The BEATL Project: embedding appropriate CAL in the teaching of Architecture

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This paper is based upon the premise that Computer Aided Learning (CAL) has been poorly integrated into schools of Architecture and it identifies some of the barriers that have prevented this. The Built Environment Appropriate Technology for Learning (BEATL) project aims to promote a climate of change within which these barriers can be crossed.

The focus of BEATL is on providing a framework within which technology assisted teaching can be adopted for particular elements of taught courses through a process of module pairing, and collaboration between Built Environment faculties at three UK Universities. The paper discusses the early stages of the Project and outlines the methodologies developed for embedding and transferring innovations between institutions, the support of 'Educational Technology Officers' and the evaluation strategies being utilised.

Early results indicate the benefits of a focus on a individual element rather than a whole module and that generic innovations tend to be more successfully transferred than 'off the shelf' Computer Aided Learning products.

Keywords*: CAL, Integration, Transferability, Collaboration*

Chequered History of CAL integration in schools of architecture

In many disciplines Computer Aided Learning has grown in prevalence as a means of enhancing student learning and aiding the teaching process. Educationalists including Laurillard (1993) conclude that many of the traditional methods of teaching and learning are not the most effective means of course delivery. For example the lecture, whilst being economical in terms of staff resources (one staff member can deliver a course to hundreds of students) does not allow for a great degree of interaction between the lecturer and the student, and tends to be a form of passive information transfer. This can lead to a surface approach to learning, where students often take facts "as they are" with little opportunity to engage with the materials in a critical manner.

The traditional alternative to the lecture is the seminar or group tutorial. Here students are in smaller groups, and therefore interaction between student and tutor is likely to be better. This facilitates a level of critical discussion that is difficult to achieve with larger groups and enables students to engage with materials in a much more active manner. There is a particular emphasis on this method of teaching within Architectural Education especially within the design studio. Small group teaching has inherent resource implications, as it requires a greater input of tutor time per student. At a time when student numbers are growing relative to staff, as are pressures to spend

more time carrying out research, the tutorial has become a more expensive option and is often abandoned in favour of lectures to larger groups (Dearing 1997).

For a number of years the UK Higher Education Funding Bodies have seen Computer Aided Learning (CAL) as a possible solution to this problem of increasing student numbers. Students can work independently, assisted by computer. This enables a greater degree of tutor time to be allotted to those students who may have particular problems. Aside from the purely economic arguments for using CAL, a good quality package can also offer pedagogical advantages:

- Students can progress at their own pace and revisit those areas that may be causing difficulties;
- Students are able to explore the subject in a non linear manner visiting areas that are of particular interest and recognising links between particular areas;
- Students can obtain immediate feedback on their understanding of a subject, through the completion of computer based formative assessment tests. This feedback can suggest where further work could be carried out;
- It allows new experiences to be simulated that may not be possible within the real world, including those that would be too dangerous or costly for real life experience, or would happen over an excessive time span. Students can swiftly grasp the consequences of changing particular parameters within simulations;
- A number of CAL packages take students' preferred learning styles into account, and tailor the learning experience to that effect;
- It can assist students to conceptualise abstract ideas through graphical visualisation in ways that would be difficult using other media;
- It may improve access to materials for those who would be otherwise disadvantaged and fosters potential for distance learning.

On these grounds the UK Higher Education funding bodies have made available £35 million over the last decade to establish an array of high quality computer based learning materials available at cost price to all UK HE Institutions. This was principally undertaken through the Teaching and Learning Technology Programme (TLTP) phases 1 and 2 whereby 73 consortia of departments across the UK were funded to develop courseware for their particular discipline.

It would be fair to say that the results of the TLTP programme have been mixed and whilst a number of excellent pieces of courseware were produced, a large number of poor quality examples were also created. Software was often naive in its pedagogical approach, paying little attention to established research in the area. Many products tended to promote a passive approach to learning, with little useful student interaction. Often materials were created that could have been taught adequately in other ways such as through lectures or as electronic books, where the only form of interaction is by pressing a button to turn a page. The better packages were those that aimed to support lecturers rather than replace them.

One key failing of the TLTP programme has been the lack of take up of the software within institutions. This is principally due to the individual nature of Higher Education courses, where two lectures covering the same subject areas may concentrate on different aspects of the subject. Much of the material may suit the teaching of the CAL producer, but it may not be so relevant to the teaching style of other tutors using it. It has been suggested that this transferability would only really be possible if a shared curriculum across HE were devised, which is an unlikely scenario. A small number of the TLTP packages were customisable, allowing individual tutors to insert their own material into the package, or direct students to areas of the package that would be relevant to their

own particular course. Even when the packages have been suitable a further barrier exists in terms of the availability of the technology to use that package and whether there is adequate technical know-how to use the package.

In Architecture there is another barrier to the introduction of CAL into the curriculum in that design studio teaching generally relies upon a one to one relationship between student and lecturer and it is difficult to see how computers may assist in this area. Generally Architecture has regarded Computer Aided Design as the key use for computers within the educational process, and whilst this can help students to develop spatial and creative skills, the learning process generally remains unchanged. This may not be a problem as the design studio is generally regarded a fairly successful way of learning, although it tends to be resource hungry. Student contact time could be reduced by *prioritising* what is taught during design tutorials to those aspects best taught in that way, often those such as creative thinking that cannot be based around a set of objective criteria. Technical, measurable aspects of students design work such as structures and energy usage could be taught by other means possibly using the computer as an *expert consultant*. Programmes such as the structures teaching package, DEFLECT (McCallum and Hanna 1996) enable students to experiment with structural forms to gain an understanding of how the structure of their building would react under load,. Of course design tutors could take the student through these principles themselves but the use of computer graphics and animations allows the computer to display a clarity in its explanation that many tutors would otherwise find difficult to achieve. For this purpose the computer is the more appropriate medium. It should be noted at this point that whilst a number of packages are used within industry to aid the professional in determining the technical aspects of their design, the majority will only assist in performing calculations. For packages to be particularly useful as a teaching aid, they must also help students to learn the principles behind the measured concepts. With such software not only can students perform calculations about their building, but they can also assimilate important principles about structures that can be used to inform future design decisions.

Unfortunately packages which both help students to solve an immediate problem and also allow them to learn the principles behind the solution to that problem are rare. Where a piece of software only carries out calculations, lecturers have to explain the principles behind those calculations themselves. This may mean that there is little benefit to the lecturer in implementing the material, and it could be questioned whether this type of software is of particular benefit to the student. Careful judgement needs to be made as to the added value to the lecturer and the student that could be attained by using the software that could not equally be gained through traditional teaching. If there is no added value, then it is unlikely that the software will be used. Draper (1997).

Once it has been determined that a particular piece of software is useful in the teaching and learning process, it is important to fully integrate its content into the curriculum. It is not sufficient to simply “bolt on” a CAL exercise onto some existing course, as students will perceive the computer based material as something that is possibly divorced from the remainder of the course. It is also important that those concepts learned through the computer form part of the assessment alongside those learned in traditional means, for if this does not happen it will be difficult to persuade students to carry out the work. Relatively few studies are in existence as examples of how best to integrate CAL materials into Built Environment Education and for this reason the Built Environment Appropriate Technology for Learning (BEATL) project has been established to determine ways that this may be possible.

The BEATL Project

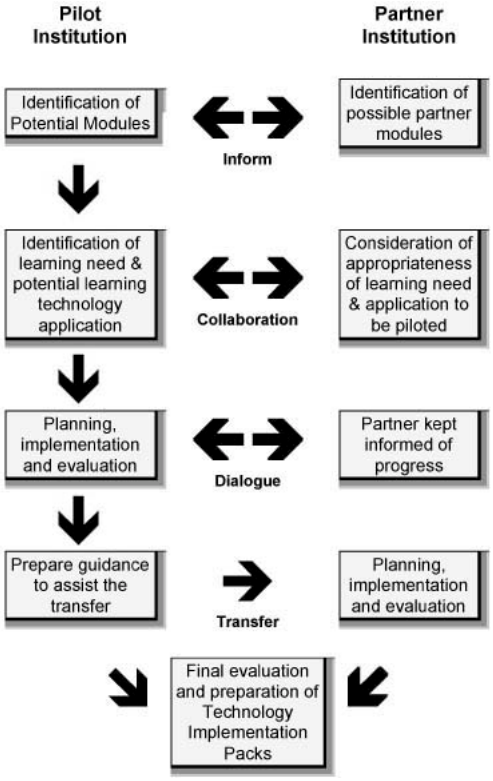
The BEATL project is funded by the Higher Education Funding Council for England and the Department for

Figure 1 (right). BEATL Partnering Process

Education Northern Ireland under the third phase of the TLTP programme. It is intended to develop effective and efficient methods of integrating technology-based learning materials into the delivery of modules within the undergraduate modular programmes at the universities of The West of England, De Montfort and Westminster in partnership with the Computers in teaching initiative (CTI) Centre for the Built Environment (Cardiff). The rationale for the project is that Built Environment undergraduate modular programmes include a wide range of disciplines, from architecture and town planning, to building surveying, and construction management. Such programmes offer an ideal test bed for embedding technology-based materials in their teaching and learning. Since the first two phases of the TLTP programme did not directly involve Built Environment disciplines, this project will seek ways of customising and embedding material developed for other disciplines. It will also include the challenge of using such material in some modules offered to large, interdisciplinary groups of students. Teams of lecturers and support staff deliver such modules and so these in particular are ideal 'levers' for embedding good practice in the use of technology in teaching and learning across large modular programmes.

A key aspect of the project is to identify appropriate topics or elements of teaching within modules that are suited to innovation and subsequent transfer. A further key element is partnering across institutions. The proposal is that staff in the Partner institutions will commit to shadowing the implementation of the innovation in the Pilot and at remote be engaged with it, able to provide comments and feed back to ensure that it can then be effectively transferred to their own teaching. See Figure 1

It was proposed that these pairs or trios of modules would include similar subject topics and have a shared interest in embedding the same technology-based materials. The diversity of 'testbeds' provided by the partner institutions should help ensure that the resulting project outputs will be fully transferable to other institutions. The project will develop



methodologies for evaluating the costs and benefits of these innovations and a series of 'Technology Information Packs'. A Project Handbook will be developed as a guide to staff on embedding good practice, and will form the basis for staff development workshops to be available nationally.

The BEATL educational development model has been developed over a period of previous collaboration between the partnering institutions. It is considered to be one that is as applicable to the introduction of transferable skills or open and distance learning as to embedding technology. It involves creating a climate for change in which innovation can flourish through the: promotion of champions in key places; deployment of Educational Technology Officers (ETOs), discussed in the following section;

and the provision of paid time for module leaders to take part based upon formal 'contractual' pilot-partner agreements.

Review, evaluation and dissemination of the project is structured on four levels: individual module; partnership between institutions; Faculty/Institution; and the Project itself. Evaluation is discussed in greater detail by Winter and Avgerinou (1999). The first two are summarised in Table 1.

There is a project leader backed by project managers in each institution and a project associate with particular responsibility for evaluating the project at all levels. The project manager in each institution works with module staff and the educational technology officers of whom there are five to identify and implement innovation in pilot projects and partnership in shadowed projects.

The ETO (with the project manager and supported by the project associate) has several key roles in creating a climate for change. One role is that of facilitator in promoting good practice to module staff and enabling them to effectively embed appropriate technology in the selected topic. Another is that of evaluation at the topic level deploying data collection and evaluation tools such as: observation; semi-structured, in-depth interviews; questionnaires; focus group discussions; and evaluation forms. A further role is in helping module staff to provide descriptive reports which enable partner institutions to decide when and how to implement the innovation and in due course bringing these together in the form of the 'Technology Information Packs'.

Results so far

The ETO role has already achieved some successes. Checklists and templates have been adapted or developed and applied in consultation for selecting, analysing and evaluating prospective CAL products or more generic software solutions, for instance based on the CERT Courseware Evaluation and Review Tool[1]. The process of discussion between project manager or ETO and module leaders has in itself been found to provide benefits without necessarily introducing technological innovation through a timely focus on teaching and learning needs. Whereas student feedback has often been sought by deploying standard and fairly simple questionnaires the ETOs have begun to implement a more structured approach. A mix of focus groups for in depth discussion and bespoke open question questionnaires which have been designed and focused on the particular module have lead to more useful feedback.

As proposed BEATL was intended to test adapt

Level	Evaluation to investigate
Module/Topic level	■ whether appropriate technology-based material has been embedded effectively into teaching and learning ■ the impact of CAL material on the quality of student learning ■ the impact on the quality of tutor experience ■ the cost effectiveness of the relevant innovation ■ whether the needs of students with disabilities have been addressed
Partnership Level	■ whether good practice has been shared and promoted across the consortium institutions ■ Identify extent of transferability of good practice ■ Identify advantages and disadvantages of partnerships ■ Investigate collaborative arrangements among consortium universities

Table 1 (left). Evaluation Strategies at Module and Partnership Level

and embed existing CAL packages rather than to develop fresh CAL material. 'Roadshows' and similar events have been organised to demonstrate a range of existing packages to staff. There appears a significant difference in approach between staff who already posses honed technological skills and staff who are less confident and this is reflected in different ways of engaging in the project. There is at present as a result a fairly even split in the initial modules identified as Pilots between 'off the shelf' and small-scale topic based generic applications. The generic applications tend to have been championed and implemented by staff with previously honed technological skills. These include Perl based in-house developments for diagnostic and formative assessment; a complete Web site for a module in ground engineering containing tutorial material, Java based models and simulations; specialist customisation of spreadsheets to teach valuation to non-valuation professionals and development of self paced packages to teach drawing and construction skills.

Early outcomes indicate that less confident staff are inspired to think about incorporating 'off the shelf' products in their teaching. Those selected to date include WinEcon (Basic Economics), The Adsetts Case Study (Construction Process), IOLIS (Law), GraphIT (Statistics) and DEFLECT (Structures). However BEATL is deliberately pedagogically rather than technologically led. It is more about how one can embed technology in pedagogically sound ways than about the technology *per se*. It is important to explore teaching and learning needs with those teaching the subject and in several instances it has emerged that a more generic application, such as a self paced assessment package, is of greater initial value than the bespoke CAL package which acted as the initial catalyst. Often it has been found that the generic package lends greater added value to the learning experience than an off the shelf package, the content of which could be taught by other means.

In practice it has proved difficult to find partners in other institutions committed to engaging with applications which are still at concept stage rather than fully developed and implemented. When an off the shelf CAL application is involved it normally has content appropriate to a specific subject area which confines it to a narrow range of possible partner modules. It has proved to be easier to transfer more generic applications that do not contain very specialised subject content. It appears that the modules that are obviously similar across institutions are not as satisfactory prospects for transfer as those less obvious but which share a potential teaching methodology.

Conclusion

The BEATL project is still in its early stages of development; at the time of writing only a small number of pilot modules have been running for one semester, and no transfer of module content to partners has been completed. Therefore it is difficult to draw many specific conclusions, however from the pedagogical research that has underpinned this project it would appear that a key issue of interest to lecturers is the transfer of specific teaching methodologies between institutions, rather than the transfer of particular teaching materials. By using generic learning packages which can be tailored to meet the needs of a particular teaching situation, lecturers can ensure that the content relevant and that the technology provides a degree of added value to the learning process.

Where modules are to be partnered across institutions, it would appear difficult to encourage lecturers to commit themselves to an innovation that has not been fully tried and tested. Other earlier TLTP projects, such as GeoTechnical, developed across partnering institutions followed an approach whereby innovations were specified and completed by individual institutions before feedback was given by partner institutions which lead to further modification and change. This is a slower, and more drawn out approach than was originally intended for the BEATL project but is likely to apply in the instances where

initial partners will not initially commit to a proposed pilot.

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