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Information communication technology (ICT) in secondary design and technology (D&T) teaching: a study of partner schools linked to a postgraduate initial teacher education (ITE) course

Marion Rutland* and Laurence Pepper+
Surrey University Roehampton*, Stanley Park High School, Surrey+

Abstract

This paper is based on a small-scale research project carried out in July 1999 by tutors and a teacher mentor of a postgraduate certificate of education (PGCE) Secondary D&T ITE course. The research examined the ICT resources available, their use in the curriculum, possible problems in the use of ICT, and inservice (INSET) requirements in a sample of nine of their partner schools working with D&T students.

The course tutors, because of concerns about the variation of ICT D&T resources available for use, initiated the research in a sample of the partner schools. In recent years there had been a marked rise in the ICT capability of the students entering the PGCE due, it was felt, to the increased use of computers on their degree courses combined with wider access and use of computers in the work place and at home.

The implications of the data collected are considered in terms of the revised Design and Technology National Curriculum to be implemented in English schools in September 2000 and the Government Circular 4/98 'Requirements for courses of Initial Teacher Training' (1998). Reference is made to the establishment of the 'CAD/CAM Initiatives in Schools', the Government-supported national computer aided design and computer aided manufacture (CAD/CAM) scheme.

The paper presents the findings of the research, draws some conclusions and makes some recommendations to address the deficiencies highlighted in the study.

Keywords: ICT, CAD/CAM, D&T, secondary, ITT, INSET

Context of the research

The use of ICT in secondary schools has a recent but relatively fast moving history in the school curriculum in the UK. In the early to middle 1960s computers were rarely seen in use in schools and few teachers had any formal training. With the increased availability of computers at the end of the 1970s, computer studies examination courses became popular and were taught in specialist computer rooms. (DES,1990a). Boyd-Barrett (1991) argues that interest was restricted to a minority of teachers, who were mostly men based in science and mathematics departments. It was not until the 1980s, with the invention of the microcomputer, that it was possible to

introduce computers into individual classrooms to support the curriculum.

The first commercial software used was often subject based computer assisted learning (CAL) which concentrated on 'drilling' children through practical exercises (Straker, 1998). It was not until the latter part of the 1980s that the use of commercial, open-ended generic software began to be introduced across the school curriculum. Developments supported by the Government in the 1980s included the Microelectronic Education Programme (MEP), Microelectronics Education Support Unit (MESU) and the Educational Support Grant (ESG) advisory

teachers. However, it was the introduction of the National Curriculum in 1990 that established a need for computers in the school curriculum. Pupils were required to use computers in their lessons to communicate and handle information, design, develop, explore and evaluate models of real or imaginary situations and measure and control physical variables and movement (DES, 1990b). Such activities raised issues of access to computers and ICT literacy for both the pupils in school and their teachers.

The latest National Curriculum document for D&T highlights the compulsory nature of computer-aided design and manufacture (CAD/CAM) in secondary schools as an integral part of designing and making (DfEE, QCA, 1999). Similarly, requirements for courses of initial teacher training state that students must demonstrate ICT specific to their subject: for example, computer-aided design (CAD) software and computer controlled equipment in design and technology (DfEE, 1998). This emphasis has been supported by the Department for Education and Employment (DfEE) through the 'CAD/CAM Initiative in Schools' launched in June 1999, which has included the provision of ICT hardware to develop the use of CAD/CAM in schools and at home. The Design and Technology Association (DATA) has established, through a DfEE grant, a process for releasing industry based software - for example, ProDESKTOP and ArtCAM - to schools through accredited trainers and teachers. Throughout these developments there has been support from a range of industries represented by BAE Systems, Jaguar Cars and manufacturers of ICT resources.

Today, the majority of D&T teachers in the UK enter the profession with a first degree in a relevant discipline and a PGCE. As mature students with industrial or commercial experience, increasing numbers of the students will have used computers in their degree, the work place and at home. In the academic year 1998/9, course tutors on the PGCE Secondary D&T course at the University of Surrey Roehampton became increasingly concerned that students were reporting variations in the types of ICT resources,

particularly for CAD/CAM activities, and difficulties in the use of ICT in their classroom practice. This was discouraging as the D&T course emphasises the development of the student's ICT capability through practical workshops in the use and application of software such as word processing, DTP, spreadsheets, databases, CAD/CAM and use of the Internet.

Research

In the summer of 1999 it was decided to use some Teaching Training Agency (TTA) funding to carry out a survey of the ICT resources and in-service requirements in a number of the University's partner schools taking D&T students in Southwest London. It had been suggested that the money should be used to fund INSET, but it was felt that there was a need to research the range of ICT resources in D&T departments and the teachers' perceived INSET needs. The money was used to release Laurie Pepper, head of department and D&T mentor, from a partner school to devise a questionnaire, visit schools, talk to the teachers and complete the survey. Nine schools were visited, all of which had a long association with the University and our students. They included boys and girls, and mixed comprehensive and selective schools.

The questionnaire (Appendix A) was divided into seven sections including CAD, CAM, electronics, control, desktop publishing (DTP)/painting packages and resources, CD databases and Internet. An initial list of hardware and software was added to when additional resources were noted in the schools. The teachers were asked about the use of ICT resources in their departmental curriculum, any problems in ICT provision for teaching and INSET requirements on the scale of a high, intermediate or starter level. The problems listed included time, cost, lack of expertise, no hardware, no software and no access to computers.

Results

The data was collated in sections based on the above headings. The final list of hardware and software in the schools can be seen in Table 1. Items marked with an asterisk were added as a result of the survey.

CAD	CAM	Electronics	Control	DTP/painting packages and resources	CD databases	Internet
Autocad 16	Boxford	Crocodile clips	PIC	Coral Draw	Focus on Food *	Department access
Autocad LT	Denford	PC Wizard	TEP	MS Publisher	Nutritients *	
Autosketch	TEP	Easy PC	Economatics	Power point *	Images *	
Turbocad	Economatics *	Electronic WB	Logicator *	Style *	TEP GCSE *	
Cadvance	Emco Compac 5 *	PCB Designer	Lego Datca	PageMaker *	Examination Boards *	
2D Design	Lathe	Lin Cad *	Commotion *	Claris works *	Own CD *	
Micro Graph Draw*	Mill			Photopaint *	Focus on materials *	
Claris Draw *	Router			Paintshop Pro *		
Swivel *	Sewing machine			Digital camera		
Draw plot *	Loom			Photo Enhancer *		
Artworks *	Vinyl cutter			Adobi Photo *		
Techsoft Netts *	Roland CAM 2 *			Photo draw *		
PTC Pro *	Tec Soft			Video camera		
	Alpha Cam *					
	Robot arm *					

Table 1 ICT hardware and software in partner schools.

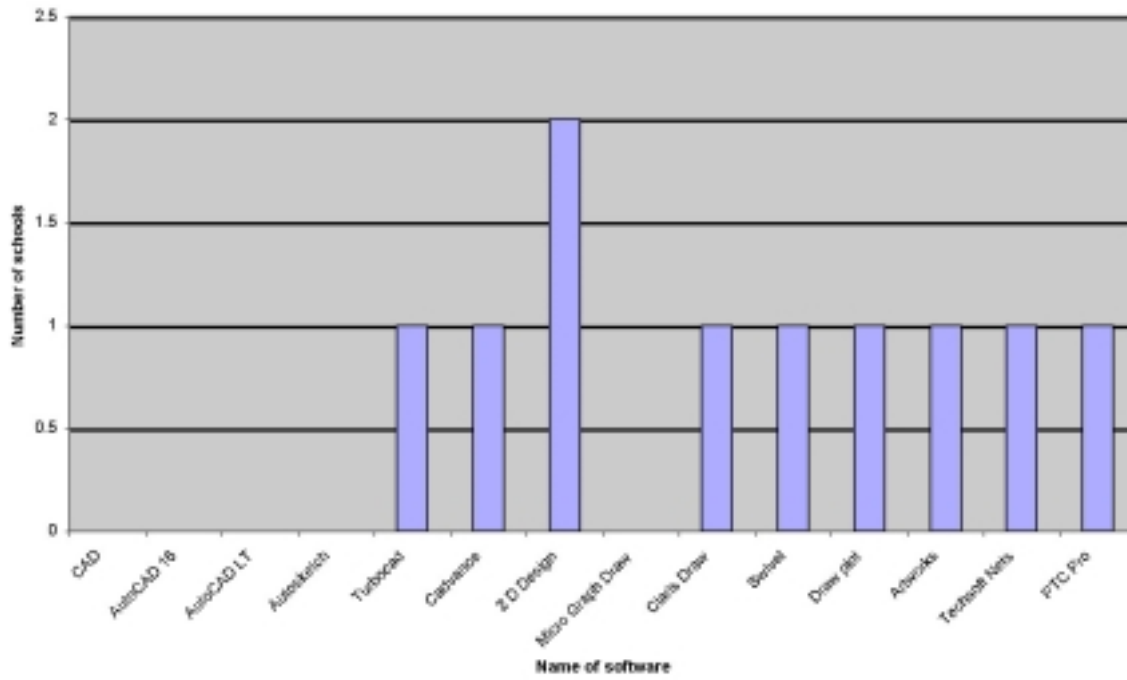


Figure 1 CAD software

CAD

The range of software used was broad and varied (Figure 1). CAD software was in use in only five of the schools across the age range 13 - 18 years. Two schools used 2 D Design with very few schools using the industry-based software. Cost and lack of software were identified as problems by three schools, and

lack of hardware in two.

INSET needs

INSET at intermediate and starter level for AutoCAD LT and 2D Design were identified as a first priority in the same two schools. Four schools were interested in intermediate level INSET for 2D Design, but it was not their first

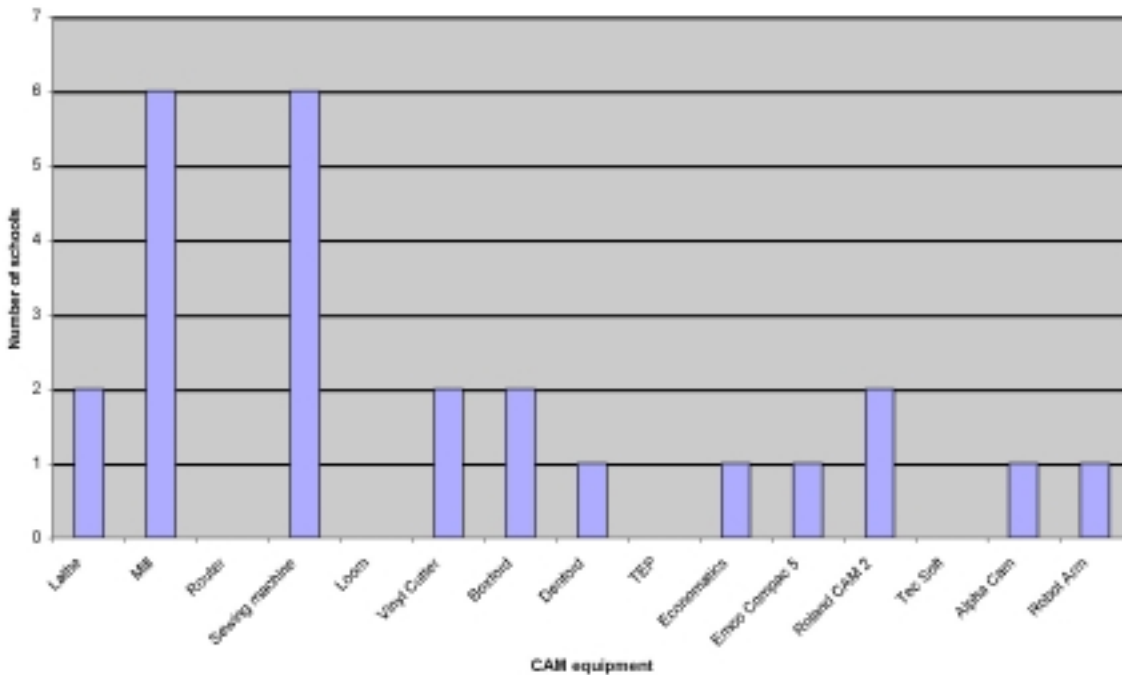


Figure 2 CAM equipment

or second priority.

CAM

CAM equipment was in use in six schools across the age range 11-18 years, with milling machines and CAD/CAM sewing machines scoring the highest use (Figure 2). One school reported a CAD/CAM sewing machine they did not use. The range of equipment manufacturers represented was wide. Lack of hardware was identified as a problem by four schools, cost by two and lack of expertise and software by one.

INSET needs

INSET training on the use of CAM equipment was highlighted as a key issue, made difficult by the range of manufacturers involved. These included Denford and Tec Soft equipment by two schools as an INSET priority at intermediate level, and Technology Enhancement Programme (TEP) equipment at a starter level. Three schools expressed interest in training on Boxford, Economatics and TechSoft equipment as a second priority at intermediate level. Two schools expressed interest in INSET training on CAD/CAM sewing machines, but not as a priority.

Electronics

It is of concern that three schools (Figure 3) had no electronics software, two had some but did not use it, with only three using it across the full age range. Lack of hardware was identified as a problem by five schools, lack of expertise by three schools and cost and lack of software by one. Crocodile Clips and PC Wizard proved to be the most popular choice of software.

INSET needs

INSET requirements were higher in this section. Two schools identified a first priority for INSET using Crocodile Clips and PC Wizard at a starter level with two other schools as a second priority. Five schools at starter and intermediate level expressed interest in INSET in the use of Crocodile Clips and PC Wizard, but not as a priority.

Control

It was noted that there were no programmable integrated chip (PIC) resources in any of the schools. Lego Dacta was found in four schools, used by science and IT in two schools, followed by Logicator in two schools (Figure 4). Only four schools were using their control

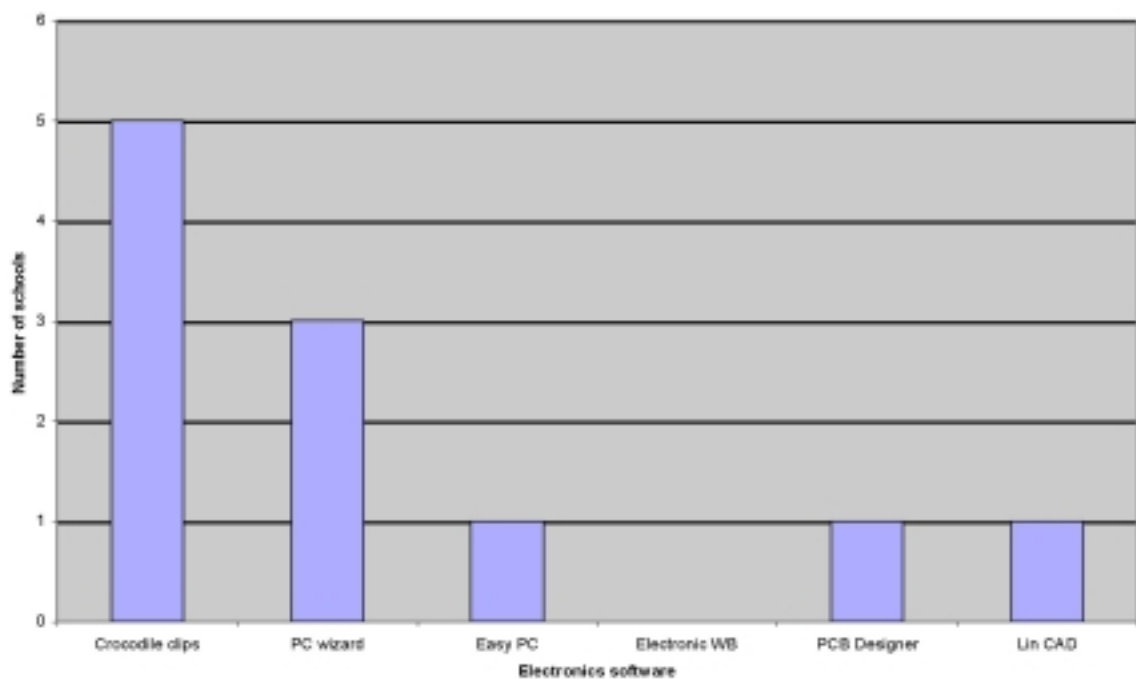


Figure 3 Electronics software

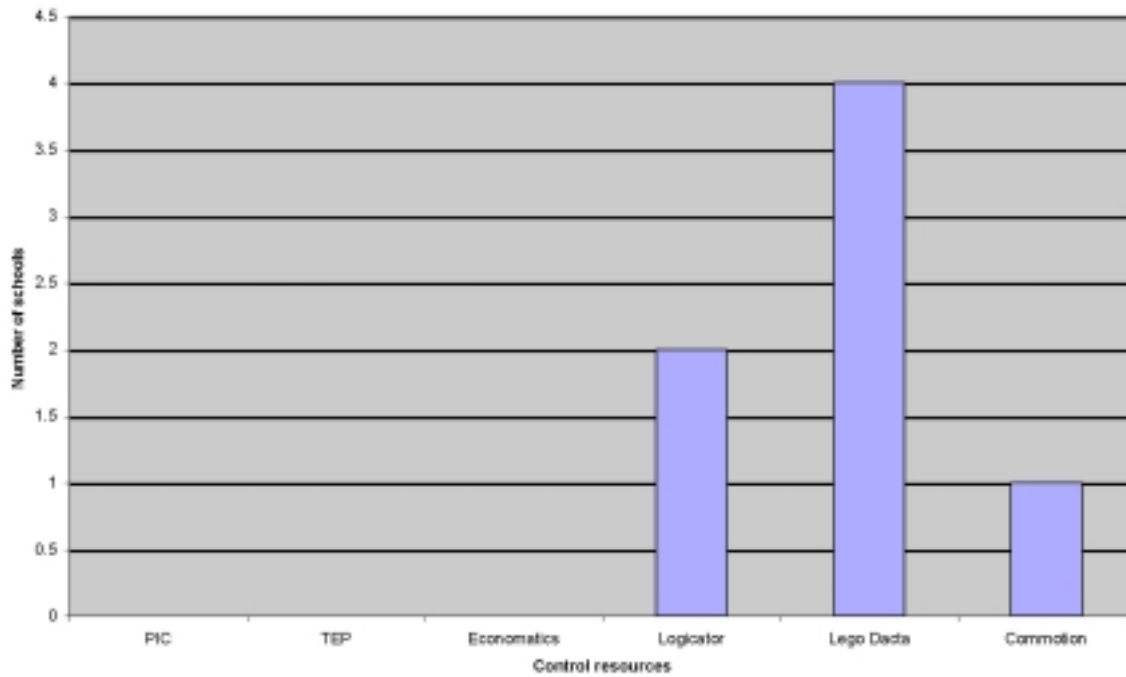


Figure 4 Control equipment

resources across the full age range. Lack of hardware was identified as a problem by three schools, followed by cost and lack of software by one.

INSET needs

Despite the apparent lack of use of their control resources, only one school requested a second priority high level, and two schools

a second priority intermediate level, INSET for Logicator. No school indicated a high priority for INSET in control.

DTP/painting packages and resources

This group (Figure 5) contained a wide range of software and resources used to produce pictures and graphics from DTP, graphics and painting packages. This was the only section

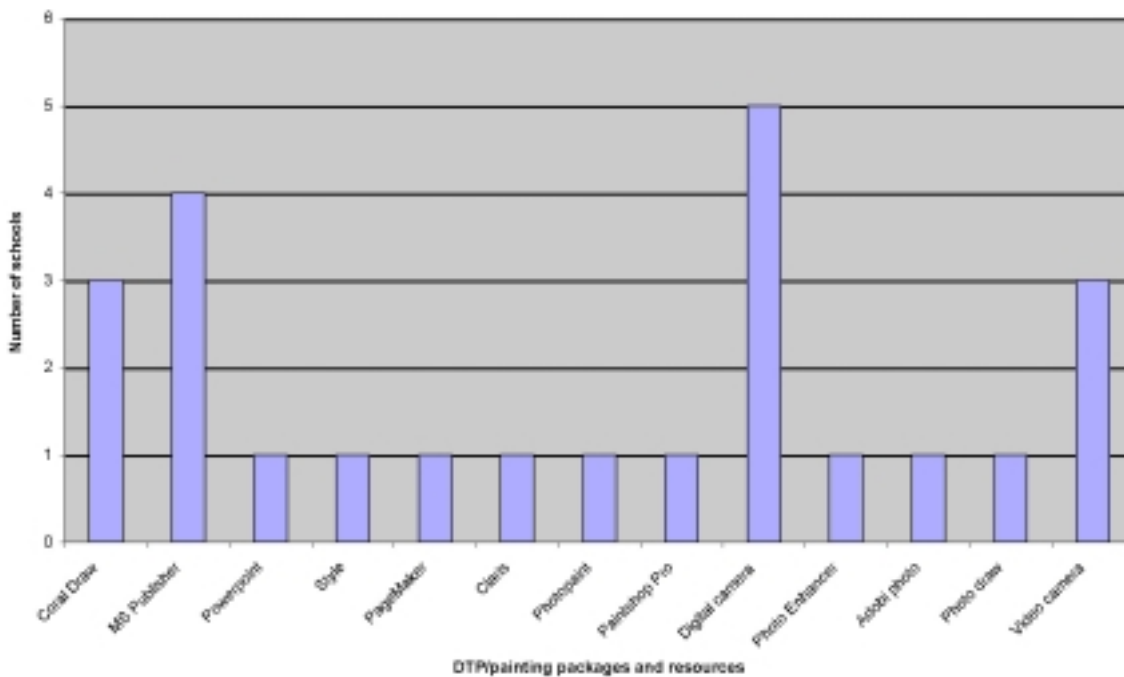


Figure 5 DTP/painting packages and resources

where all the schools had desktop publishing software and used it across the full age range of their curriculum. The digital camera was in use in five schools, particularly for recording course work for examination courses. Three schools had a video camera. Problems in this section were limited to cost by two schools and lack of expertise by one.

INSET needs

Schools appeared more confident in this section, with requests for INSET very low. One school identifying the use of the video camera, but this was not as their first or second priority.

CD databases

A limited range was found in use in schools with materials based CDs in three schools, food analysis CDs in three school and TEP CDs in two schools. CDs produced by examination boards for revision were found in one school (Figure 6). Two schools had none. As a rich research, analysis and revision resource for pupils this is disappointing. No school identified any problems in this section.

INSET needs

No INSET needs were given as first or second priority in this section. One school was

interested in INSET on the use of nutrition based CDs, but not as a first or second priority.

Internet

Six schools had Internet access at school level, and one school expressed a need for starter level INSET as a first priority. No school had access at departmental level, making the use of the Internet as a research tool in the classroom difficult to achieve. Lack of direct departmental access was identified as a problem by seven schools.

Conclusions

The use of computers is now established as an important aspect of teaching D&T in schools, with CAD/CAM as a high priority. These developments result from Government directives and support and a commitment from the D&T teachers in schools. It is recognised that the survey is based on a limited number of schools in one area of the country and for one PGCE ITE provider. However, it has been very useful in providing information for the D&T tutors on the range of ICT software and resources in the partner schools. It has been used to identify deficiencies and make recommendations to support the development of ICT activities for our students and teachers in schools.

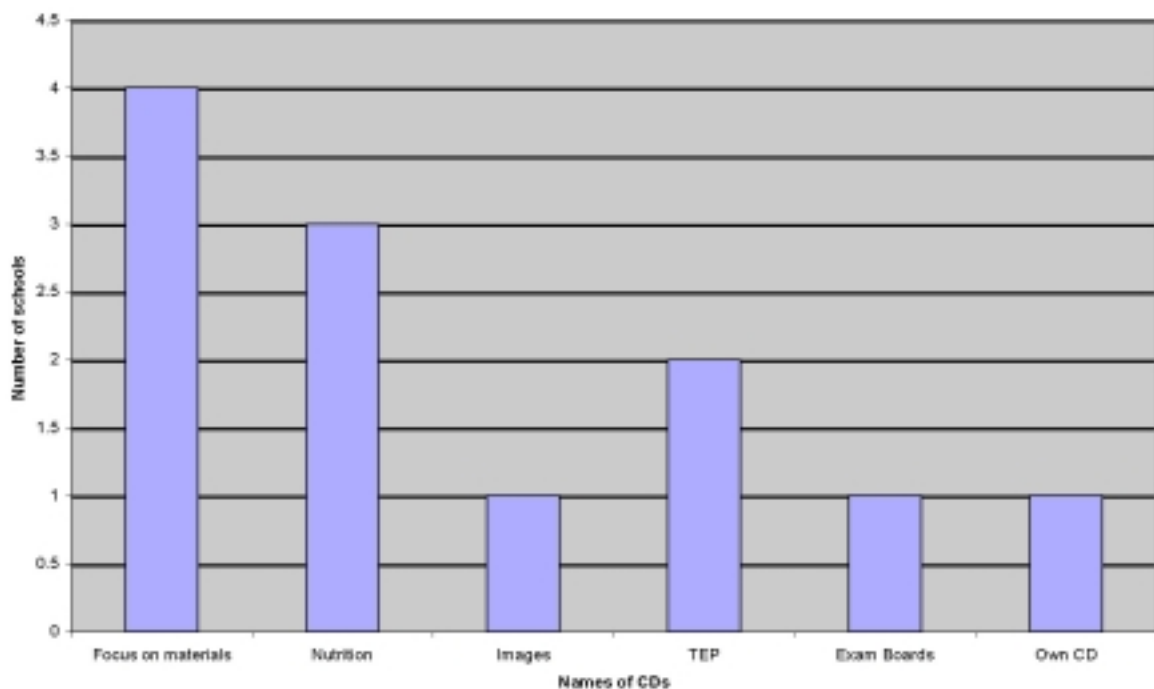


Figure 6 CD databases

The findings indicated that:

- CAD was not well developed in the schools, with only five of them integrating it into their curriculum. There was no pattern of the use of specific software and little use of commercial and industrial software. A need for INSET was identified but it lacked a focus.
- Schools had a broad range of CAM equipment, but a lack of hardware, expertise and money were highlighted as problems in this area. INSET needs were identified for training on the use of equipment, but because of the variety of machines it lacked a coherent pattern.
- Electronics software was not widely available and its use in the curriculum was restricted to a small number of schools. Lack of hardware and lack of expertise were identified as problems in this area. INSET needs focused on the use Crocodile Clips and PC Wizard.
- The recently developed PIC control resources were not found in any school. Generally, control software and hardware were available schools but they not widely used in the curriculum. Despite this, INSET needs were not identified.
- Generic software, such as desktop publishing packages, proved to be widely used in the partner schools. The use of the digital camera to record D&T activities for examination work was noted.
- D&T CD databases, though a rich sources for research and analysis, are not widely used in the partner schools.
- Internet access is available in the schools but not in the D&T departments.

Recommendations

- To focus on the areas of CAD/CAM as a first priority for PGCE students and for INSET for our D&T mentors.
- To encourage the use of CAD by PGCE students and schools. To make the industry based CAD/CAM software ProDESKTOP and ArtCAM available to our PGCE students and mentors in our partner schools through accredited training.
- To encourage increased use of CAM by

PGCE students and schools. To set up a partnership with industry and establish a centre at the University of Surrey Roehampton for PGCE students and partnership schools to develop CAD/CAM manufacturing through video conferencing.

- To encourage schools to develop expertise in the use of their CAM equipment.
- To focus as a second priority on developing the use of electronics software and hardware by PGCE students and schools. To offer INSET on electronics software to schools to encourage its use in the curriculum and increase the teachers' expertise.
- To develop sessions for the PGCE students on the use of PIC control resources in the curriculum and encourage teachers to explore this new area and attend INSET.
- To increase the PGCE students awareness of the potential use of CDs in the teaching of D&T.
- To encourage schools to lobby locally and nationally for additional ICT resources and training for the teachers, including Internet access within the D&T department.

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Appendix A

School

Software and Hardware	√	School Curriculum - used in Years -	Problems	√	INSET High	INSET Inter	INSET Start	Comments
CAD								
Autocad 16			Time					
Autocad LT			Cost					
Autosketch			Lack of Experience					
Turbcad			No hardware					
Cadvance			No software					
2D Design			No access to machines					
CAM								
Boxford			Time					
Denford			Cost					
TEP			Lack of Experience					
Economatics			No hardware					
Emco Compac 5			No software					
Roland CAM 2			No access to machines					
TecSoft								
Alpha CAM								
Robot Arm								
Lathe								
Milling machine								
Router								
Sewing machine								
Loom								
Vinyl cutter								
Electronics								
Crocodile clips			Time					
PC Wizard			Cost					
Easy PC			Lack of Experience					
Electronic WB			No hardware					
PCB Designer			No software					
Lin CAD			No access to machines					
Control								
PIC resources			Time					
TEP			Cost					
Economatics			Lack of Experience					
Logicator			No hardware					
Lego Dacta			No software					
Commotion			No access to machines					
DTP								
Coral Draw			Time					
MS Publisher			Cost					
Powerpoint			Lack of Experience					
Style			No hardware					
PageMaker			No software					
Claris works			No access to machines					
Photopaint								
Paintshop Pro								
Digital camera								
Photo Enhancer								
Adobi Photo								
Photo Draw								
Video camera								
CD databases								
Focus on materials			Time					
Nutrition			Cost					
Images			Lack of Experience					
TEP			No hardware					
Examination Boards			No software					
Own CD			No access to machines					
Internet								
Departmental access			Time					
			Cost					
			Lack of Experience					
			No hardware					
			No software					
			No access to machines					