DfEE/DATA CAD/CAM in Schools Initiative – A Success Story so Far

Abstract

This paper explains the structure and early development of the government's major initiative to develop CAD/CAM in schools as part of an overall strategy to update and enhance design and technology. It looks at the origins of the project and then sets out the structure of the programme and the rationale behind the structure. The paper then goes on to describe the role of pilot schools and CAD/CAM hubs and this is followed by the analysis of the effectiveness of such programmes.

There is a brief analysis of what the project has currently achieved, with examples of work and the challenges that are emerging and where the work is leading in the future.

Introduction

The second half of the 1990s saw design and technology consolidating itself in secondary schools after the turmoil of the early 1990s. The new GCSEs were delivered with considerable success. Despite the excellent work of Nuffield and RCA/TCT with new textbooks and TEP with new affordable products to stimulate work in new technologies, there was a lack of any major drive in curriculum development in many parts of the country. In many ways this was due to the demise of the time available to LEA advisers/inspectors. In 1997 DATA published their initial thoughts on the National Curriculum Review. Three major new areas of development were identified, namely CAD/CAM, electronics and communications technology and biotechnology. In the 2000 Orders for design and technology CAD/CAM was made compulsory at Key Stage 3 and a greater emphasis has been placed on electronics, use of ICT and new materials.

CAD/CAM is not, however, new in our schools. Much work has taken place during the last decade through the excellent TechSoft products and a range of other software packages. Many schools purchased CNC lathes but gradually millers and routers were found to be more flexible tools for students who design products. In 1994 Computervision offered the CBI a software package that was free to all requesting schools. The package, Manufacturing by Design, had good industrial backing and support from NCET. However, despite the distribution of more than 2,000 copies over five years, its impact was limited to a relatively small group of schools. There was a range of developments with CAD/CAM in areas such as North Wales, North Yorkshire, Staffordshire, Shropshire and Wakefield, which had the highly successful Face to Face initiative using remote manufacturing and video conferencing.

In 1998 Parametric Technology Corporation (PTC) through Professor Kumar Bhattacharyya, Head of Warwick Manufacturing Group, offered the UK government Pro/DESKTOP to all schools. PTC, which is now the name of the company, has taken over Computervision. The government asked DATA to carry out a review of the software and establish a plan for implementation. The review of the software had positive and negative elements, much to do with its suitability for school use and its affect on the current educational CAD/CAM industry in this country. DATA concluded that the software should be accepted as it could stimulate schools to get involved in this stagnant area of work, there was little additional funding to purchase any software and the new PTC 2000i software was a major step forward in terms of ease of use and capability. Conditions were applied in the advice given to government, including a planned programme where training was an integral part of the scheme, schools established targets for using the software and that other companies could join the scheme by offering their software under similar principles.

Discussions took place between DATA, DfEE and PTC about the nature of the license agreement and how the project was to be managed. It was clear that lessons in design and technology are frequently too short when working in CAD so PTC agreed to a free license for home use. This has given a new dimension to the whole work. In January 2000 PTC agreed that student teachers could also be added to the scheme.

Nature of the software license

The Pro/DESKTOP software license will have a full site license (300 seats) and home use by staff and students for educational purposes. Where a school requires more than 300 seats more can be provided with no additional charges. DATA has the capacity to take updates of Pro/DESKTOP software – these will be issued when it is considered relevant to do so. A design and technology student teacher seeking qualified teacher status (QTS) can have a license during their training. The license holder is a named trained teacher working:

- in a maintained school

- in a Sixth Form College

- in an independent school recognised by the DfEE or

- as a student teacher.

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The site license will be withdrawn if the accredited teacher leaves and no other teacher is accredited. A teacher once accredited may apply for a license for the school they have moved to. This approach ensures that any school using the software has a trained member of staff. Further Education Colleges and Universities other than those training design and technology teachers are outside of the scheme.

Project management
The DfEE with the agreement of PTC appointed DATA to manage the programme and a steering group was established with the DfEE, PTC, Warwick Manufacturing Group at the University of Warwick, CBI, BAE Systems, QCA, Internet Solutions for Business (IS4B) and DATA. This group agreed the aims for the scheme and the method of working. In August 1999 DATA signed the legal agreements for the release of the software which makes DATA the sole distributor to UK schools. DATA is responsible for releasing Pro/DESKTOP and for managing the software licenses. Pro/DESKTOP cannot be sold to UK schools as part of the agreement. DATA has established a team of staff who manage training, software release, monitoring and management of the scheme.

Aims of the scheme
- to ensure all secondary schools have access to CAD/CAM

- in English schools, seeks to provide support for the teaching of CAD/CAM at Key Stage 3 and beyond

- to use Pro/DESKTOP software freely provided by PTC to enhance and develop CAD/CAM in schools

- to ensure all teachers using the software with students are adequately trained

- to ensure all students can make maximum use of the software

- to provide an effective scheme which is well communicated to all parties

- to develop industrial links with companies which provide realistic contacts for school.

Implementation strategy for releasing the Pro/DESKTOP software
The implementation strategy established a number of features:

- accredited trainers who will allocate the license

- trained teachers to use it in schools

- flexible training patterns

- targets for implementation.

Accredited trainers are licensed to release the software; this is the only method of acquiring the software. The trainers are lecturers, teachers, advisers, employees of supplier companies and consultants. The accreditation lasts for one year. Trainers are trained at Warwick Manufacturing Group, which is part of Warwick University. The course is three-day residential and has four elements.

- Pro/DESKTOP software specific training

- future development of CAD/CAM and related technologies

- professional matters including running courses, helping schools establish implementation strategies, setting targets, using curriculum materials in school and procedures for releasing the software

- a test to assess capability in using and applying Pro/DESKTOP software and an assessment of general capability to train teachers in a professional manner.

Trainers can lose their license during the year if they make excessive charges or they fail to maintain standards in their work. The trainers receive full training documentation in paper and CD-ROM format and a copy of the software with a license to train up to 15 people at any one time. The key roles of the accredited trainers can be summarised as:

- contact for a school to obtain a Pro/DESKTOP software license

- responsible for training and advising the trainee teacher on Pro/DESKTOP

- signing off the teacher when they meet the competences, maximum period of three months

- obtaining the school targets on the proforma and the registration fee so that the full license/certification can be allocated.

Training teachers and allocating the software license
The setting of the structure for training teachers and student teachers and allocating the licenses was critical to the success of the project. Having invested heavily in training accredited trainers, the scheme has established set competences and a release strategy for the software. It decided to allow trainers to decide how best to train teachers, the key requirement was to get the teacher to be able to meet the competences. This strategy appears to have been successful; there has been innovation, flexible training patterns and overall very positive feedback. Some have placed emphasis on face to face training on a traditional course, others have worked through

a school-based approach, some have used day and evening sessions over a period of time and others have used a combination of approaches. The competences set out below show what a teacher/student has to do before an accredited trainer can sign off their trainee.

CAD/CAM competences for teachers

1   CAD/CAM in the wider context

1.1   has an understanding of the use of CAD/CAM in industry and its future developments

1.2   has the capacity to communicate this to pupils in school

1.3   is aware of a range of CAD/CAM products, including different software, that can be used in schools across a range of applications including electronics design, engineering design, product design, architectural design, graphic design and textiles

1.4   recognises the need to keep up to date.

2   Curriculum implementation

2.1   has an understanding of the design and technology curriculum requirements in schools

2.2   has an understanding of the use of CAD/CAM in different areas of design and technology

2.3   can develop and use units of work which involve CAD/CAM

2.4   can set targets for CAD/CAM implementation in schools

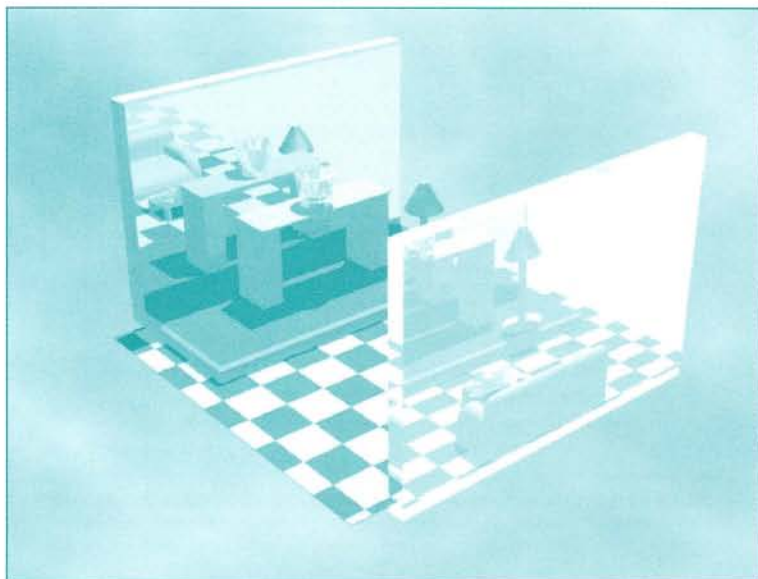2.5   can assess students' work against a set of competences.

3   Using Pro/DESKTOP and associated software and hardware

3.1   understands the nature of the software license, its use and procedures

3.2   can load and run with confidence the software on a single machine and on a network

3.3   understands how to deal with common faults and problems that may occur

3.4   can demonstrate the Pro/DESKTOP user interfaces

3.5   can demonstrate how to use the sketching

3.6   can demonstrate how to use feature modelling

3.7   can demonstrate how to use assembly modelling
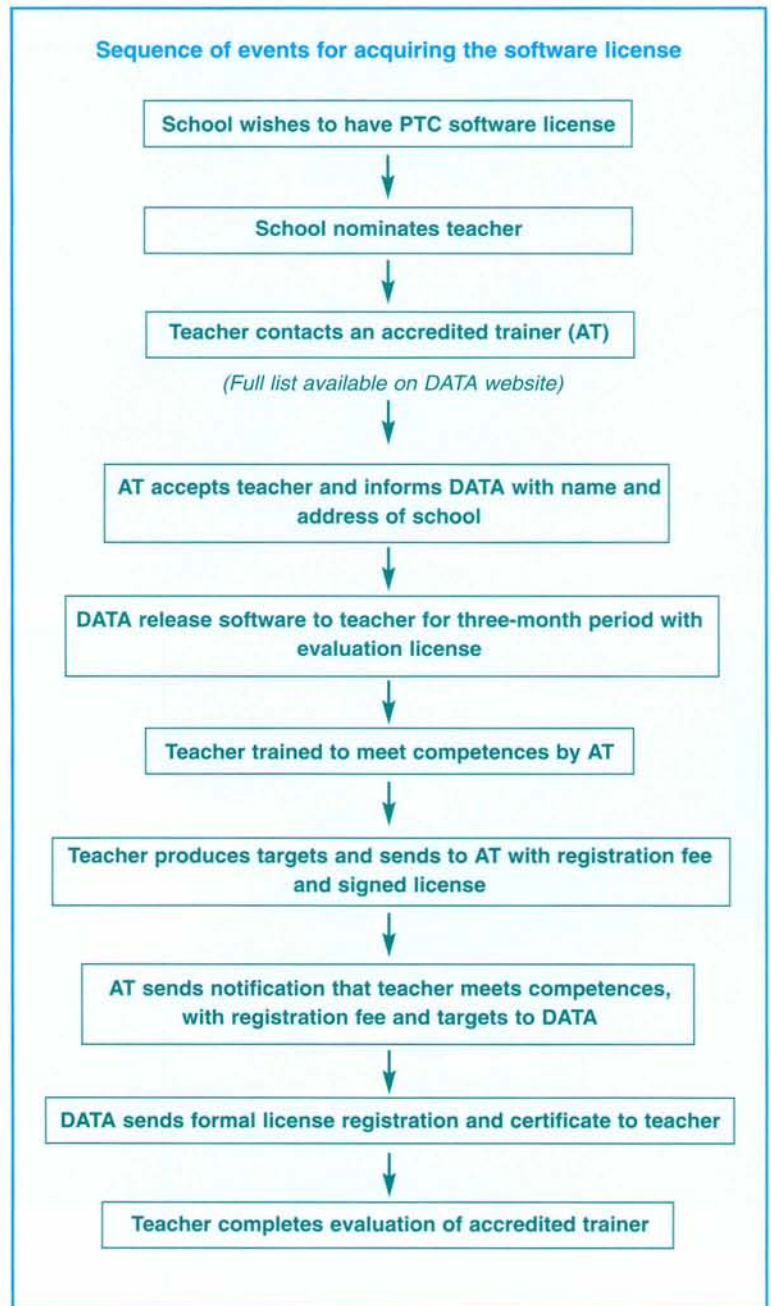
3.8   can demonstrate how to use Photo Album Rendering

3.9   can demonstrate how to create drawings and dimensioning to appropriate standards

3.10   can demonstrate how to download designs to peripherals.

The second part of the strategy was that teachers must set targets for implementation in their schools. A proforma has been given for schools to help them complete the exercise. The targets are expected to cover four areas and may be spread over a period of up to three years. The areas are:

Sequence of events for acquiring the software license

School wishes to have PTC software license

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School nominates teacher

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Teacher contacts an accredited trainer (AT)

(Full list available on DATA website)

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AT accepts teacher and informs DATA with name and address of school

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DATA release software to teacher for three-month period with evaluation license

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Teacher trained to meet competences by AT

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Teacher produces targets and sends to AT with registration fee and signed license

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AT sends notification that teacher meets competences, with registration fee and targets to DATA

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DATA sends formal license registration and certificate to teacher

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Teacher completes evaluation of accredited trainer

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Examples of student work from Wolstanton High School.

- how CAD/CAM is to be built into the schemes of work

- distinctive applications of CAD/CAM for your school

- planned level of student access and usage

- planned number of students having the software on their own computers.

DATA will use the targets set by schools to monitor the programme and carry out evaluation reports; the targets will be all filed at DATA and are made available to authorised groups such as LEAs and Ofsted. DATA maintain a full list of teachers who are accredited and all schools with the license. If the teacher moves schools then the license moves with them, as a result a number of schools have invested in another teacher being trained; equally if a student teacher is appointed to a school who does not have the software then they can register the school by drawing up targets and paying a registration fee. The school makes a one off payment of £75 together with their targets and the signed competences to DATA. The fee covers all administrative costs, certification for the teacher, website access including the students' work showcase and dealing with licensing with PTC.

Pilot programme

This programme was set up in February and March 1999 with DfEE funding. A national advertisement was placed and all LEAs were informed that the pilot was going to be established. There were 413 schools who bid to take part in the pilot project. The chosen schools ranged from rural to inner city, from large to relatively small schools, and there are mixed and single sex schools, there are selective schools and specialist colleges including language colleges and technology colleges. There were schools who were at risk as well as schools with outstanding standards and there were schools with an outstanding record in CAD/CAM and those with no experience. This very mixed group were chosen to see what effect giving schools equipment and software would have. Thirty-five schools were chosen to have 10 laptops plus software and hardware, and a further 20 schools were allocated 1 laptop plus software and hardware. All schools were given TechSoft 2D as well as Pro/DESKTOP. These 55 pilot schools could have the PTC software without training to see how they progressed. Electronics software and a range of hardware were also put into the pilot schools. These

ranged from large CNC milling and routing machines to TEP millers and Roland CAMM equipment. All of these schools set targets for the next three years.

In June 1999 the Minister Charles Clark launched the CAD/CAM in Schools Initiative at Warwick University. He stated that it was vital that design and technology moved forward with the introduction of new technologies and how delighted he was that PTC had been so generous. The 55 pilot schools were given their equipment during the summer term and received Pro/DESKTOP in September 1999. The emphasis on laptop computers was to develop the use of this software and other packages in school and at home and to see if issues of exclusion could be addressed. Charles Clark also announced additional funding to establish some CAD/CAM hubs that would facilitate local training places and to help establish a target of 150 schools by the 31 March 2000. The project had established 18 hubs, trained 101 accredited trainers and more than 800 teachers by the end of March. In addition some 45 student teachers are now part of the programme.

What has been learnt so far?

Some pilot schools have been highly successful; others have made limited progress. Schools that took training seriously and invested in staff time have been very successful with excellent work, new schemes of work and great excitement from students. Some pilot schools had perhaps too much new material and were slow to try everything, some schools had key staff who moved and disturbed the development of the programme. Schools in the pilot had been very ambitious with some targets and were therefore struggling to tackle everything. Despite the clear instruction to allow computers to be taken home it was a worry for many teachers, students were in some cases put at risk carrying expensive equipment home. The laptops were considered excellent for staff training and as flexible tools in the school, however the laptops proved not to withstand heavy use by the students. The release of software for home use had been very popular but demanding for staff and where schools did not have a technician then problems had emerged. The single most important outcome to date from the pilot is that teachers need quality time to develop skills in using the software. The other key factor to emerge is that where teachers have had the confidence to let students have the software, significant progress has been made. Some schools have begun to use students in Years 10 and 11 to act as tutors to fellow students and in one case, staff. DATA now encourages accredited

AUTOMATA DESIGN BY JAMES RADTKE YEAR 9
CARLETON HIGH SCHOOL TECHNOLOGY DEPARTMENT
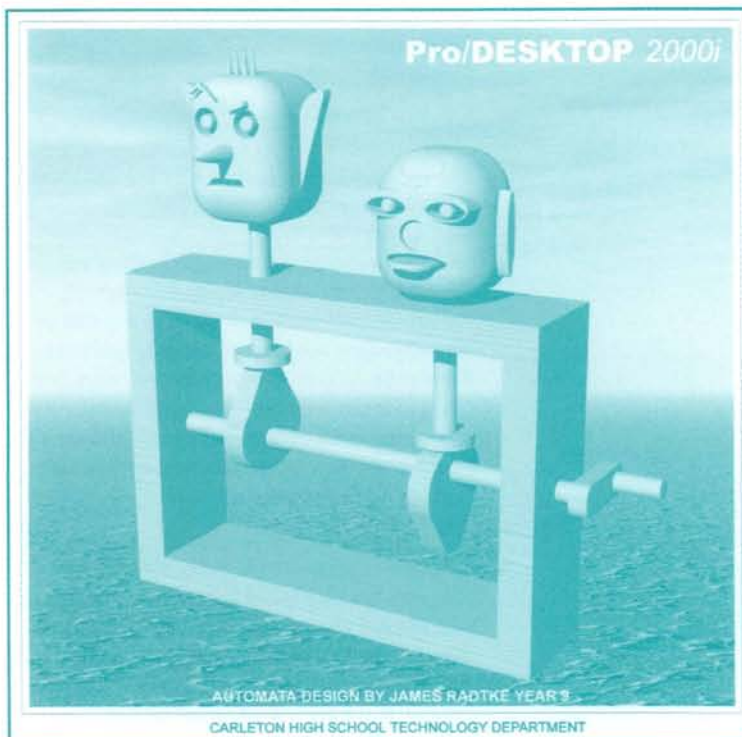
tutors to emphasise to teachers not to master the software before letting their students access the software. Schools like Theale Green, Reading, John Kelly Boys, Brent and Wolstanton High School, Staffs have produced excellent early results and already schools trained by accredited trainers such as Carleton High School in Wakefield have demonstrated first class results.

A most positive feature of this programme is the level of support from industry and the encouragement given with major innovation from companies like BAE Systems. Following major successes with the BAE Systems Euro-collaborator project being developed around the company's plants we are beginning to develop new technologies such as rapid

Example of student work from Carleton High School.

Students from John Kelly Boys School.

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For further details contact DATA or see the website www.cadinschools.org

prototyping. This we believe is the best way to develop new engineers and designers for the future, which can show creativity and innovation in the new 'e' design-based society.

The hubs have been very successful and some LEAs like Cornwall, North Yorkshire, Staffordshire and Wakefield have run comprehensive programmes and others are planning similar events for all their schools. Pro/DESKTOP is a CAD package and one of the challenges has been developing software that can be used to convert the CAD files into CAM outputs. Delcam has created MiniCAM that can be used by Boxford and Denford machine tools. A number of trainers have also created CD-ROMs to help teach Pro/DESKTOP.

Since the launch of Pro/DESKTOP a British company Delcam based in Birmingham has now offered another software package called ArtCAM free to all UK schools. We are currently training trainers for this programme and are in the process of releasing the software. At present we have trained more than 40 trainers and the software is just starting to be released to schools. This software is complimentary to Pro/DESKTOP. In addition, there are many high quality CAD/CAM products available to schools, these include TechSoft, whose software has recently received millennium products status and ROBOCAD software.

What next?

DATA is establishing a series of new initiatives related to the scheme.

- All schools who have a qualified CAD/CAM teacher and are developing CAD/CAM will be able to use the new special logo for the CAD/CAM in Schools Initiative.

CAD/CAM IN SCHOOLS

- CAD/CAM in Schools Initiative has its own website www.cadinschools.org or go to the DATA website www.data.org.uk. This contains a number of features including a showcase of students' work, a demonstration online assessment facility as well as sections for accredited teachers

and accredited trainers, plus the most recent developments in CAD/CAM.

- DATA will be establishing centres that can locally access the PTC hotline for schools.

- New posters for the project which highlight Pro/DESKTOP and Delcam software.

- DATA will be providing advice to those who will have networking problems in schools.

- The launch of the new version of the PTC software 2000i^2 towards the end of the summer term.

- Major strides are being made to work with the rapid prototyping industry to bring these new CAM products to schools.

In conclusion this is a curriculum development project that is moving extremely fast and is being very well received by schools. Clearly it has major challenges for the examination system and how students work in design and technology. Although in the short term this will cause significant problems for the subject; in the medium term and longer term it may make us begin to assess creative ability and design capability rather than currently being too influenced by the quality of presentation. This and other software packages can undoubtedly help those who have poor drawing skills or who lack confidence in presenting their design thinking. It can also be effective with very able girls who look for excellence in all their work. This is a remarkable initiative, which after eight months has had a tremendous impact on design and technology and already other countries are looking at our success. The main factors for success can be summarised as:

- a collaborative effort between DfEE, its agencies, industry, LEAs and DATA

- clear strategy and direction

- compulsory training

- enthusiastic teachers

- good publicity

- government resources

- interested and able students

- new National Curriculum requirements

- quality software packages from PTC and Delcam

- full collaboration from major equipment suppliers

- targets for implementation.