CAAD - The Role of the Design Tutor

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Abstract

Whilst it is often argued that computers have an positive role to play in the educational process, design tutors frequently view computer based design work as being of inferior quality to that of designs produced by traditional means. This may be no fault of the technology, but more likely a consequence of a student's inappropriate use of that technology. It could be argued that part of the role of the design tutor is to encourage students to use technology in a more appropriate way, rather than to totally discourage the use of computers in their designs.

The introduction of computer technologies has led to new ways of designing, which may be very different to the methods of design that are traditionally taught. This paper proposes that the successful implementation of CAAD in Architectural design education, can only be achieved if design tutors fully appreciate and embrace these new design methodologies, in a way which extends beyond the need to simply accept the new technology.

The role of computers in education

There has been considerable debate in recent years concerning the way in which learning technologies will affect the educational process, and more specifically the role of the teacher. It is ever increasingly necessary for institutions to review their teaching and learning strategies. In the UK the Computer in Teaching Initiative (CTI) has been established with 24 subject specific centres to encourage a greater integration of appropriate learning technologies into the curriculum.

The traditional UK higher education lecturer has previously been concerned with two principal objectives: the creation of new knowledge, and the transfer of knowledge between himself and the student. This knowledge is derived from a constantly expanding knowledge base, one that is increasing exponentially with the benefits of IT. It has been suggested that this situation may lead to ”information overload”[1] and the traditional perception of the lecturer as the ”fount of all knowledge” is increasingly being questioned. In the future it may be that the lecturer moves away from his traditional role to that of a guide, advising students where the best place to obtain that knowledge, and the best way to use it.

For this reason, there is a tendency for educators to move from a passive *learning by lecture* mode, to an active *learning by doing* approach, often with the use of specifically written Computer Aided Learning (CAL) packages. Students work independently, and are able to follow their own route, at their own pace through a predetermined piece of courseware. This new approach to learning also facilitates the possibilities of distance and lifelong learning.

Architectural education has (albeit without computers) subscribed to this *learning by doing* philosophy for many years now. The design studio has been seen as a successful way of allowing students to learn about design, learn about design*ing* and learn to be critical about design[2]. This may partly explain why research by the CTI Centre For the Built Environment[3] has shown that specifically written CAL packages are uncommon in architectural education (as

compared to other subject areas). Much of the computing taught in architectural schools is based around the use of commercial Computer Aided Design Packages packages. If used appropriately, Computer Aided Architectural Design (CAAD) can be used as a way of enhancing the design abilities and learning experience of students[4]. In this way it would follow that CAAD could become a vehicle for Computer Aided Learning in Architecture. It will become part the role of the design tutor to determine how CAAD can be used to its full potential, in order to benefit that learning experience.

Despite a push both from profession and educational authorities (and indeed the students themselves) to integrate CAAD into the traditional curriculum, experience shows that there still appears to be a degree of resistance amongst all but an enthusiastic few. It is not uncommon for students to be prevented from using computers in their designs for fear that this may have negative pedagogical benefits. However, as the greater introduction of IT becomes an inevitability in society as a whole, educators must be in a position to guide students as to how the technologies may be most *appropriately* used.

A model for studio teaching

Design tutors are generally aquainted with the techniques of design by hand drawing. When the computer is introduced into the studio it may seems logical to apply that knowledge of drawing to the computer. This however may not be entirely appropriate[5], and the students may rapidly have their design freedom limited by the constraints of the system.[6]

In order to assess how technology can be used appropriately to benefit the learning experience, it is useful to look at the design process, and examine how design tutors have traditionally interacted with that process. It should then be possible to identify those areas in which computers have the greatest potential. Whilst it should be noted that everybody designs differently, the model proposed by Jones[7] represents a useful point of analysis. Jones breaks the process down into three fundamental parts *divergence, transformation* and *convergence* (which may or may not occur in that order)

The *divergent* stage of the design process represents that phase where the initial design problem is initially defined and analysed, the building requirements are assessed and where research may be carried out into historical precedents, design theory, user needs etc. This phase is largely concerned with the collection and analysis of *information.* Jones claims that it is important to obtain this information at an early stage in the design process in order to ensure that later decisions are made on a correct basis. Much of this ”theory of architecture” information has traditionally been taught outside the design studio in the more formal lecture/seminar situation. As the extent of available information constantly increases, it will become part of the role of the design tutor to guide students in where the best sources to find this information.

The *transformation* (or ”black box”) stage represents the mystical, creative phase of the design process where by the information analysed in the *divergent* stage is transformed into a number of design possibilities. It has been suggested[8] that the activities carried out in this phase are carried out by the right hemisphere of the brain, which is the non rational, intuitive side. During this phase it is possible to make leaps in insight based upon incomplete, and non-logical patterns. Problems are considered in a holistic manner, rather than as a series of parts. The right side of the brain is the non verbal and non temporal side, when it is used one often has the sensation of ”doing something without thinking”. By contrast the left hand side of the brain works in a more rational, logical, analytical way.

When a line is drawn on a piece of paper, one makes an intuitive judgment as to the length and weight of that line. This is done without noticeable thought and is essentially an activity of the right side of the brain. If one is required to carry out the same task on a computer it will be necessary to tell the computer what line length and weight is required, this is a decision carried out by the left hand side of the brain. Design ideas made whilst drawing directly on computer may well be less free flowing and creative. However other activities such as the ability to manipulate and transform geometric primitives (through rotation, duplication, stretching etc.) can now be performed in a more intuitive manner on a computer, than on paper.

In his book the *design studio*[9]. Schön describes in detail the role of the design tutor in a one to one situation with a student. The tutor carries this out by what Schön describes as ”reflection in action”, a process of explaining his intuitive (transformations) ideas through both talking and drawing. In this situation the design tutor takes on a *virtuoso* role.

The *convergent* phase is the stage where the solutions processed during the *transformation* stage are narrowed down to form a single product. It is the phase where the design is critically analysed, evaluated and ultimate decisions are made. Schön talks about the design tutor moving through a web of possibilities questioning each one with a series of ”what if” questions and this represents typical convergent behavior. Jones points out that this is an area where computers are likely to have their greatest impact.

Models of CAAD Teaching

The CTI Centre for the Built Environment has discovered a rich diversity in the way that CAAD is taught in Schools of Architecture. It is possible to break these different teaching methods down into one or a combination of four broad categories:

Design By Modelling

Three dimensional models are an established method of encouraging students to appreciate the three dimensional nature of their work. Hand produced models are time consuming to produce, computer models by contrast are relatively quick to generate, and whilst they may lack the sensation of physical form, computer models can produce a rapid ”half way house” between physical models and a three dimensional sketch on paper. A common use of computer models is one where a student prepares a simple sketch on paper. This is then transferred to the computer by way of either a scanner or by manual digitization and converted into a 3D model. From this model, a student is able to critically analyze the design (both visually and/or by the use of some performance analysis software). The student continues the process by sketching over a print out and the process repeats itself.

From this we can see that the process can be broken down into two principal parts. The first part is the creative part, which is carried out on paper. This is the ”black box” transformation referred to earlier where the computer could prove limiting. The second part, is a an analytical decision making process, which is a convergent activity carried out with the assistance of the computer. As the computer is limited to this convergent process only, this method is likely to be successful. This model of design represents an extension of an existing design methodology, and whilst there is likely to be little change in the way design is taught using this method, it may be useful for tutors to have an understanding of the limitations of computer models[10].

Design by Computation

Computational design teaching is less common, but in recent years has attracted research interest and represents a relatively new methodology for design.[11] The techniques vary but generally a set of rules about design (possibly derived from precedent studies) is established and developed upon.

Considerable time is spent by designers in reworking problems that have been previously solved by others. Case Based Design eliminates this ”reinvention of the wheel.” by using an existing design as the starting point, from where rules are developed, analysed and applied to new design situations.

This process is very much one of rules, logic, and analysis and information. The process places a far greater emphasis on the *divergent* part of the design process than both design by modelling and traditional design teaching. This may lead to a change in how design is taught, as elements of design history and theory, traditionally taught in the lecture theatre, may be moved into the design studio. A number of computer based systems are being developed in order to assist students in the selection and analysis of appropriate precedents, whist ensuring that students do not simply copy an image of a building[12]

In the *transformation* stage this model is likely to involve modification of existing shapes on the computer screen, and as such the computer is less likely to be hindrance to the design.

The Virtual Studio

In a world where global communications are increasingly important, architectural schools are starting to collaborate on a global basis. The virtual studio allows a more divergent range of ideas to be input into the design process from many distinct participants. Whilst the design tutor has a role in facilitating these studios, it also possible that if students collaborate and discuss ideas with each other, then a lesser input of ideas may be required from the design tutor.

Design Presentation/Documentation

This is the area where architectural practice has traditionally utilised CAAD technologies. Generally students take an existing design, (be it paper based, or a 3D model) and translate this into computer format. In this way the student is able to experience the limitations and benefits of using a computer for presentation without allowing the computer to limit his design process. In its simplest terms a student is involved in passing on information about his design. Traditional architectural presentations were typically a set of two or three dimensional drawings. With the introduction of multimedia technologies, a fourth dimension of time is introduced which in turn introduces new ways of structuring the information. If the tutor is to guide the student in the best ways of presenting his work, then it is important that he has an understanding of these new ways of structuring information.

Discussion

As we can see from the two models of CAAD teaching, in successful projects, the computer is only used at appropriate times - that is when it is not likely to compromise creativity, but rather enables information to be structured and evaluated in an efficient way. It will become part of the role of the design tutor to help students develop an understanding of this.

Part of the educational process is to develop a critical understanding of the subject being studied. This critical understanding should not be limited to the product itself, but also to the process of designing. Just as with paper based design, a student faced with a fixed set of media will learn to evaluate which is most appropriate for the particular task (for instance a student may use soft pencil, freehand early in the design process and an ink pen and rule at a later stage) so, it is necessary for students to be able to critically evaluate how computers can benefit or be of detriment to their designs[13]. This implies a far deeper level of learning than simply being trained in how to use a particular piece of software. It may become the role of the design tutor to invoke a critical discussion of this amongst students.

Conclusion

Often CAAD has been taught by a small number of enthusiastic tutors with some degree of computer knowledge. This is often done during a specialist computer elective. If (as is likely) computers become more widespread throughout architectural schools as well as practice, it will become increasingly necessary for other tutors be able teach design through the medium of computers. If they are to do this then it is imperative that they are knowledgeable of the appropriate (and inappropriate) uses of computers. It will no longer be acceptable for a design tutor to simply stop a student from using computers, if they feel that the computer is having a detrimental effect on a students design. The tutor needs to instill guidance as to a more appropriate use for the computer (or indeed a more appropriate design methodology). In this way students should be able to use computers in a way that does not limit their creative skills, but enhances the learning experience. At the same time the design tutor of the future will need to embrace the revolutions in multimedia technologies, new methods of communication, and the greater accessibility of information.

Successful implementation of CAAD in architectural design education, can only be achieved if design tutors fully appreciate and embrace new design methodologies, in a way which extends beyond the need to simply accept the new technology. A fundamental re-evaluation of how design is taught may be the solution. In the UK the CTI Centre for the Built Environment, will have a vital role to play in challenging academic staff to rethink their approach to teaching and learning..

References

[1] Hills, G ”Embedding technology into teaching: the broader scene” in J.Derby,J.Martin, and S.Turpin (eds) *Embedding Technology into Teaching, Conference proceedings of the TLTP/CTI Conference, London 1995*, CTISS Publications.

[2] Schön D, ”The Design Studio”, RIBA Publications, London,

[3] A survey was undertaken evaluating the usage of computers in Built Environment Education. This has been supplemented with expert discussion groups, and selective visits to departments.

[4]Bridges AH, "CAD - A Matter of Course", *Architects' Journal IT Supplement*, 20 April 1988, pp13-16

[5] Bridges AH, ”Computer Aided Design, or Computers in Design” in F.Penz (ed) *Computers in architecture, Tools for design*. London: Longman. 1992

[6] Gross MD, "Roles for Computing in Schools of Architecture and Planning", *Journal of Architectural Education*, September 1994, pp56-63

[7] Jones JC. ”Design Methods: Seeds of Human Futures”, New York: Chichester: Wiley 1981,

[8] Edwards, Betty , ”Drawing on the Right Side of the Brain” Chapter 3 pp 26-43, Fontana/Collins 1981

[9] Schön D, ”The Design Studio”, London: RIBA Publications, 1985

[10] Kadysz A, "Looking for the best place for computer models in Architectural Education", in Maver T, Petric J (eds) *The virtual Studio, proceedings of the 12th European Conference on Computer Aided Architectural Design, pp 43-46*

[11] Gero JS, Maher ML ”Current CAAD Research at the key centre of Design Computing”, summary available at http://www.arch.su.ac.uk/kcdc

[12] Kuehn C, Herzog M, ”On the Role of Hypermedia in Architectural Design Education” in Maver T, Petric J (eds) *The virtual Studio, proceedings of the 12th European Conference on Computer Aided Architectural Design*

and

Gero JS, Maher ML ”Current CAAD Research at the key centre of Design Computing”, summary available at http://www.arch.su.ac.uk/kcdc

[13]Gross MD, "Roles for Computing in Schools of Architecture and Planning", *Journal of Architectural Education*, September 1994, pp56-63