E-LEARNING & PEDAGOGICAL CHALLENGES IN CONSTRUCTION MANAGEMENT: BRIDGING THE GAP BETWEEN ACADEMIA AND INDUSTRY.

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In this day and age, there are a number of challenges that are facing higher education and the construction industry. Many of these challenges are driven by the need for change. These changes are forced upon us often due to changes in government policies, society and culture, making it harder to strike the balance between the educational methods of delivery and meeting the demands of a highly competitive construction industry. This also adds pressure on educators and curricular developers to bridge the gaps between academia and industry, which is often proven uneasy, particularly in view of the rapid changes due to the arrival of new technologies. E-learning however, is a tool that can aid with filling these gaps through monitoring its impact upon individual learning and organisational learning. This paper describes the stages of the learning process for both, individuals and organisations and the role of E-learning in producing a blended learning approach. The paper also describes a framework that can be adopted to enhance this process and assist in bridging the gap between academia and industry and bridge the gaps.

KEYWORDS: e-learning, CPD, e-learning in construction management

INTRODUCTION AND BACKGROUND

The construction industry is a key economic driver for both the Irish and British economies. At the end of 2002, 238,000 people (or 14% of the workforce) were employed both directly and indirectly in the Irish construction industry (www.irishconstruction.com). The value of construction activity in Ireland at the end of 2002 was €20.3 billion or over 20% of economic activity in Ireland (www.cif.ie). By comparison, in the UK construction output was valued at £69 billion in the same year (Compagnia; 2003). The nature of construction is that of a service industry. The companies offer skills, not products. Projects can range from straightforward housing projects through to complex pharmaceutical developments. As a consequence it is an industry with low barriers to entry. This has resulted in the industry being very fragmented, which has accounted for its competitive nature and the variety of suppliers and skills required by people within the industry. Construction organisations continue to be affected by government policies, the changing demands of clients in the industry, changes in procurement routes, changes in the use of information and communication technology (ICT) and integrating technology into the operations of the business. The demands on professionals such as engineers, architects, quantity surveys and construction managers are considerable in terms of their time and experience. Similarly, the requirements of tradesmen and other personnel in the industry are no less stringent.

Recent studies in both the UK by Latham (1994) and Egan (1998), and in Ireland by Forfas (2003) into the construction industry have addressed some of these issues and have made recommendations to improve practices and performance within the industry. A key driver in addressing the issues identified in many of these studies has been the recognition that learning and training are a key element in delivering these projects, resulting in more certainty of time of completion and within budget. However, the intensity of workload that exists within the construction industry in the British Isles means that frequently there is insufficient time available for effective learning to take place to meet deficits within the industry (Construction Industry Council; 2004).

Continuing Professional Development (CPD) can be considered as the planned acquisition of knowledge, experience and skills and the development of personal qualities necessary for the execution of professional and technical duties throughout a constructional professional life, encompassing both technical and non-technical matters (http://www.iei.ie/Education/Education.pasp accessed 19th June 2004). What distinguishes CPD from other forms of learning, however, is that it is self-motivated, self-directed and self-monitored (Bridges and Grierson; 2000). Recognition exists within professional bodies for both formal and informal methods of learning. Figure 1 outlines the formats that CPD can take.
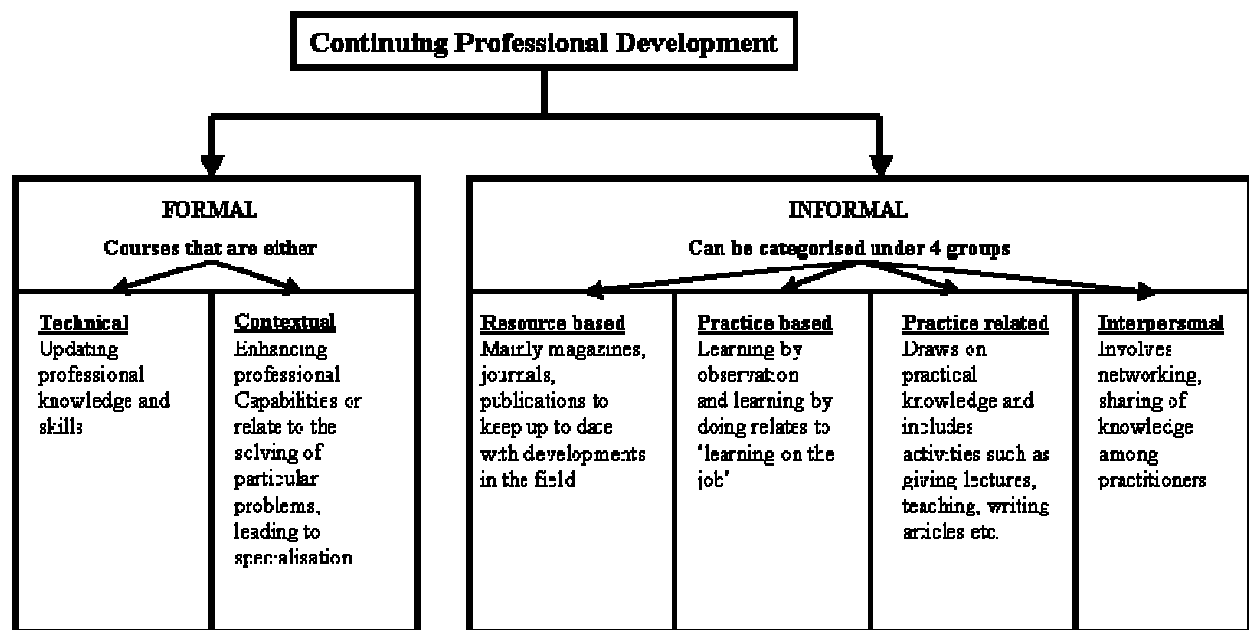

Figure 1 Forms of CPD learning that exist

Source: compiled from Bridges and Grierson (2000) and various professional institution websites including Royal Institute of British Architects, Institution of Civil Engineers, Royal Institute of Irish Architects Institution of Engineers of Ireland and the Society of Chartered Surveyors

A study by Brosnan and Burgess (2003) highlighted that 76% of professionals surveyed engaged in using the Internet to support their professional learning. Supporting this Brosnan and Burgess (2003) cite an earlier study, which found that out of 34 professional bodies, 33 anticipated more use of Internet technologies within a 2-year period to support members' CPD requirements. In a situation where construction professionals and professional bodies are open to using technology to address their

CPD requirements, the key question that this research will address is how can educational providers develop a framework to meet these needs?

CHALLENGE TO EDUCATIONAL INSTITUTIONS

A model that can be quite useful to illustrate the position of traditional learning and the integration of ICT in educational institutions can be seen in figure 2. This proposes 4 scenarios for the future of e-learning development for educational.

### Figure 2 Future Development of E-learning
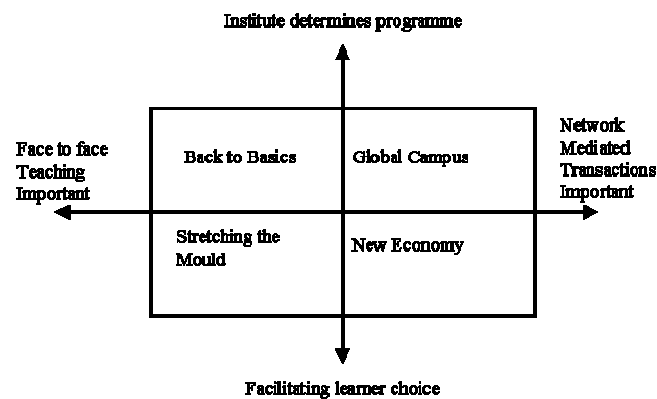
Source: Collis and van der Wende (2002)

Much research on Higher Educational Institutes in Europe indicates that the model most educational bodies are adopting is 'Stretching the Mould' often referred to as 'blended learning'. Blended learning at its most basic level is "the thoughtful integration of classroom face to face learning experiences with online experiences" (Garrison and Kanuka; 2004). Blended learning can affect the way people learn and can help to promote the experiential learning experience and enable or empower the learner.

A logical progression of this approach is the targeting of markets for professional development and up-skilling where short modules can be offered on line on 'needs' bases to learners. This model is referred to as the 'New Economy' model. Klein and Ware (2003) state that CPD requirements can be fulfilled through the use of learning resources available on-line or packaged into specially tailored e-learning resources. There are various options available in implementing "The New Economy Model" to address these CPD needs in the construction industry. Klein and Ware (2003) believe that the continuing need for CPD opens up new opportunities for the application of e-learning to address learning needs.

Attempts to exploit the 'Global Campus' model (where there are highly developed programmes, fully supported on-line, are offered and services in a global rather than national or local environment) have been more prevalent in the US, however not always successfully (Collis and van der Wende; 2002). The crash of NYU Online and the failure of the UkeU initiative are more recent examples illustrating the dangers for educational institutions in embarking on a 'Global Campus' pathway.

Figure 3 E-Learning Hype Cycle and "Dot-com" crash
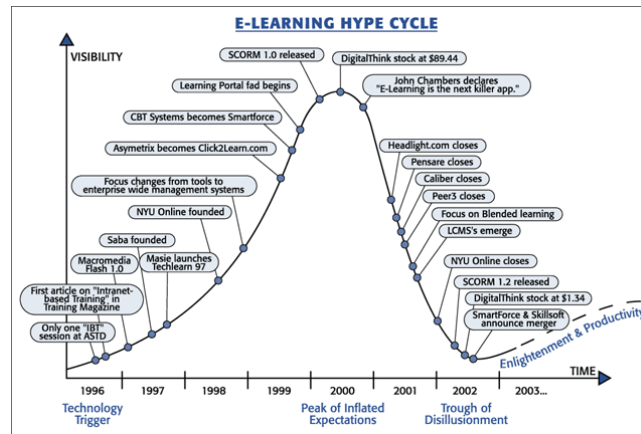
Source: http://www.e-learningguru.com/articles/hype1_1.htm accessed 18th June 2004

Often it is in an eagerness to embrace technology that an understanding of the fundamentals of learning and how it occurs is overlooked (Hamid; 2002). This coupled with the "dot-com" crash resulted in the sharp decline of many e-learning providers and on-line institutions. Figure 3 illustrates dramatically the rush to market and the consequent crash that has occurred with the evolution of e-learning. In looking forward to the period of "enlightenment and productivity" one key issue is what model or framework will avoid the costly lessons learned by educational organisations such as NYU Online who attempted to set up a "for profit" wing unsuccessfully (Publishers Weekly; 2001)?

E-LEARNING AND MEETING THE CHALLENGE

There is no definitive agreement on what e-learning is and on terminology used to describe the use of technology in learning (Romiszowski; 2004). Romiszowski (2004) found more that 50 different definitions of the term. From this research Romiszowski developed what he terms a "structured definition of e-learning". The framework developed is as illustrated in table 1.

**Table 1 Structured definition of e-learning**

	INDIVIDUAL SELF STUDY Computer Based Instruction/Learning/Teaching (CBI/L/T)	GROUP COLLABORATIVE Computer Mediated Communication (CMC)
ONLINE STUDY Synchronous Communication ("REAL-TIME")	Surfing the Internet, accessing websites to obtain information or to learn (knowledge or skill)	Chat rooms with(out) video Audio/Video conferencing
OFFLINE STUDY Asynchronous Communication ("FLEXI-TIME")	Using stand-alone courseware / Downloading material from the Internet for later local study	Asynchronous communication by email, discussion lists or a Learning Management System

Source: taken from Romiszowski (2004) page 6

This framework emphasises that e-learning may be either a solitary individual activity or a collaborative group activity where both synchronous and asynchronous communication can take place or a combination of all of these. There are a variety of technology levels, tools, frameworks and architecture systems available to the developer of a CPD programme (Ismail; 2002). Guerra and Heffernan (2004) developed the Guerra Scale (see figure 4), which outlines the range of e-learning content that a learner can use. It is an attempt to describe an increasingly interactive

user experience using a 1 to 10 scale in which 1 involves simple reading text on a screen through to 10 representing a virtual reality scenario.

Figure 4 Levels of Online User Experience
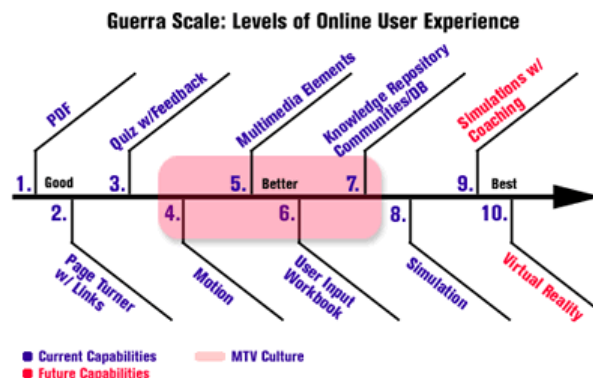
Source: Guerra and Heffernan available at
http://www.learningcircuits.org/2004/mar2004/guerra.htm

Typically when budgets are restricted, there is a tendency to upload lecture notes in PowerPoint, Word or PDF format (McNamee and Wall; 2001). While this can aid the learning process, the key question is whether this is instruction or just information. It can be effective as a supplement to other classroom instruction or as background material. However, a key question is, if it is just information, does effective learning really occur?

Buch and Sena (2001) posed important questions when looking at the benefits of using the Internet in education. The questions they asked were:

1. Do individuals learn differently with on-line instruction than traditional classroom situations?

2. Can the same teaching strategies be used with on-line as traditional methods and will they be as effective?

3. Do individuals' react differently to on-line instruction and how can individual differences in learners be accommodated?

An understanding of how learning takes place, learning theories and consideration of learning styles can help in answering some of the issues with respect to how learning takes place (Ertmer and Newby; 1993).

HOW LEARNING OCCURS

Learning can be defined as the acquisition of knowledge or skill (Oxford English Dictionary; 1991). Learning is not a simple act. The Chinese proverb, attributed to Confucius (450 B.C.), summarises the importance of understanding the pedagogical processes that take place when learning occurs:

"Tell me, and I will forget, show me, and I may remember, involve me, and I will understand."

Key to understanding cognitive processes is an understanding of learning theories. Learning theories have evolved from psychological studies and have changed in response to, and because of, advancing theories of cognitive development (Ertmer and Newby; 1993). For any type of learning to be effective, whether it is classroom based

or computer based, it has to be built on sound pedagogical principles. What has changed considerably in more recent times is the evolution of ICT and how technology can be configured to incorporate the "tell", "show" and "involve" that are prerequisites of effective learning (Sit; 2001).

A number of pedagogies and approaches to learning are referenced in literature, from behaviourism and constructivism in terms of learning theories, to experiential and organisational learning (Ertmer and Newby; 1993, Kolb; 1984). Three of the principle learning theories can be identified as behavioural, cognitive and constructivist (Ertmer and Newby; 1993). In designing learning it helps to understand the principal attributes, strengths and weaknesses of behaviourism, cognitivism and constructivism (see table 2).

Table 2 Principal Attributes, Strengths and Weaknesses of learning theories

Learning Theory	Principle Attributes	Strengths	Weaknesses
Behaviourism	Based on observable changes in behaviour. Behaviourism focuses on a new behavioural pattern being repeated until it becomes automatic.	The learner is focused on a clear goal and can respond automatically to the cues of that goal. Pilots in simulators can be conditioned to react to in a particular way when an emergency landing is required so that the response becomes automatic.	The learner may find himself or herself in a situation where the stimulus for the correct response does not occur, therefore the learner cannot respond. A school child that has been conditioned to respond to an action by a teacher in a particular way is unsure as to do when a new teacher arrives.
Cognitivism	Based on the thought process behind the behaviour. Changes in behaviour are observed, and used as indicators as to what is happening inside the learner's mind.	The goal is to train learners to do a task the same way to enable consistency. Logging onto and off of a workplace computer is the same for all employees, it may be important do an exact routine to avoid problems.	The learner learns a way to accomplish a task, but it may not be the best way, or suited to the learner or the situation. For example, logging onto the Internet on one computer may not be the same as logging in on another computer.
Constructivist	Based on the premise that we all construct our own perspective of the world, through individual experiences and schema. Constructivism focuses on preparing the learner to problem solve in ambiguous situations.	Because the learner is able to interpret multiple realities, the learner is better able to deal with real life situations. If a learner can problem solve, they may better apply their existing knowledge to a novel situation.	In a situation where conformity is essential and divergent thinking and action may cause problems. Imagine the problems that would arise if every person decided to report their taxes in their own way - although, there probably are some very "constructive" approaches used within the system we have.

Source: compiled from Ertmer and Newby (1993)

Ertmer and Newby (1993) believe that the strategies promoted by different learning theories overlap (the same strategy for a different reason). This is illustrated in Figure 6.

Figure 6 Cognitive Processing Required
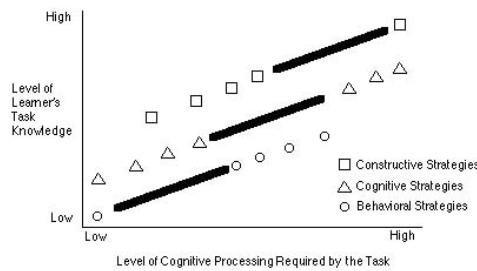
Comparison of the associated instructional strategies of the behavioral, cognitive, and constructivist viewpoints based on the learner's level of task knowledge and the level of cognitive processing required by the task.

Source: Ertmer and Newby (1993)

Ertmer and Newby (1993) believe that learning theory strategies are concentrated along different points of a continuum depending of the focus of the learning theory - the level of cognitive processing required. Ertmer and Newby's (1993) suggestion that theoretical strategies can complement the learner's level of task knowledge, allows the designer to make the best use of all available practical applications of the different learning theories. In progressing from behaviourist to cognitive to constructivist theories the focus of instruction moves from teaching to learning (Ertmer and Newby; 1993). With this approach the designer is able to draw from a large number of strategies to meet a variety of learning situations.

A key question posed by Ertmer and Newby (1993) is how does one facilitate a proper match between learner, content and instructional approaches when one considers that both the instructional strategies used and the content addressed would vary depending on the profile of a group of learners. Different learners have different cognitive processes, learning style preferences and past experiences that they apply when learning takes place (Kolb; 1984, Riding; 1996). An individual's learning style will affect the manner in which information is processed during learning and thinking, having a considerable effect on the learning effectiveness and efficiency (Riding; 1996). Kolb (1984) conceptualised learning as a four-phase process starting with concrete experience, followed by reflective observation, then abstract conceptualisation and the active experimentation.

Kolb (1984) observed that learners do not engage with each step of the process but rather have a particular affinity for certain aspects of the cycle (Buch and Sena; 2001). Kolb (1984) identified individual differences in the process along 2 axes, on a vertical axis representing how an individual prefers to apprehend information and a horizontal axis denoting a preference for how an individual processes information.

Figure 7 Kolb's Experiential Learning Circle
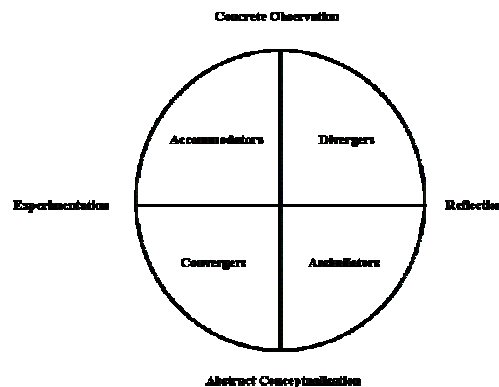
Source: Buch and Sena (2001)

Kolb (1984) classified these as four preferences or learning styles that learners have and he referred to these as accommodators, divergers, convergers and assimilators. Later work by others including Buch and Sena (2001) and Svinicki and Dixon (1995) identified possible instructional strategies that could be used in both classroom and on-line situations to accommodate the learning characteristics of the different learning styles. These are summarised in table 3.

The Sharable Content Object Reference Model (SCORM) defines a Web-based learning "Content Aggregation Model" and "Run-time Environment" for learning objects (http://www.adlnet.org accessed 21st June 2004). Learning objects and

SCORM address the need to combine self-contained units of learning (learning objects) into larger instructional experiences, and enable designers to reuse these smaller components of learning content rather than developing the same components over and over again (Robson; 2003). Having identified that there are different technologies and different learning styles for different learners the challenge is to configure technology to deliver CPD learning in an effective manner.

Table 3 Learning Styles characteristics, traits and instructional strategies

Learning style	Learning Characteristic	Description	Possible Instructional Strategies
Accommodator	Concrete experience and active experimentation	➢ Greatest strength is doing things ➢ More of a risk taker ➢ Process information actively ➢ Performs well when required to react to immediate circumstances ➢ Solves problems intuitively ➢ Often ask question 'what if?'	➢ Simulations ➢ Observations ➢ Examples ➢ Laboratories
Divergers	Concrete experience and reflective observation	➢ Strong in imaginative ability ➢ Apprehend information through concrete experience ➢ Good at generating ideas and seeing things from different perspectives ➢ Interested in people ➢ Broad cultural interests	➢ Laboratories and observations ➢ Simulations ➢ Brainstorming ➢ Rhetorical questions and log entries
Assimilators	Abstract conceptualisation and reflective observation	➢ Accurate and organised information ➢ Strong ability to create theoretical models ➢ Excels in inductive reasoning ➢ Concerned with abstract concepts rather than people ➢ Do not enjoy active participation ➢ Like problem solving and conducting experiments	➢ Solving problems ➢ Conducting experiments ➢ Demonstrations ➢ A logical step-by-step Internet tutorial ➢ An Internet demonstration allowing reflection on the original information
Convergers	Abstract conceptualisation and active experimentation	➢ Not risk takers ➢ Prefer to learn in an environment that allows fail safe ➢ Learn by trail and error ➢ Strong in practical application of ideas ➢ Can focus on hypo-deductive reasoning on specific problems ➢ Unemotional ➢ Prefer to process material actively ➢ Have narrow interests	➢ On-line information presented via a well defined systematic and theoretical tutorial ➢ Completion of a case study with singular answers and immediate feedback on-line

Source: compiled from Kolb (1984) Svinicki and Dixon (1995) Buch and Sena (2001) and www.infed.org accessed 21st June 2004

METHODLOGY

Blended learning may bring about major changes in the way educational material is designed, developed and delivered to people who want to access learning but have other constraints that affect the process of learning (Pailing; 2002). The challenge that faces educational institutions is that in a situation where learning is recognised as complex set of interrelated cognitive processes and the evolution of ICT continues unabated developing a framework to address the lifelong learning needs of construction managers becomes a challenge. Previous failures outlined earlier increase the complexity of this task.

The aim of this research is to investigate the current methods of delivery of CPD in the construction industry in Ireland and the UK to promote lifelong learning within the industry. SCORM is a key consideration in the design of e-learning content and in considering the reusability, durability, interoperability and accessibility of content. An adherence to SCORM requirements in the development of e-learning content

should facilitate an increase in learning effectiveness significantly while reducing time and costs in development of material. In addition this research aims to bridge the educational gaps between industry and academia by developing a suitable blended learning solution. Figure 8 is an attempt to illustrate the process in developing a new framework to deliver CPD learning in the construction industry.

Figure 8 Outline of Methodology for Research Work
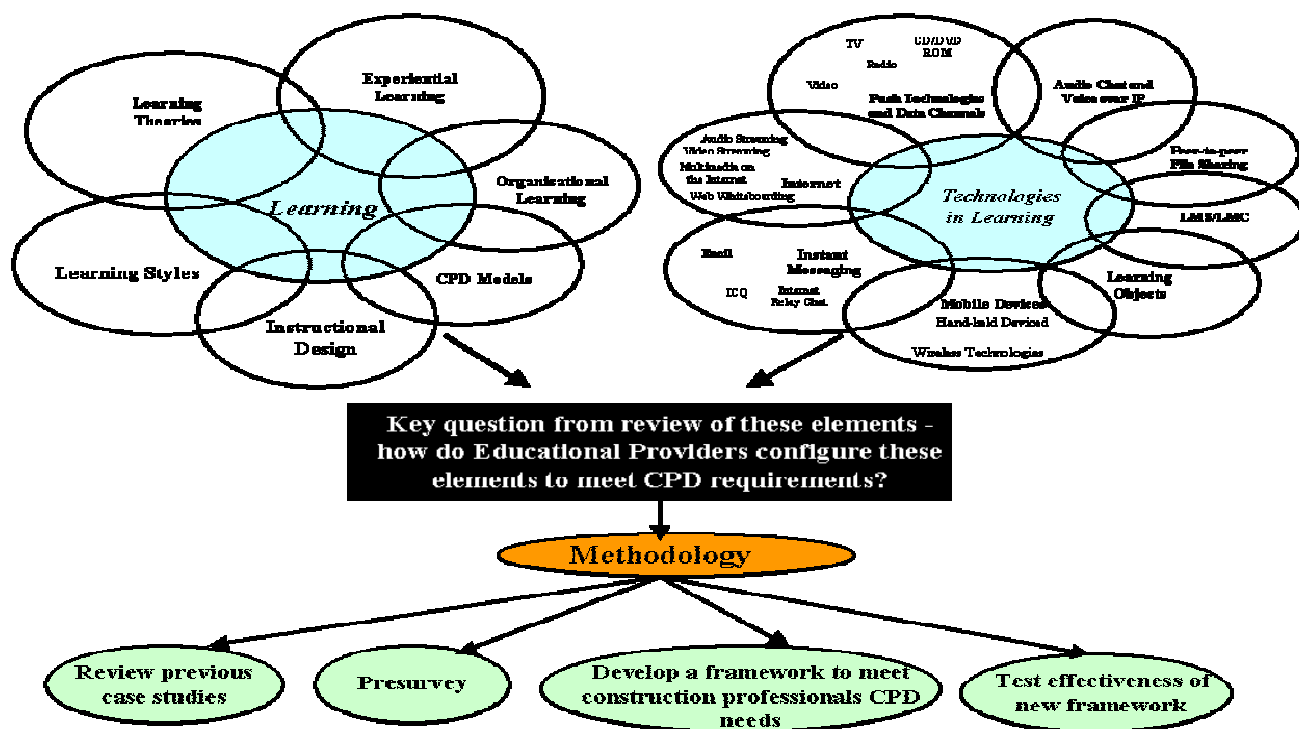
Wearne (2004) in a survey of chartered engineers identified two areas of managerial skills and expertise requirements, in leadership and in the management of projects. Using the area of project management as a module, a blended learning programme on project management will be developed and tested to formulate a framework. This framework will recognise the costly lessons that have been previously experienced by educational institutions and take account of learning theories and experiential learning to formulate a module of CPD in project management in the construction industry. To achieve this aim, the steps in the methodology outlined in table 4 will be adopted.

Table 4: Methodology

Step	Approach
1	Review previous case studies
2	*Pre-survey*
3	Formulation of New Framework
4	Test New Framework

The review of previous case studies will involve a review of two CPD programmes (i) Master of Science in International Construction Management and (ii) Certificate in Logistics where blended learning was used with limited success to identify potential pitfalls and review reasons for the pitfalls. Using previous research and the information acquired from the in-depth case study analysis a qualitative focus group survey will be established. It is anticipated that this survey of approximately 30 people will consist of detailed questionnaires and in depth interviews to identify issues

such as current CPD needs, barriers that exist to undertaking CPD, learning style preferences and comfort level with using technology. Based on the results of the pre-survey, a proposed framework for improving the delivery of CPD learning will be developed to incorporate the anticipated variations of learning preferences and the knowledge levels of the pilot group. A module on project management will look at using different technologies to address different learning styles and preferences and how these can encourage collaborative and organisational learning. Following on from this a post survey to measure the effectiveness of the framework module developed. Through the alignment of these various drivers focused on the delivery of CPD, a framework to bridge the gap between academia and the CPD needs of construction professionals will be postulated.

CONCLUSION

As funding mechanisms continue to change and rapid advances in ICT continue to transform the way education is delivered, developing a framework to deploy learning to address the diverse lifelong learning needs of construction professionals presents a challenge. The key question of this research addresses the way educational institutions can configure the various technologies to bridge the gap and address the CPD needs of construction professionals. The paper has described the concept of learning, and how e-learning can be used to promote experiential learning, hence, the mode of learning in construction. Future work will integrate these concepts and benefit from the analysis of cases studies developed for promoting CPD in order to bridge the gap between industry and academia.

BIBLIOGRAPHY

Bridges Alan & Grierson Hilary *The use of Internet Technologies in Delivering Architectural CPD* Construction Information Technology 2000 taking the industry into the 21st Century Volume 1 2000 pp 136 - 144

Brosnan Kevin and Burgess Robin C. *Web based continuing professional development – a learning architecture approach* Journal of Workplace learning Volume 15 Number 1 2003 pp 24- 33

Buch Kim and Sena Chris *Accommodating Diverse Learning Styles in the Design and Delivery of On-line Learning Experiences* International Journal of Engineering Education 2001 Volume 17 Issue 1 pp 93-98

Compagnia *Collaborative software in the construction industry* (2003) available to download http://cobweb.businesscollaborator.com/pub/english.cgi/0/6618106?op=rdb_add_record&template=10555902

Collis, B. and van der Wende, M.[Eds., 2002]. *Models of Technology and Change in Higher Education: An international comparative survey on the current and future uses of ICT in Higher Education*. Centre for Higher Education Policy, Twente University, Netherlands. http://www.utwente.nl/cheps/publications accessed 19th May 2004

Construction Industry Council *Built Environment Professional Services Skills Survey 2003/2004 Survey Results* 2004 report available at http://www.cic.org.uk/services/publicationsCIC.shtml accessed 20th May 2004

Egan, Sir Michael *Rethinking Construction The Report of the Construction Task Force to the Deputy Prime Minister, John Prescott, on the scope for improving the quality and efficiency of UK construction* (1998) Department of the Environment, Transport and the Regions London

Ertmer P.A. and Newby, T.J. *Behaviorism, Cognitivism, Constructivism: Comparing Critical Features from and Instructional Design Perspective* Performance Improvement Quarterly Volume 6 Issue 4 1993 pp 50-72

Forfas *The Demand and Supply of Engineers and Engineering Technicians* Expert Group on Future Skills Needs Report To the Tanaiste, and Minister for Enterprise, Trade and Employment and the Minister for Education and Science 2003

Garrison D. Randy and Kanuka Heather *Blended learning: Uncovering its transformative potential in higher education* Internet and Higher Education Volume 7 Issue 2 2nd Quarter 2004 pp 95-105

Guerra Tim and Heffernan Dan *The Guerra Scale* paper available to download at http://www.learningcircuits.org/2004/mar2004/guerra.htm accessed 7th May 2004

Hamid Azma Abdul *e-learning Is it the "e" or the Learning that matters?* The Internet and Higher Education Volume 4. 2002 pp 311-316

Ismail Johan *The design of an e-learning system Beyond the hype* Internet and Higher Education 2002 Volume 4 pp 329-336

Klein Donald and Ware Mark *E-Learning: new opportunities in continuing professional development* Learned Publishing Volume 16 No. 1 January 2003. pp 34-46

Kolb David A. *Experiential Learning: Experience as the Source of Learning and Development* Prentice Hall Englewood Cliffs, NJ 1984

Latham Sir Michael *Construction The Team Joint Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry* 1994 HMSO

McNamee F. & Wall J. *Delivering Effective E-Learning* December 2001 pp19 – 21 HRD Ireland.

Oxford English Dictionary 1991 Third Edition

Pailing Marcus *E-learning: is it really the best thing since sliced bread?* Industrial and Commercial Training Volume 34 Number 4 2002 pp151-155

Publishers Weekly *NYU online Folds* Volume 248 No. 50 2001 page14

Riding Richard *Learning Styles and Technology-Based Training* University of Birmingham 1996 Department of Education and Employment UK

Robson Robby *Leveraging modeling & simulation capabilities* Training and Innovation 2003 Vol.4, Issue 5; page 11

Romiszowski Alexander J. *How's the E-learning Baby? Factors Leading to Success or Failure of an Education Technology Innovation* Education Technology Jan-Feb 2004 pp5-48

Sit K. H. *Facilitating the Shift from 'Tell Me' to 'Involve me' in GER* 2001 Article available at URL: http://www.cdtl.nus.edu.sg/link/nov2001/teach2.htm access date: 24th April 2004

Svinicki M.D. and Dixon N.M. *The Kolb model modified for classroom activities* College Teaching Volume 34 Number 4 1995 pp141-146

Wearne, Stephen *Professional engineers' needs for managerial skills and expertise* Proceedings of the Institution of Civil Engineers February 2004 Volume 157 No. 1 pp44-48