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# **INNOVATION IN CONSTRUCTION EDUCATION: THE ROLE OF E-LEARNING**

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The effectiveness of e-learning depends on technological support, institutional culture, staff development and students' receptivity and learning behaviours. Learners expect online interactivity. Successful online delivery requires shifts, both in understanding and behaviours, for the change in pedagogical curriculum development. This paper proposes a research framework to investigate the current e-learning diffusion in construction-related programmes in UK's higher education and the effect of organisational (and/or national) culture on students' learning behaviours and e-learning effectiveness.

Keywords: culture, e-learning diffusion, learning behaviours.

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## **INTRODUCTION**

E-learning in higher education can be understood as “technology-enhanced teaching and learning within an education institution” (Nichols, 2008:598) and this context is widely adopted (Salmon, 2005; Sharpe, Benfield and Francis, 2006; Wilson and Stacey, 2004). To be effective, e-learning requires support from new technologies which allow online interaction and a culture to support delivery of e-learning on- and off-campus which underpins a pedagogical framework that engages with curriculum development and evaluation.

Institutions have various levels of success in e-learning diffusion. Some institutions have remained reactive while others have accepted e-learning as part of everyday activity in teaching and learning. Nichols (2008) highlights the importance of the policies set and the role played by the institutions and conclude that e-learning may be limited to enthusiasts unless “institutional sustainability”, a state of sustainable embedding for e-learning, is achieved.

## **E-LEARNING DIFFUSION**

A framework used frequently in discussions for introducing new technology to academic staff is Rogers' (2003) theory of adoption of technology, Diffusion of Innovations, which was written in 1960. It suggests, inherently, that people are more or less predisposed to innovative behaviour. Roger (2003) defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system and involves social change.

An increasing number of online programmes use advanced ICT (information and communications technology) which offer students an innovative and flexible learning environment, e.g., e-LEARN in Loughborough University, UK, and the Hong Kong CyberU in the Hong Kong Polytechnic University. The possibilities offered by e-learning enhance the flexibility in programme delivery, in particular, that of distance learning programmes. While the literature in e-learning in construction/engineering education is growing (examples are Chung, Shen, Leung, Hao, Hills, Fox and Zou, 2006; Bourne, Harris and Mayadas, 2005; Ellis, Thorpe and Wood, 2003), Kadiyala and Crynes (2000) review the effectiveness of the use of ICT in engineering education concluding that ICT can “enhance learning when the pedagogy is sound and when there is good match of technology, techniques and objectives”.

The views of Kadiyala and Crynes (2000) are echoed by Salmon (2005), amongst others, who also conclude that pedagogy, technology and organisation must be aligned to diffuse e-learning and emphasise that there must be coordination between managers, administrators and faculty. However, according to Nichols (2008), there is a fragmented view of the success of e-learning diffusion. Lynch (2002) suggests that the success of web-based programmes is primarily a result of faculty buy-in. General barriers to e-learning adoption include factors such as time-commitment and workload issues, poor leadership, information technologies self-efficacy, lack of effective staff development and drawn-out implementation.

The important role of staff development in e-learning diffusion is emphasised by Wilson and Stacey (2004) who identify four levels of need and stages in staff development from ‘operational training’ to ‘consolidation of theoretical knowledge and project-based learning’, to ‘focus on collaborative group learning and interactivity

on line', to 'becoming role models for other staff members'. Anderson, Varnhagen and Campbell (1998:94) conclude that "comprehensive adoption strategies cannot be based on support of early adopters, but must be designed to appeal to the mainstream faculty, drawing from the mainstream faculty the role models that are essential for the diffusion of innovation, staff who are better integrated into the traditional administrative and social norms of faculty culture". Hence, there seems to be two groups of staff in relation to e-learning diffusion: the early adopters (innovators and early adopters) and the mainstream majority (early and late majority, and laggards).

Jones and O'Shea (2004) suggests that clear communication and professional development are essential elements that affect faculty buy-in and Nichols (2008) advocates that interpersonal or social activities are central to effective diffusion. Since the responsibility for aligning the institutional elements of education rests with management (e.g., Salmon, 2005), hence, an e-learning strategy should be set up at institutional level, implemented at faculty level and embedded in curriculum design.

However, positive learning outcomes and academic achievement are not linked only to online course communication. Students' learning behaviours also play a role in the overall success of e-learning implementation.

## **LEARNING BEHAVIOURS**

The increased adoption of e-learning happens on- and off-campus and particularly facilitates distance learning, workplace learning and training programmes, for instance, in the case of corporate universities (e.g. UK BAE Systems offers training in partnership with universities and through their "virtual university" – Macpherson, Homan and Wilkinson, 2005). Macpherson et al (2005) review the corporate university concept and argue that pedagogical and learner preferences perspectives must be incorporated into their use of e-learning in order not to devalue the training experience offered.

Dringus (2000) warns that e-learners may be unable to sustain their momentum due to lack of or insufficient capability in (1) skills for self-directed learning and technology management, (2) self motivation, (3) preparedness for isolation. Horwath (1999) criticises that evaluation of e-learning often concentrates on its uptake rather than the comparative effectiveness of online and traditional courses.

What is important is the quality of the learning and the impact on the learner that takes place. Many pedagogical paradigms such as story-telling, writing and the dissemination of printed material emphasise on learning as an outcome expressed in terms of performance through the transfer of knowledge and skills. However, e-learning now requires not only the ability to listen, read and write, but the technical competence and network depth to create a learning community in cyberspace (Horwath, 1999). Hence, more work is needed to analyse learner needs and learner demands for e-learning. The emphasis of e-learning should not be directed towards technological solutions and potential economic efficiencies but to put issues of pedagogy and learner experience at the forefront of implementation.

Barnard, Paton and Lan (2008) find that (online self-regulatory) learning behaviours mediate the positive relationship between student perceptions of online course communication and collaboration with academic achievement. Although online self regulatory learning behaviours were only weakly associated with better academic achievement by themselves (Barnard et al, 2008), it is alleged that students must first

have positive perceptions of online course communication in order to engage in self-regulated learning.

More importantly, it follows that designers of online course curricula should be concerned with creating learning environments where positive perceptions towards online course communication and collaboration may be fostered, i.e., fostering a positive e-learning culture to support students' learning approach.

## **SIGNIFICANCE OF CULTURE**

To foster a positive e-learning culture, there is a need to prepare the organisation for e-learning at all levels. The need to prepare the organisation culture is stressed by Macpherson et al (2005) and Newton, Hase and Ellis (2002). The issue of 'organisational readiness' has a number of aspects including managing the change process and managing technology.

However, cultures evolve in path-dependent directions, occasionally punctuated by periods of stability and by rapid, step-type changes, "The evolution of culture is shaped by agency and power" (Weeks and Gulunic, 2003). Furthermore, "despite agreement that cultural evolution occurs..., espoused approaches to culture interventions are more commonly revolutionary in nature" (Harris and Ogbonna, 2002). When faced with change, most people exhibit strong preference for the familiar and so, tend to resist; if change does occur, there is a strong tendency to revert to prior norms.

Perspectives on changes in cultures span two extremes. Functionalists believe that organisational culture can be controlled by management directly and so, are instrumental in promoting the cultural basis for determining organisational performance. The alternative perspective regards culture as a context within which action must be taken and so, necessitates compatibility of action with the cultural environment. A third category is the perspective that culture is malleable and so, may be adapted – albeit that adaptations are likely to be difficult and require effort over long periods. However, even the most carefully devised and conducted change initiatives are likely to have unanticipated consequences – including ritualisation of change, cultural erosion, hijacking of the process, and uncontrolled and uncoordinated effects (Harris and Ogbonna, 2002).

Sharpe, Benfield and Francis (2006) discuss a range of change practices and identify the important factors: flexibility in practices that allow institutions to contextualise their plans for change, the facilitation of communities of key staff and creating opportunities for staff to voice and challenge their beliefs about e-learning. Adoption of technologies to support the change for e-learning is important, as is the development of an institutional e-learning strategy.

The significance of strategic and cultural issues is highlighted by McPherson and Nunes (2006) who analyse 66 critical success factors into 4 clusters for e-learning implementation. Out of 66 factors, 31 related to the first cluster of 'leadership, structural and cultural issues'.

As Macpherson et al (2005:44) point out, the complexity of the change involves a number of interfaces, e.g., senior management, suppliers and potential learners, and change management must be "a strategically led and supported initiative that

integrates with the overall business strategy and not just a cost-saving and efficiency measure”.

E-learning is no longer seen as a ‘tool’ but is at the forefront of driving a culture change – changing the way teachers teach and learners learn. Salmon (2005) reminds us that a sustainable change is not achieved by learning technologies alone but involves art, craft and science and, so, offers a four-quadrant model. The model being based on experiences at the University of Leicester, of e-learning and pedagogical innovation strategic framework to capture the complex strategic processes of e-learning in universities. The four-quadrants represent ‘stages’: Quadrants 1 and 2 suggest deployment of a university’s key strengths in teaching excellence (but with adjustments to new technologies), Quadrant 3 suggests deploying the understanding of technologies already in place to promote business development, solve problems and increase quality of all kinds, Quadrant 4 represents a more radical view of change using peripheral technologies, new products, new markets and missions.

Since the role of innovative technologies is like a platform on which the staff and students could work towards effectiveness of e-learning diffusion in terms of learning outcome, it is important to examine the current use of ICT in various universities regarding construction/engineering education. Some examples are given in this paper.

## **USE OF ICT IN CONSTRUCTION/ENGINEERING EDUCATION AND TRAINING**

There is great importance of interaction in the online teaching environment and the role of staff development in developing teacher presence online (Wilson and Stacey, 2004). Online technologies must be integrated into teaching to make interaction possible. The types of interaction can be categorised into learners interacting with computer programmes, learner-to-teacher or learner-to-learner interaction requiring mediation of tutors. To cultivate on-line communication, the pedagogical design of courses/programmes must allow for student peer communication and provide a means of instant feedback to all participants.

Collaborative learning models are being incorporated increasingly in course design. E-learning delivery is introduced into institutional policies in Australia, Hong Kong, UK and other countries to various extents. For instance, Ahmed et al (2006) of the University of Salford develop web-based teaching of construction via the semantic web and it is advocated that the semantic web offers platform independence and intelligence in web-based educational applications and a solution to e-learning tools (Ahmed et al, 2006).

Hodgson et al (2008) report their use of e-learning materials for building measurement to undergraduate students in Loughborough University, UK and the University of Newcastle, Australia. One aspect of their e-learning delivery aims to improve quantity surveying students’ understanding of construction drawings; thus, various 3D models using Google SketchUp and Camtasia Studio are utilised. It is emphasised that the e-learning tools are not intended as a replacement for traditional course delivery but rather complementing conventional approaches by providing students with convenient access to repositories of knowledge and procedures. An on-line survey (28 responses) was conducted among the on-campus and distance learners in both the universities (Loughborough and Newcastle) using the e-learning materials for building measurement. Most students (56%) from the survey responded that they wanted on-

line as well as face-to-face tutorials. It was also reported that some students found it difficult to acquire the mix of skills and knowledge within the timeframe allowed.

A student-survey (192 responses) at Leeds Metropolitan University by Ellis, Dickinson, Green and Smith<sup>4</sup> regarding undergraduate virtual reality surveying application suggested that e-learning complements traditional learning approaches, maintains student interest, and reinforces understanding. There are however, significant differences in student ratings for part-time and full-time cohorts leading to suggestions for enhanced interactivity within construction technology teaching.

In Asia, Chung et al (2006) report the use of e-learning to deliver construction technology to undergraduate students in the Hong Kong Polytechnic University. Their online mode is offered through the Hong Kong CyberU. Their on-line survey (185 responses) conclude that e-learning is a practical method to deliver teaching in construction technology as it helps student to improve their learning independence, learning efficiency and, to a certain extent, learning effectiveness. It is however to be noted, these improvements would not necessarily result in achieving a better examination result.

A more comprehensive survey in a Taiwanese university (560 responses including students other than construction/engineering) investigating students' perceived satisfaction and effectiveness of e-learning is given by Liaw (2008) who concludes that (1) learners' characteristics will influence learners' perceived satisfaction, and perceived usefulness of a product, (2) environmental characteristics affect perceived satisfaction, perceived usefulness and e-learning effectiveness, (3) perceived satisfaction and usefulness positively affect learners' behavioural intention of e-learning usage, (4) there is a significantly high correlation ( $r=0.70$ ) between learners' behavioural intention to participate in e-learning and its effectiveness.

In collaboration amongst universities in UK, Hong Kong, Singapore and Australia, Kumaraswamy, Miller, Rahman, Pickernell, Ng, and Wong (2006) develop web-based tools for teaching and training university engineering students as well as small and medium contractors in Hong Kong. It is envisaged that it would enable users to communicate seamlessly on project-specific information management platforms to improve performance on specific projects across more sustainable construction supply chains. Kumaraswamy et al's endeavour to advance ICT in web-based delivery of construction education/ training is supported by a group of universities – the University of Hong Kong, Hong Kong University of Science and Technology, City University of Hong Kong and the Hong Kong Polytechnic University – to develop a web-based learning package known as CIVCAL. Both UK and Australian advisers are involved in the development of CIVCAL including the Centre for Innovative Construction Engineering at Loughborough University, the Welsh Enterprise Institute at the University of Glamorgan, the Australian Centre for Construction Innovation at the University of New South Wales, Australia and the National University of Singapore in Singapore.

However, students' learning behaviours are important and these behaviours can be cultural-bound. An interesting question is whether, and how, cultural differences might affect students' responses to e-learning effectiveness.

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<sup>4</sup> [http://www.leedsmet.ac.uk/teaching/vsite/teachers/beecon\\_ellis.pdf](http://www.leedsmet.ac.uk/teaching/vsite/teachers/beecon_ellis.pdf) accessed 18<sup>th</sup> June 2009

## **Cross-cultural delivery**

The approach of acquiring learning materials from institutions/programmes developed in other parts of the world for local learners “is not without risks in terms of the suitability of materials embedded with cultural contents ‘foreign’ to local learners, or in terms of the suitability of assumptions in the communication context” (Wong, 2007). Globalisation enhances the possibilities of cross-cultural delivery of programmes, e.g. distance-learning construction programmes offered overseas, but at the same time there is the issue of how the cross-cultural delivery of educational programmes could be handled with sensitivity to the threat of cultural imperialism (Wong, 2007).

McLoughlin and Oliver (1999) mention that having a culturally uni-dimensional course (a culturally neutral course) may run the risk of having a course for all people but pleases nobody since instructional design cannot be culturally neutral because the process of instructional design is about the creation of cultural identity. Other recent research investigating the issues in cross-cultural comparison are Ge and Thomas (2007) who look at accounting students, while Leung, Wang and Chan (2007) and Leung, Xu, Chen and Lu (2008) investigate construction/engineering students to compare surface-learning and deep-learning approaches of students from different cultures.

## **TOWARDS A RESEARCH FRAMEWORK**

Based on the current research directions relating to e-learning, the important areas identified are:

1. student learning behaviours – leading to effectiveness and satisfaction
2. institutions’ support – leading to staff development, technology acquisition, strategy and culture
3. student-staff-institution integrated issues – pedagogy, interactivity, cross-cultural sensitivity and appropriate evaluation management tools.

A framework for research is shown in figure 1 with the research aim:

*“To investigate the current e-learning diffusion in construction-related programmes in UK higher education and the effect of organisational (and/or national) culture on students’ learning behaviours and e-learning effectiveness”.*

The following research questions are formulated:

### *Students*

1. Is self-regulatory learning behaviour a significant factor in achieving e-learning outcome?
2. What is an appropriate e-learning culture to support students’ learning approach?

### *Institutions*

1. What is the current e-learning diffusion in construction-related programmes in the UK?
2. Does the existing organisational culture in the higher education institutions enhance e-learning?



### *Integrated*

1. Do national culture dimensions affect on-campus student learning behaviour in an overseas environment?
2. How to develop an evaluation tool for e-learning in the learning management system?

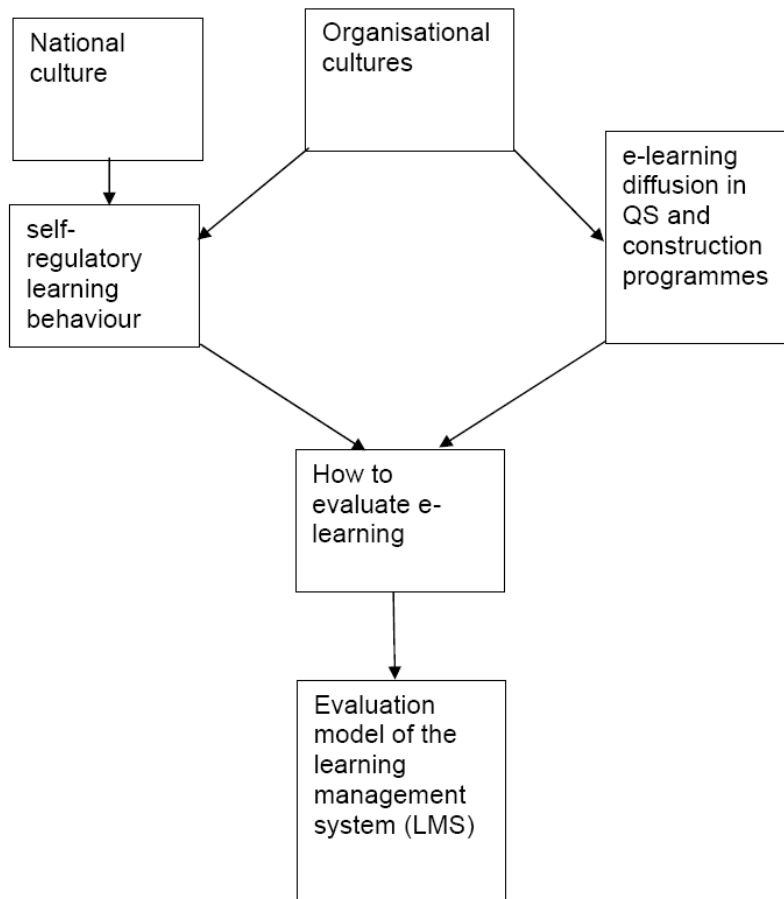


Figure 1: Research Framework

## **CONCLUSION**

A few issues underpin the proposed research framework: (1) pedagogical, (2) cultural, (3) technological. Social constructivism as an explanatory theory for online learning effectiveness enables learners to actively construct their own perspectives.

Expectation of learners for online interactivity means that learner control of the environment with active communication to provide feedback is essential.

Furthermore, cross-culturally delivered programmes should begin with the epistemology of constructivist theories of learning and to acknowledge that “learning is socially-grounded and located within communities with particular cultures, values and expectations” (Wong, 2007). To underpin the shifts, both in understanding and behaviours, required for the change in curriculum and pedagogical processes arising from e-learning is the re-engineering of institutional culture that recognises the variety of supportive, especially technological, mechanisms.

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