systems and control but although our pupils are very aware that the computer is controlling the machine, little else has so far been emphasised to the Year 7 pupils.

Our Year 9 project was a more open-ended assignment and is based around the theme 'Keeping things tidy'. A wide range of ideas were encouraged from pupils and then modelled using card of the same size as the perspex which they would finally use. Whilst in this first year we were not fully prepared for a wide range of 'hands on' investigation and disassembly work, classes did investigate the range of items which might benefit from being kept in a more tidy way and researched the range of products which already did this task. We did show pupils how individual pieces could be made to fit together by using 3mm thick perspex and a 3mm milling cutter, and this technique was well developed in many pupils' design proposals. CAD work needed pupils to work individually and took longer, so half the class worked on computers whilst the others



A completed Year 9 product and box

developed packaging 'nets' using the card models as a size guide. Using the 3mm perspex each piece on average took 40 minutes to machine. This is a considerable amount of additional work for staff. We found that we could complete around 6 each day by setting up and running the machine at certain times during the day. Over a period of about three weeks, finished work was able to be given back to pupils. Demonstrations to show the use of strip heaters and how to finish off the edges enabled pupils to complete the products and place them in the finished packages.

For this next year we would like pupils to gain a better understanding about the CNC milling process and some of the technology involved . After the designing is completed, pupils will return to the now free computers and in pairs, work their way through a specifically prepared CD-ROM. The activity should take around 30 minutes for each pair, requiring them to work through a number of sections, answering on screen questions and learning about issues such as axis movements, motor control, types of cutter and material removal.

By extending the basic design and make assignment with the packaging and CD-ROM work, pupils have more relevant tasks to complete within the unit. As well as giving a longer period of time for the teacher to organise the machining of pupils' work, the teacher also has more time available to help develop individual design ideas or to help pupils catch up if lessons have been missed.

We are all pleased with the results of our first year. In total, around 480 pupils have had first-hand involvement in the CAD/CAM process and have spent a considerable amount of time developing their IT skills. Possibly the most important resource, next to the actual machine itself, was having easy access to computers. Without sufficient access to the software, the slow rotation of pupils through the CAD process would have left too many pupils without meaningful work to complete.

Pupils' reaction has been very good and the following comments from Year 7 help to reward staff for the additional efforts which this development has required:

"I think it's quite good how it works because I've never seen any thing like it before"

"I think it's brilliant, it can make things very neatly and carefully"

"The CNC machine works really fast and the product you are making comes out really well"

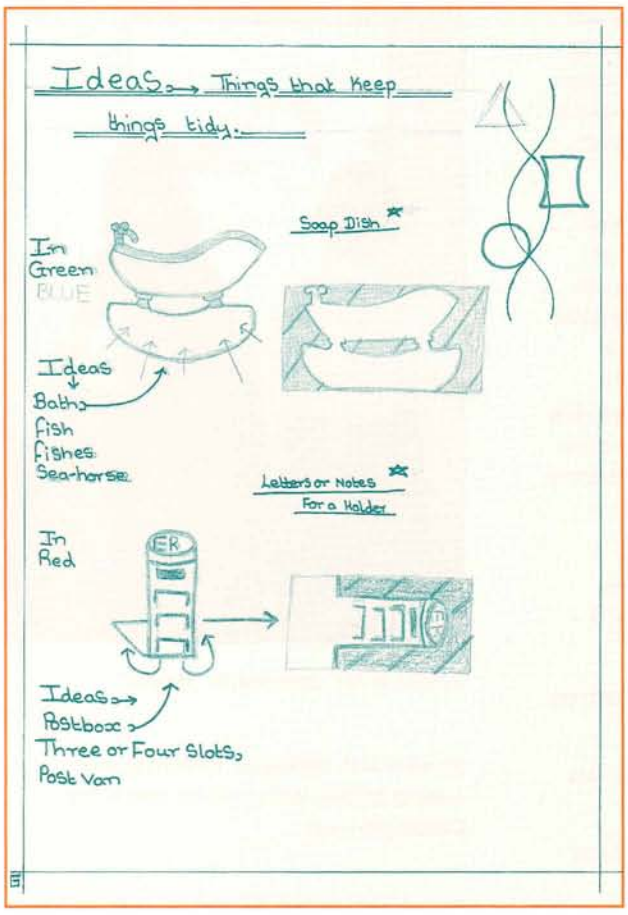
"I liked it when we watched the machine cutting out our stencils"

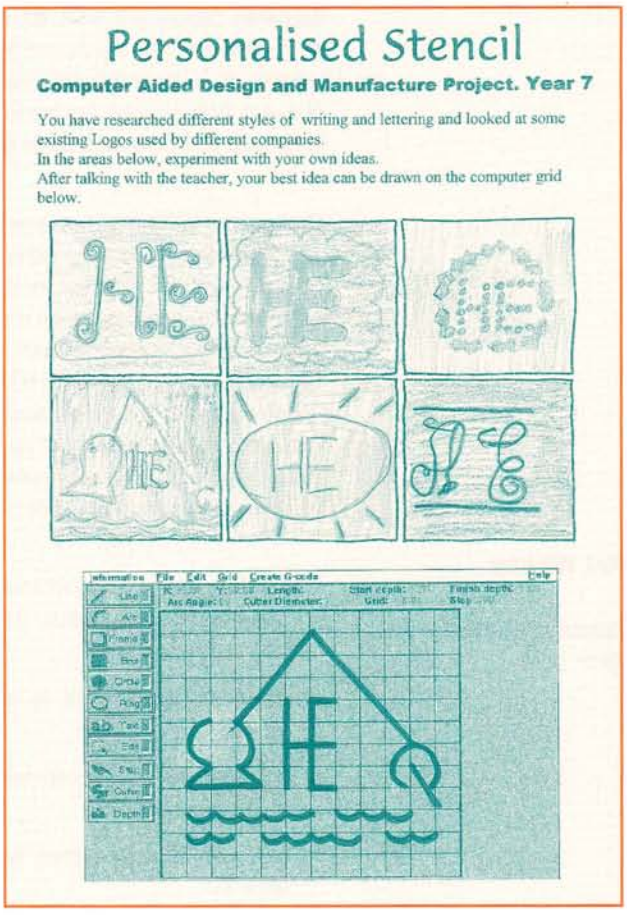
"I thought that the machine was smart and I liked the way it cut it out"

"It was a big machine"

"I found the machine extraordinary and the way it works was really clever"

Most of all, I feel that we have shown that one CNC machine can be used by a large number of pupils in a school. Although considerable work is involved, the standard of pupils' work has been raised, credibility for the subject has been improved in both





pupils' and parents' eyes, the senior management team have felt that the money was well spent and staff have enjoyed and benefited from the chance to work with and develop the system.

However, now we are into our second year we still have a number of issues to address. There are still features of the software and hardware with which staff feel they need more time to become familiar. We hope to involve our technician more in the actual machining process so that the full load does not solely fall onto teaching staff. We need to look further at the link which we are trying to make with industrial practices. Although we now have an industrial type machine in school, the link between this and the world of business and manufacturing is still not fully demonstrated.

Lastly, we need to be able to stand back, review what we have been doing and not only make appropriate changes to what we have begun to do but also to present further opportunities for pupils as they progress into GCSE courses. An example where this has already begun to happen is with a current Year 10 electronics class. With pupils and staff familiar with the system they were quite easily able to machine shapes for the front of their emergency light products.

I hope that this account may encourage others if the opportunity should arise.

Thanks must go to the staff at Sawston Village College for their efforts in making this development work.

Above right: Personalised stencil (Year 7)

Above left: Ideas for keeping things tidy (Year 9)