Teaching Computer Aided Architectural Design
Problems of Identity and Support

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Introduction

A recent survey carried out in the U.K. [1], which identified the activities in the majority of the Schools of Architecture in the field of CAAD, broadly indicated that whilst most of the schools provided a taught course in CAAD, the nature and extent of the content varied significantly. In many cases, student participation in CAAD was entirely voluntary, whilst in other cases a considerable amount of time was allocated within existing course structures.

Guidelines, issued from the respective examining bodies, CNAA [2] and RIBA [3] relating to the course content, have hitherto been vague or non-existent, and whilst some criticism regarding lack of coverage has recently been published by CNAA [4], it appears that there is some misunderstanding, at least by the RIBA, as to the extent of CAAD in relation to the needs of professional practice.

The computing resources available at the different schools clearly have a bearing on the extent and nature of their courses. Some schools in the U.K. have been engaged in CAAD for over ten years, and as a result have amassed a great deal of equipment and expertise; others have entered the field more recently, and in the prevailing economic circumstances, find it difficult to catch up to the levels of the more established courses. The conflict between limited amounts of equipment and large classes nearly always constrains the extent of student involvement.

Lastly, the position of CAAD within the overall course structure, and the attitude of other members of staff towards new technology, largely determines the 'timeslot' available for CAAD teaching. After all the other subject areas have been covered in accordance with course requirements (and personal preferences) it is difficult to find the expensive timescales required to allow students to acquire a reasonable depth of practical knowledge in this area.

From discussions held at a recent conference [5], it is apparent that many UK schools of architecture are experiencing these problems, and it is the purpose of this paper to relate some of the difficulties related to the teaching of CAAD in the Department of Architecture and Landscape, Manchester Polytechnic, one of the larger TJK schools, and the means by which we are attempting to overcome them.

Background

The CAAD course at Manchester Polytechnic is designed to cater for both undergraduates and post graduates in the Schools of Architecture and Landscape Design. In addition, the Department offers teaching and CAD support facilities, on a more limited basis, to other units in the Faculty of Art & Design, notably the Schools of Interior Design and Product Design. The total number of students supported is around 300. Additionally, last year, we instituted a mid-career CAAD course for local architectural practitioners, which ran for ten weeks, one evening per week and which proved to be very popular. Further courses of this type will be run in the current academic year.

The computing facilities and support for these activities are split into three main areas, two of which are departmentally based, the third centrally administered.
The hub of the Department's computing resource is located in a small computer workshop ($60m^2$) on the ground floor of the School of Architecture, one half of which contains a range of business microcomputer systems, the other a range of VDU/GDU terminals connected by landline to the Polytechnic computer system consisting of PRIME 850, 750 and 2550 processors. Secondary points of access to the systems, in the form of VDU terminals, have been introduced on each of the design studio floors and which connect, via our local area network, to either the central system or to processors in the workshop below. It is thus now possible to carry out non-graphics applications from the studios up to the time at which the building closes in the evening. The third resource, which is located in the computer building a short distance away, is a stand-alone graphics terminal running a simple perspective drawing package. In specific circumstances, for example, special short courses, it is possible to borrow this equipment to have available 'in house'.

Staff and software support, tends to pose some difficulties with respect to the computer workshop, particularly since Polytechnic regulations demand that a member of academic staff is present whilst students are working. Even the presence of a technician - if we had one - would not obviate this problem, so in common with many other schools of architecture, the main difficulty is one of staff availability.
Bearing in mind the size of the Polytechnic, (approximately 10000 students), the central Computing Services Department struggles to support the various software systems within its own domain, without extending its interests to specialist departments. The nature of architectural applications, particularly graphics, largely excludes them from all but the most basic support, and the high cost of multi-user CAD software, and its associated maintenance implications render it an unattractive purchase when considered in competition with other departmental requirements.

CAAD Course Philosophy

It is our philosophy that CAAD is a constituent part of architectural practice and education, and that it should be considered in the same context as other design aids - to be used when required, but not to the exclusion of other subjects. We are also of the view that students should be exposed to a range of different systems, both hardware and software, so that on entering architectural practices possessing computer aided design facilities, they will already be familiar with some of the systems encountered.

We also take the view that all students in the school, particularly those in the earlier years, should be given a sufficiently detailed knowledge of the facilities available from CAAD to enable them to try out the various techniques during their course. Generally, this involves a minimum number of lectures and tutorials in first and second year, but elective, or optional projects thereafter.

As a result of these philosophies, the CAAD courses in the Department are 'applications orientated', that is to say, computer utilisation by the various year groups is primarily concerned with running 'off the shelf' commercial program , rather than programming or developing software. The hardware in use also tends to reflect this, and is therefore dominated by a range of the most commonly available business microcomputers, namely: Apricot, Sirius, IBM-PC, Olivetti and Dec Rainbow. These run wordprocessing, spreadsheet, database and other, more specialist applications such as Environmental Services, Critical Path Analysis, Structures, Drainage, 2D Drafting etc. A number of different software packages of the same generic type are available for comparison. This, together with the diversity of hardware, has proved extremely useful in highlighting the various advantages and disadvantages of different hardware and software combinations, particularly with respect to the mid-career courses, although it does lead to a somewhat complicated system support problem.

As far as possible, other members of staff are encouraged to support, and teach, their own particular applications packages, and in recognising the difficulties of finding the requisite time and solitude for such an exercise, our present practice is to lend out the Apricots to staff for use during the vacations. Although it is too early to assess the effectiveness of this action, it has, at least, enabled a dozen or more colleagues to explore some of the facilities offered by our systems, and at the same time, contribute to their own 'staff development'.

Research within the department is encouraged, and although research posts in the Faculty are scarce, several applications have met with success, the most recent in CAAD being Microbe [6]. Other departmentally based research projects, not necessarily CAD, are given access and support wherever possible.

Course Structure

The first and second year students of both the Architecture and Landscape schools commence with a short, 6 week, introductory lecture series which is followed by tutorials (typically 10-12 hours) in the computer workshop. In the first year the introductory lectures will cover the principal CAAD application areas, hardware configurations and basic terminology, and will be followed by a project-related exercise which utilises some of the computing facilities available. Generally, the architecture students use the environmental services software, and the landscape students axe be introduced to the plant manual, a computerised database numbering over 400 specii. As a further incentive to using the facilities, and to aid keyboard familiarity, all students are encouraged to make use of the wordprocessing facilities for producing their C.V.'s, dissertations, essays etc.

The second year students follow a similar format, where the lecture courses extend to a discussion of more detailed application areas, operating systems, local area networks etc. A further project related workshop session follows, thus extending the students knowledge of the various systems. At this stage, as part of their planting design project, the landscape students each research and input two plant specii to the ever-increasing plant database. This latter contribution has been of considerable benefit to Department and students alike, since it replaces a manually operated system which could not, as now, be passed down from year to year. Third year for the architects is their year out in practice, hence the necessity to ensure that, by the end of second year, each has at least a passing acquaintance with CAAD systems. The third year landscape students have not yet been through the new 'system', but it is envisaged that their involvement will encompass the larger systems running the graphics packages such as GDS [7]. Fourth year architecture students, on their return from practice, follow a similar route.

By this stage most students have sufficient knowledge in the use of the systems to operate them independently when required, under the guidance of the member of staff responsible for that application area. Options, or elective studies, are also introduced at this point in the courses, enabling some students to concentrate on specific aspects of CAAD, possibly programming. A typical options period lasts for 6-8 weeks, and in some cases, a whole term, and usually provides sufficient opportunity for an in-depth study culminating in a dissertation, a working computer program, or some other exposition of CAAD. Due to limited resources, a maximum of six students, at any time, can benefit in this way.
Post-graduate students tend to use the system on an 'ad hoc' basis except in the case of options previously referred to. Utilisation is, governed largely by the nature of the studio projects undertaken. but 2 and 3D graphics and environmental calculations seem to be the favourites. No other formal CAAD teaching is undertaken at this level of the course.

Identity

One of the most interesting problems facing the integration of CAAD within architectural courses is that of where to locate it in the curriculum. Whether a school decides to treat it as a separate topic, or merge it into one of its existing subject areas, depends largely on the relative importance accorded to it by the institution concerned.

Since computer aided architectural design has evolved from primarily technical roots it is not unusual to find it encapsulated within the technology content of the course. To the purists this relationship might be said to satisfy the 'computer aided' part of the title, but what of the 'architectural design? The other extreme seems to involve incorporating it with subject areas such as Design Methods, or Design Theory, thereby affording it a higher plane of reference than that implied by mere 'number crunching'. In practice, however, the ability to provide working examples of design orientated software to illustrate the theoretical subjects discussed, is severely constrained.

Whatever the name, it is clear that there is little concensus regarding the role of CAAD within architectural courses, nor is there much guidance coming from the academic and professional bodies with respect to its future development. Whilst we are continually reminded of the importance of introducing 'information technology' within our course structures, those of us involved with its development often find ourselves fighting a lone battle for more lecture/workshop time, financial resources, technical support, etc., in an arena where no-one appears willing, or able, to define the boundaries. Perhaps, as an example of the subject's nomadic nature, I should admit that, during my ten years at Manchester Polytechnic, CAAD has been associated with no fever than four different subject areas! It started under the auspices of 'Design Methodology', graduated to the heights of 'Design Theory', narrowly escaped a merger with 'Communication Studies', and has finally realigned with 'Technology'.

Identity of purpose is important if meaningful coordination between the different subject areas is to be achieved. in a subject as wide ranging as CAAD overlaps are inevitable, indeed they are desirable, but without a consider amount of organisation any computer aided design input can soon become isolated from design and project work - the very subjects it seeks to assist. As well as coordination, cooperation is required, particularly in the context of exchanging studio time for 'lab time', - always a difficult problem! It is here that the understanding, or otherwise, of the relevant board of study can most noticeably affect the support required, and ultimately the progress of the course. Many architectural staff are unaware of the amount of integration required between CAAD and "real" design work, and tend to regard it as a wholly separate subject area. As a result they may dissuade their students from more extensive participation in CAAD lest they be considered to be 'wasting time'.

Support

During a typical academic year, all of the 300 students on the various courses spend time in the computer workshop, and the logistics involved in ensuring that the appropriate facilities are available at the right time are considerable. First and second year classes, which tend to number around 45 students, pose the biggest problem, and the normal approach is to divide the group into smaller units of 10 or 12. Using our six Apricots, and alternating the groups between morning and afternoon sessions, it is usually possible to cover, for each year group, the requisite ground within a week -other commitments permitting. In real terms this means each student spends only 3-4 hours 'hands on'.

At the 'mainframe' end of the workshop applications tend to divide into two groups:- large databases and graphics. These too are 'off the shelf' packages, and with the exception of the 'stand-alone' graphics terminal which runs a 'home made' perspective drawing program, are supported by the Computing Services section. The INFO [8] database package is used largely by the School of Landscape for the plant database, and the recently installed GDS drafting system is used by the post graduates and students on options projects. The emphasis however, remains firmly with a 'plug in and go' approach.

In the first two terms, the computer workshop is scheduled for use 4 days a week, two of which are for formal classes, and two are 'free for all' where terminals or micros can be booked by students in advance, or used on an 'ad hoc' basis. The fifth day, which seldom survives intact, is for maintenance, software support, and staff development. In the third term, which is reserved mainly for 'options' and the development of final design projects, the workshop is less densely populated, but because of the increased scale of the work, more intellectually demanding!

The most acute problems are those of software support and staff development. The difficulties, and time demands, of software appraisal, selection, commissioning and assimilation, need no introduction to CAAD workers. Because of our departmental policy of providing as wide a range of systems as possible, the benefits of standardisation seldom apply. Although we do not seek to explore operating systems or languages to any significant extent, each software package acquired needs to be studied in some depth before it can be put on general release. This is particularly true of commercial packages which have to be encapsulated in a 'foolproof' shell to avoid necessary operator malfunction! It is in this context that the other members of staff are encouraged to assist with those items of software which reflect their own teaching interests. In common with other schools of architecture, most staff involved with CAAD teaching have more onerous commitments in other design areas, so that opportunities for experimenting with new products are severely limited. Although professional training courses are available for many of the software packages on release, their cost is high, and the likelihood of staff being able to spend, or three days away from normal duties is negligible.

One might expect an alternative source of software support to come from the Polytechnic Computing Services Department, but due to the size of the campus (10000) students, the shortage of programming staff and the specialist nature of CAAD applications, particularly computer graphics, only a minimal level of assistance from that source is possible.

Apart from the 'Project Assistant' or 'Research Assistant' posts, a very rare appointment - and a temporary one, no one has yet provided a satisfactory solution to the architectural software support problem. The ideal combination would be an architect/programmer, highly skilled in computer graphics, employed at a technicians salary!
Beyond the 'fringe' benefits which do accrue as a result of CAAD research within an institution, there is little in the way of 'off the peg' software which seeks only to demonstrate basic concepts of a particular application area. The only alternative to further staff involvement in program development is to buy the fully fledged commercial packages, if they are available, and accept that they are, in the majority of cases, far more sophisticated than the need demands. One avenue of approach to relieve this problem is to approach dealers or software vendors who are prepared to supply demonstration copies of their software. Some of this software, whilst having a reduced capability, is perfectly adequate for teaching purposes. We have adopted this solution in a number of cases, particularly in respect of software which we know will be used infrequently, and for demonstration purposes.

Hardware and software availability notwithstanding, CAAD teaching is, as they say in the airlines, a 'bodies on seats' business. No student has ever learned much without spending a considerable amount of time using the systems in a working situation. Because of this, and the time involved, there is always the danger of a clash with other subjects. Partly as a result of limited equipment, but largely to avoid denuding the studios of students, we have instituted a rota system whereby 4-6 members of a particular year group take time out from studio to work on CAAD projects. This has worked well so far, and is a sufficiently flexible arrangement to allow for exchanges to be made if necessary. The disadvantage, from a staff viewpoint, is that it is labour intensive, and because of the extended timespan, is difficult to link to ongoing projects.

Perhaps the most successful solution to many of those difficulties is to integrate CAAD more closely with project work, but over a longer period. In this way students can maintain a more direct interest, and other staff can contribute their own specialist interest or expertise. The crux of the matter is to demonstrate that CAAD can assist at levels of the design process, and that to do so will not involve a significant erosion of time from other commitments.

Summary

During the development of the course at Manchester Polytechnic a number of factors have proved to be more effective than others in improving CAAD teaching.

Apart from a general increase in hardware availability, particularly over the last two years, it has been the shift in emphasis from theory to applications, and from mainframe to micro, which has had the most significant effect. A further improvement in CAAD literacy has been achieved by introducing the subject in the first year of the course. This, coupled with project work, has done more than any other to dispel the myth that computer aided design is only for specialists. The most frequently heard comment from first year students is that it was 'nowhere near as difficult as I thought it would be'.

Keyboard for keyboard, the transition to microcomputers with their extensive range of cheap business software, has provided the department with a much more cost effective per capita resource than the central mainframes, even although we still use the Primes, with their cumbersome operating systems, for the 'number crunching' applications.
The adoption of commercial business microcomputers, rather than the smaller, schools orientated machines such as the BBC micro, has simplified the task of obtaining appropriate software, and the transition to IBM and IBM compatibles such as the Olivetti M24 is significantly extending software availability and thus reducing development time. The introduction of our local area network system, VNET [9],[10], has provided an extremely flexible and powerful communications resource, although it has to be admitted that it is still not very tolerant of misuse, particularly by the more remote stations.

Initially, the introduction of CAAD to all students in the department posed massive staffing problems which could never have been adequately resolved by one person. Fortunately, one of the staff from the School of Landscape began to take an active interest in developing CAAD for landscape, and was able to take on some of the teaching duties in that area. Latterly, as a result of our 'micros on holiday' scheme, more members of staff are beginning to get involved with CAAD, within the context of their own subject areas.

For the future, although the migration of terminals, from the workshop to the studios, has already started, we intend to this trend, and, security conditions permitting, to include the micros in this exodus. Efforts are also being made to more 'design orientated' software, so that a more complete applications spectrum can be covered. Only time, and determine whether those aims are achieved.

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