The Place of E-learning in Architectural Education

A Critical Review

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E-learning is rapidly becoming a key element of institutional teaching and learning strategies with many academic departments seizing the opportunity to use technology to enhance their educational provision. This review aims to investigate the effects of E-learning on design teaching in schools of architecture. In order to achieve those aims, the outcome of a number of academic experiences conducted to explore E-learning in architectural design teaching, were analysed. The role of E-learning was critically analysed in design teaching, and consideration was given to the way in which E-learning might promote new learning environments, and learning methods. The review attempt to identify the barriers that might face schools of architecture when integrating E-learning in the design teaching, and resulting in short-lived project. The review formulated important findings that explain the reasons, which underpin the schools' attempts to use E-learning in design teaching and how schools integrated different technologies in their learning.

Keywords: *E-learning; Remote collaboration; Virtual design studio.*

Introduction

E-learning is rapidly becoming a key element of institutional teaching and learning strategies with many academics departments seizing the opportunity to use new technologies to enhance their provision.

The term E-learning was defined distinctively by different people, Littlejohn and Higgison (2005) define E-learning as the term used to describe any use of information and communication technologies to facilitate, support and enhance learning. In a broader sense Kaplan (2000) defines E-learning as the term covering wide range of applications and processes, such as web-based learning, virtual classroom, and digital collaboration, include the delivery of content via the internet, intranet/extranet, audio and video tapes, satellite broadcast, and interactive TV and CD-ROM. This research has adopted a wide view as to the definition of E-learning, which would be any use of information and communication technology that was introduced primarily to assist students in learning architectural design. That might include for instance, the use of proprietary or custom-built environment, or involve the use of 3D virtual worlds. It might refer ways in which IT is used to encourage students to collaborate or reflect, or involve some innovative use of proprietary CAD system to encourage students to explore design in a particular way. It may also refer to learning objects specially created to teach particular issue in design.

E-learning in higher education

Recently, the expansion in the use of information technology in education has had an impact on society (Thierry and Deborah, 2000), imposed demands on higher education to produce a new educational system that support a flexible access to the educational programs and broadening the geographical boundaries of universities, supporting lifelong learning and students continuous professional development (Littlejohn and Higgison, 2005). Higher educational institutions are facing a wide range of changes in terms of delivery methods for the diverse educational curriculum. According to the National Committee of Inquiry into Higher Education (1997) there was an increase in participation in higher education, and change in their patterns that required higher education to respond to those changes in order to ensure that education is responsive to the aspiration and distinctive abilities of individuals.

Aims and objectives

The project aims to explore the potential implications of E-learning in design studio education. The project is essentially a scoping study, where existing examples of the use of E-learning in design studio education would be critically analysed, particularly in terms of the pedagogical benefits encountered.

The project aims to establish the following objectives:

• To ascertain why E-learning has been used in schools of architecture.

• To identify how E-learning has been used in design teaching within schools of architecture (including what technologies have been utilized, their mode of use, what the teaching program was? how these technologies were integrated and why were they deemed appropriate).

• To identify the perceived benefits of the use of E-learning in architectural design education (for both staff and students).

• To identify the barriers that occurred when E-learning was implemented, and how these barriers might be alleviated.

Methodology

The research methodology involved the collation of a series of case studies, based upon literature reviews and semi-structured interviews with academics around the globe. In order to address the project aims, fifteen case studies were analysed. These were collected from academic conference papers, journals, and web sites that were published during the last ten years. The method of selection concentrated particularly on academic examples involving the use of information and communication technologies to enhance learning environments, promote new methods of design teaching, and enhance the students' learning experience. The study excluded examples that emphasize technology development without considering the pedagogic outcome in design teaching that might arise as a result, of integrating technology in design teaching.

Why has E-learning been used by schools of architecture?

Evidence from the case studies suggest many reasons for using E-learning in architectural design education, it has been difficult to find examples where the principal motivation has not been technology-focused. In many cases, the examples have been instigated by those who have a particular interest in using technology to support learning, in an attempt to explore the potential for particular technologies. There is very little evidence to suggest that E-learning has been introduced to support particular pedagogic needs. Many of the examples have related to the development of possible new ways to design using new technology, with the design studio being used as a 'test bed' for new practices, which might subsequently be implemented by the architectural profession. It has been noticed that the early attempts to integrate technology, encouraged by the introduc-

tion of networking applications, schools made use of electronic networking transferring protocols to facilitate CAD files drawing exchange between participants (Wojtwicz et al., 1993). Since then, schools have followed a similar trend, and continued to explore technology in order to produce new methods in design teaching and release the traditional studio constraints, like time and place.

The advancement in communication technology represented another motivation for schools, and instigated them to explore different applications to arrange a collaborative design studio. An online project carried out by students at Strathclyde University (Grierson, 2004) indicates that investigating the weakness and strength of communication technology in the design studio has stimulated the school to implement communication techniques into the studio. Other schools suggest that the need to develop a better understanding of Virtual design studios, and identify the implications that might arise as a result, of using this technique in design teaching motivated them to experience this technique in their teaching (Maher et al., 1997).

Other reasons for integrating E-learning have been to develop students' skills sets, particularly in the areas of IT and communication skills; to enable communication between students in disparate locations, facilitating cross-cultural exchange; and to provide support for students' design thinking through the provision of digital repositories and design support systems. Some of the reviewed papers suggest that developing the students' communication and team working skills and equipping them with technical and collaborative skills was the reason to conduct a collaborative virtual design. The international studio is a collaborative studio that was arranged between a number of schools around the globe (Maher et al., 1997) is one of the projects that evidenced schools' desire to engage their students in a collaborative design studio, and encourage them to explore collaboration and develop better skills.

The Development of students' practical and technical skills to provide them with a better understanding of real life work is crucial, as technology has influenced the practice and affected design making. Technology is seen as a potential solution that offer new methods in design teaching that might be able to connect academic study to its profession. Gross and Do (1999) argue that digital tools offered an opportunity to incorporate instruction about the performance of building into design studio teaching, describing one of the studios which integrated a suite of knowledge tools (CAD Plus studio) appropriate to the design project, which students could draw on for information and analysis as they carry out their design. A similar reason has instigated the Welsh school of architecture to incorporate ECO-TECT into design studio teaching Roberts and Marsh (2001) indicate that integrating the environmental performance knowledge of building into design teaching and develop students' awareness of those issues related to their project has motivated their studio. While, a number of schools have attempted to integrate a custom interactive structure software (ISS) into studio teaching, in order to develop the students' awareness of design structural knowledge, facilitate a flexible access to various educational resources, and help students to apply sufficient structural knowledge into their design project (Vassigh, 2005).

How has E- learning been used?

Two key approaches to the implementation of E-learning in the design studio have been identified. Some schools have integrated E-learning to augment their existing teaching and learning environment, while others have attempted to generate a new design environment, however, it has not been possible to identify the relative success of either of these approaches. Technologies used by architectural schools have ranged from simple exchange of information using Email and Web pages, through 3D computer modeling to fully immersive virtual reality. Many of the examples have placed an emphasis upon using these technologies to allow students to

collaborate and share design ideas. However, the use of bespoke VLE systems in architectural design teaching has been limited. There is no evidence as to the use of e-assessment, and there appears to be little demand for the generation of individual learning objects.

Schools experience indicates different methods of integration, a variety of technologies were used by schools to support design activities in ways that cannot be achieved in the innovative setting. Technical applications were used for different purposes in the studio, in some cases, for instance, in a collaborative studio held between Liverpool and Montana schools of architecture, technology used to support traditional face-to-face communication (Dunne, 2001), and played a great role in connecting students when needed to exchange their design ideas. Some schools have attempted to use technology to develop a combined approach of design studio teaching, and integrate the design-related knowledge in studio teaching in ways that enable students to apply this knowledge in the design projects, and develop a better understanding of various design-related issues. This approach has been adopted by different schools, as mentioned previously. The software (ISS) was integrated by a number of schools in design studio in early stages, to help their students to gain a comprehensive knowledge of structural design, to access a number of educational resources through the internet, and to apply those principles into projects during the design process (Vassigh, 2005).

Other types of technical tools have been used for other purposes: for example the use of a collection of portable tools for the capturing of site information and assisting in design studio teaching, as been used in Oregon University (Cheng, 2003). Students captured the spatial characteristics of the site by using a number of digital tools during their site survey. These tools have been used in the studio as well to help students to translate the site information visually.

As mentioned earlier, some of the reviewed papers show that their intention was to develop an effective design environment that supports new approaches of teaching in design studio. Kvan (2000) argues that most of the virtual studios engaged in to overcome constraints in teaching process.

The majority of the reviewed studios have emphasized the use of combined tools that have a wide spectrum of functions to facilitate the vast activities of design. The used tools include communication tools that support both synchronous and asynchronous modes of communication. Email, Hypermail, Hypernews archives, and mailing list were used by most of the studios, to facilitate communication, and the exchange of ideas between staff and students.

Other tools used include a variety of documentation and date sharing technologies. The reviewed studios indicated that the shared workspace is an important requirement, where all participants can share and exchange the design data, presentation, and resources. Web sites, Web-based database, central database, Digital pin-up, and HTML documentation are different techniques that have been used in most of the studios, to provide a shared work space, where students have been introduced to design brief, shared site information and design schedules, in addition, staff could trace design progress (Grierson, 2004). In addition to the mentioned technologies, schools have used a number of computer-aided design (CAD) software and modeling tools to help students to create 2D, and 3D drawings, these software were varied, and include; AutoCAD, 3D studio, Form Z, Adobe Photoshop, and VR aided design. Students generated 3D models of design proposals in early stages, and navigated through their design to investigate their design space and volumes, as evidenced by the majority of reviewed studios. Schnabel and Kvan (2002) argue that model-based communication is an effective technique when supporting a dual communication channel in addition to text-based communication, where students are able to interact with their design, and its spatial arrangement virtually.

What were the perceived benefits for both staff and students?

The benefits of E-learning were varied, but in many cases were seen as having allowed the schools to develop new teaching methods. Principally the main benefits were seen to:

- Promote different types of collaboration
- Develop team working skills
- Facilitate date sharing, flexible resources and information access anytime, any place.
- Enhance students' communication skills and help them to exchange their design idea, drawings, and information
- Facilitate students' work evaluation and feedback
- Enhance students' ability to translate their mental intentions, create new forms of arrangement in their design and increase their creativity
- Improve students' awareness of related design issues
- Improve the richness and diversity of design ideas

E-learning has allowed schools to promote different types of collaboration amongst students, and to enhance students' communication skills and help them to exchange their design ideas, drawings, and information. It is arguable that the virtual design studio approach can break the traditional boundaries between disciplines, and develop the students' learning experience by exposing them to different learning environments. The cooperative studio that was set up between Surrey environmental psychology school and Strathclyde School of architecture indicates the creditability of this studio technique to facilitate a remote collaborative studio between disciplines, claiming that it was time effective, and allowed collaboration between participants despite distance (Uzzell and Ombretta, 2005). It can be concluded that this type of collaborative studio has a number of advantages, for instance, students became less defensive towards their designs, it enhanced peer learning and enabled both disciplines to exchange their knowledge.

Another advantage has concluded from the reviewed studios suggests that this technique of teaching might contribute in developing the students' team working and communicational skills, and help them to gain important skills for working in practice. Dunne (2001) describing the cooperative studio held between Liverpool and Montana schools of architecture, suggests that students worked as a part of group, and were able to develop their communicational with tutors and clients when they collaborate on real-world design, and that got students better equipped for practice. Cheng (1995) argues that engaging in group working can eliminate students' isolation and help to get design feed back by sharing opinions

Technologies used in virtual design studios have enabled students and staff to exchange, and share all kinds of design ideas, and facilitated the flexible access to additional educational resources. Students were able to share design data, and resources without being limited by restricted time, and that can be seen as a crucial benefit. Strathclyde University has made a great use of the World Wide Web in their studio, Websites were used to store design information, brief, and progress, acting like shared work space (Grierson, 2004). This characteristic of the World Wide Web can be seen as a potential solution to overcome schools shortage of resources, schools can enhance their resources by sharing their educational resources, bridging the gap by collaboration. It is arguable that the Virtual design studios can develop students, providing them with an opportunity to share design information, resources, and critiques in ways that could not be facilitated in a traditional setting, as technology could release time, place constraints. Similarly, students were able to develop their communicational skills with tutors and clients when schools engaged collaboratively in real-world design. The cooperative studio arranged between the Liverpool and Montana studio (Dunne, 2001) indicates that students promote better communication skills between each other and with clients when they collaborate in real-world design, using telecon-

ference to communicate remotely.

Many authors claim that feedback and evaluation play a crucial role in students learning. The feedback resulting from students' evaluation and assessment contributes positively to enhancing students' learning. The majority of the reviewed studios indicate the tutor ability to evaluate, and trace students' work. Tutors supervised students and gave them advice regarding their design progress any time, any place. That can be noticed in some studios, for instance the (A place 2 wait studio), the Strathclyde online studio, and the Oregon collaborative studio with UBC.

In addition to the mentioned advantages, further benefits were experienced in a number of studios, which used particular technology in studio teaching. The Pennsylvania experience with VR-desktop indicates that students are able to develop better ways to translate their mental intentions. Students could review their ideas and navigate inside their project, examining their design during the early stages of design (Kalisperis et al., 2002). Virtual reality gave students new opportunity to produce new forms and arrangements in their design (Schnabel and Kvan, 2002). The possibility offered by technology for students to create 3D design in early stages, can be seen as an advantage in the design studio, providing students with an opportunity to investigate their design spaces, forms, and modify their design during the conceptual stage.

Design studio teaching lies at the core of architectural education, yet students are expected to develop a knowledge of various architectural and urban design theories, show awareness of important design related-issues. Some of the studios that have integrated technology to assist design teaching suggest that they have observed an improvement in students' awareness of different issues, for instance environmental, spatial, and design construction knowledge of their design. Describing their design studio, Roberts and Marsh (2001) suggest that integrating ECO-TECT helped students to achieve better understanding of their design environmental performance. Students were able to analyse and modify their design

according to their design response to these factors. Another aspect of E-learning in design teaching that was considered as an advantage for design studio teaching, is exposing students into different design environments, cultures, and approaches. Architects are challenged to design and work in Multi-cultural environments, thus, it is important for students to develop better understanding, awareness of different requirements during their education. Integrating technology into design teaching arguably is seen as a possible way to bridge the gap between various design educational environments, approaches, and expose students to different cultures, and human needs. The collaborative design studio arranged between Melbourne and Toronto schools, indicates that various technologies used in design studio encouraged students to engage in group work, and has resulted in more interesting and diverse of design ideas (Danahy and Dave, 1998).

What barriers existed?

The majority of the reviewed papers indicate that virtual design studios have encountered some difficulties and barriers, schools claim that they were faced with various difficulties. Technical problems, the high bandwidth required to guarantee a better communication, and design ideas exchange, the incompatibility of software, and Servers' firewalls integrated in the collaborative studios appeared to be the main barriers that existed in the virtual design studio. Schnabel and Kvan (2002) assume that some barriers arose as a result, of the technical system complexity required to facilitate the immersive virtual environment. While communication barriers were indicated by a number of schools, for example, the poor quality of synchronous tools affected on the flow of information, causing difficulties for students' while sharing design ideas, and information. Another problem is caused by students' lack of motivation to engage in collaboration and teamwork. Cheng (1998) argues that students showed less desire to collaborate despite the collaborative agenda. In addition to

students' motivation, some of the studios claim that time differences and different schools' schedules have affected the collaboration in the studio. Some of the reviewed papers assume that design quality might be affected by the limitation of technology. Danahy and Dave (1998) describe the collaborative studio set up by Toronto and Melbourne schools, arguing that design presentation indicated the lack of discursive quality of the traditional drawings, as a result, of the used techniques inability to support the development stages of design. They suggest that these stages would be invisible to a viewer, in contrast to the innovation technique.

Conclusion

There is little evidence to suggest that E-learning has been introduced to support particular interest in using technology to support a particular pedagogic need. The majority of the reviewed examples have related to the development of possible new ways to design using new technology, with the design studio being used as a "test bed" for new practice, which might subsequently be implemented by the architectural profession. Other reasons for implementing E-learning have been to develop students' skills, facilitate cross-cultural exchange, and support students' design thinking through the provision of digital repositories and design support system. Two key approaches for the implementation of E-learning in design studio have been identified, some of the reviewed examples indicate that schools have chosen to use E-learning to augment their existing teaching and learning activities, while others have attempts to generate new design environments. Yet, it has not been possible to identify the relative success of either those approaches, although it is hoped that this might be determined as a result, of further work on the project.

The benefits of using E-learning were varied, but in many cases were seen as having allowed schools to develop new teaching methods. Principally, the main benefits were seen as E-learning ability to promote different types of collaboration, enhance students' set of skills, and facilitate a flexible access to multimedia data, educational resources anytime, any place. In addition, E-learning can improve the richness and diversity of design ideas. Most of the reviewed examples claim that they have encountered some barriers, technical problems like system complexity, software incompatibility, and bandwidth were appeared to cause technical problems. Other difficulties, caused by students' lack of previous experience in collaboration and team working, and in some cases the lack of motivation.

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