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An Empirical Study on E-Learning for Construction Education

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Abstract

It is commonly accepted that information and communication technology has made much impact in the ways we work and learn. The paper aims to measure the change of the students' perception on e-learning by comparing the survey results before and after having experienced an e-learning session. This paper presents the results of an empirical study on e-learning in undergraduate construction education where there results were cumulated over a period of three years. The results show that while the majority of students indicated that it is feasible and effective to use e-learning in construction education, they prefer an integration of face-to-face and e-learning methods rather than solely face-to-face or solely e-learning method. From learning outcome perspective, the students considered that there was little difference in the level of mastery obtained by e-learning compared with face-to-face method. It is concluded that e-learning is an effective tools for learning and teaching and should be integrated into today's learning and teaching.

Keywords: e-learning, construction education, learning outcomes, face-to-face learning, effectiveness

Introduction and Research Needs

E-learning (also called online learning or multimedia learning) refers to the use of information, communication and Internet technologies to deliver a broad array of solutions that enhance knowledge and performance. E-learning has the capability of instant-updating, storage/retrieval, distribution and sharing of instruction, information and knowledge. It also has the capability of providing instant assessment, evaluation and feedback on learning performance. The other advantages of e-learning include: capable of presenting the learning materials in different forms, including text, photo, video or animation; more efficient and centralised maintenance of up-to-date course materials; paperless delivery; allow local or remote classroom access; flexible learning time; self paced learning; online assessment; better monitoring of learning participation and performance; capable for large class size; enables cross disciplinary collaboration and reduces unnecessary duplication; and maybe more appealing to the dot.com generation.

Past research showed that e-learning continues to grow in popularity since it provides convenience and flexibility to learners and organizations the ability to deliver training quickly at reduced costs (Golladay, Prybutok and Huff, 2000; Lundgren and Nantz, 2003 and McDonald 2000), and "mastery of course material

(by e-learning) is equal or superior to that in traditional classrooms; students report higher levels of subjective satisfaction when compared with a traditional classroom on a number of dimensions, including access to their instructors, and overall quality of the educational experience; students perceive the experience as group learning rather than individual learning (Hiltz et. al., 1997)."

On a slightly different view, past research indicated that a "blended" approach (of e-learning and face-to-face) may be a better way of using e-learning. In the blended approach, besides using e-learning on the "front end" of classroom learning, it can also be used after the classroom experience to maintain an ongoing discussion among a community of users about course-related issues via chats, electronic discussion boards, or other technologies (Cappel and Hayen 2004). In addition, research by Oliver and Omari (2001) concluded that while the majority of the students saw the value to be gained from e-learning in student-centered and collaborative setting, many expressed a preference for learning in the more conventional teacher-directed forms. Abas (2003) claimed that "there isn't a so-called best method of learning. E-learning is probably the best at providing a different learning experience. It may be comfortable and exciting for some, not so for others. What's certain is that e-learning is a good addition to the list of pedagogies currently available. In spite of what it offers or does not offer, it has caught the attention of many and convinced others to go in that direction (Abas, 2003:1)."

On the other hand, research showed that develop and implement e-learning requires major time, effort and commitment and there are a number of issues must be considered. Beasley and Smyth (2004) claimed that when developing an online learning environment, it is important to consider the likely educational experiences of students in relation to online learning and give explicit instructional guidance on how to operate them as well as provide self-assessment tools and materials to allow students to test their understanding and reflect on the effectiveness of their learning. Research by Lindh and Soames, (2004) also showed that when implementing e-learning, it is important to develop a well-structured course which includes the administration as well as the content and consider individual learning styles/approaches and their computer skills. Furthermore, learning in an online environment requires a significant amount of discipline and self-motivation (Golladay et al 2000 and Serwatka 2003);

In summary, while e-learning has been seen as an effective manner there is still much research needed to make better decisions about how e-learning can be applied most effectively. As mentioned by Cappel and Hayen (2004) "e-learning has often been pursued out of the convenience and flexibility it offers to learners, and the cost savings it provides to organizations. However, there is an ongoing need to assess its effectiveness compared to more traditional instructional approaches. Future research studies utilizing other samples, types of course content, technologies, and settings are encouraged. Research about e-learning as part of a blended approach to learning, which appears to hold significant promise, would be particularly beneficial. Additional research will allow academicians and practitioners to make better decisions about where e-learning can be applied most effectively, how, and under what circumstances" (Cappel and Hayen 2004: 55-56).

In light with the above mentioned past research findings and research needs, an empirical longitudinal study on e-learning has been carried out over a period of three years using an undergraduate third year course "Construction Technology" and this paper summarizes the main findings of this research.

Research Methodology

In this research, the targeted group was the students enrolled in third year course "Construction Technology", in a Bachelor of Building Construction Management study. The reason of testing e-learning using the construction technology course, is because it is a core subject, and it is believed that if a course of such complex nature is viable to be conducted using e-learning, it would imply identical viability on other construction courses.

A course website (as shown in Figure 1) was first developed using a number of software including, WebCT, Dreamweavers, Macromedia flush etc. The following WebCT tools were integrated into the e-learning course website where students have full access to.

- Syllabus -- to create a customised course outline with course and lecturer information.
- Content Module / Lecture Notes -- to organise, index and store course material, such as, lecture notes, references and multimedia presentations.
- Assignment / Tutorials – to create assignments and tutorials and allow submission of work through WebCT with the option of setting a time condition.
- Quizzes – to create multi-format online quizzes capable of being graded instantly, can include true/false, multiple choice, and short and long answer questions.
- Grade Management / My Grade – a register for marks that permits students to view their marks for each assignment, tutorial or quiz. Quizzes are automatically assessed and marks are automatically recorded here once a quiz has been completed.
- Discussion – to discuss topic areas. Discussions can be either public or private domains.
- Emails – allows students to send email messages to each other and the lecturer.
- Calendar – to post dates and provide information about course-related events.
- Site visits – contains information and instruction about visits to related construction sites, as part of the course requirement.

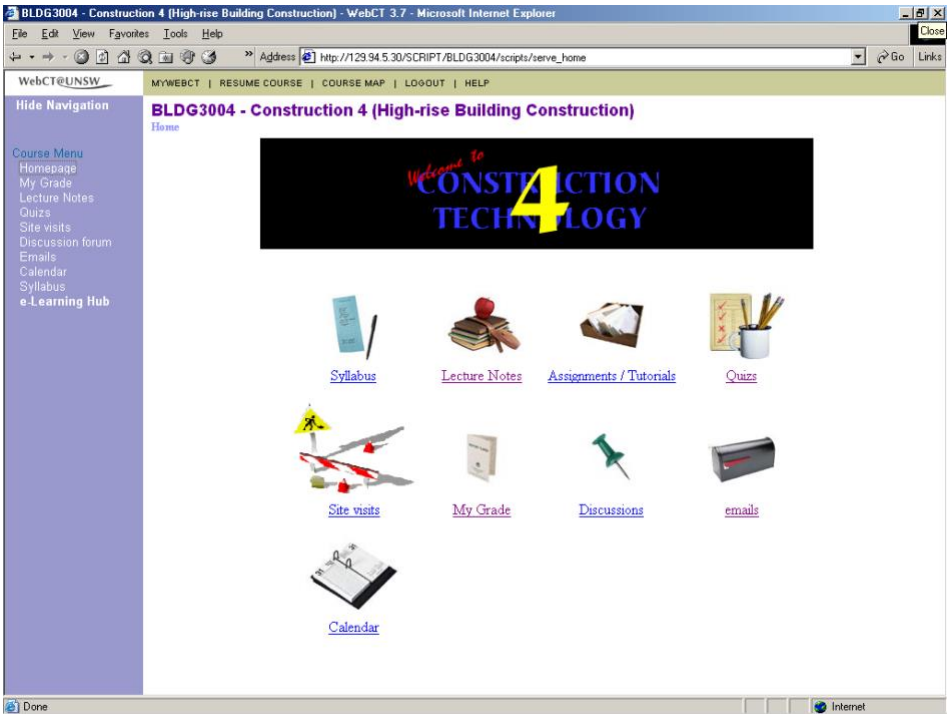

Figure 1 WebCT Tools used in the course website

The method of pre-e-learning and post-e-learning surveys was used with the aims set out as below:

1. To measure the shift in student's perception and understanding between pre and post e-learning.
2. To measure the effectiveness of the e-learning modules.
3. To identify the students' experience with the e-learning modules.
4. To identify areas for improvement in developing e-learning modules.

5. To conclude the viability of using e-learning in construction courses.

A survey (pre-e-learning survey) was conducted before the implementation of e-learning module. Another survey (a post e-learning survey) was carried out after the implementation of e-learning module. The post e-learning survey was conducted immediately after the complete delivery of the e-learning module, to prevent any undue influences from deterring a bona fide survey result. In order to allow the students to express their views freely in the survey, they remained anonymous throughout the research. Figure 2 shows the process of pre-e-learning and post-e-learning surveys.

Figure 2 Research method and procedure

In the surveys, the students were expected to rate/respond from a series of four options where the first two values (rating 3 and 4) constitutes positive implication on the questions asked, and conversely, the last two values (rating 1 and 2) constitutes negative impression. Software SPSS (Statistics package for social science) was used to analyze the data and their significance (by *p* tests).

Results and Discussions

There were 215 students enrolled in Construction Technology over the three years period (2002 to 2004). The response rate of pre e-learning survey was 66% (61%, 72%, 64% respectively), and the response rate of post e-learning survey was 60% (61%, 54%, 67% respectively).

Baseline survey -- Pre e-learning Survey

A total of 141 students participated in the pre e-learning surveys from 2002 to 2004 (50, 50, 41 respectively). Table 1 presents the results of the pre e-learning surveys over three years. The feasibility (ability) to access to the Internet outside university increased significantly over the years, from 78% to 100% ($p=0.006$, Table 1). Furthermore, the students' knowledge on e-learning also increased significantly over the three years from 60% to 88% ($p=0.01$, Table 1). These two indicators provided green light for using e-learning in construction education. However, only 50% of students consider that it is feasible to teach 'Construction Technology' using e-learning and this number seemed unchanged over the three years. On average about 44% of students considered e-learning as an effective method to teach 'Construction Technology' (but the figures increased from 34% to 54% over the three years). Further it is interesting to note that if given a choice, only 18% of students reported that they would be likely to enroll in this course if delivered by total e-learning. On average, more than half (53%) of students preferred combining face-to-face and e-learning together, and 36% still preferred face-to-face teaching only. It is interesting to note that

over the three years the shift on "total e-learning only" method dropped from 18% to only 2% despite the fact the students have gained more experience on e-learning. At the same time, there was also a drop in the total face-to-face preferences, from 46% to 28% and 32% in 2002, 2003 and 2004 respectively. On the other hand, the blended/combined method of face-to-face and e-learning has increased from 36% to 60% and 66% over the three years. Such shift indicates that the students, on one hand have positive experience of advantages of e-learning, but at the same time, they also felt a total e-learning may not be the best method to learn construction technology courses. These findings are in close agreement with Capel and Hayen (2004).

Table 1 Students' knowledge and attitudes to e-learning prior to e-learning (baseline survey)

	2002	*2003*	*2004*	*average*	*p*
Access to Internet outside university (percent)	78	88	100	88	0.006
Students' knowledge on e-learning (percent)	60	64	88	70	0.009
Feasible to teach construction courses using e-learning (percent)	40	57	54	50	0.2
Effective to teach construction courses using e-learning (percent)	34	47	54	44	0.2
Would enroll in a construction course that uses total e-learning if given a choice (percent)	6	26	22	18	0.02
Preferred method of teaching and learning:					
Face to face only	46	28	32	36	0.02
e-learning only	18	12	2	11	
Combination/blended face-to-face and e- learning	36	60	66	53	

Based on the face-to-face teaching method students had experienced, 66% of students reported satisfied and 69% reported mastered the course 'Construction Technology'.

Post e-learning

Feasibility and effectiveness of e-learning in construction education

A total of 130 students participated in the post e-learning surveys from 2002 to 2004 (50, 37, 43 respectively). Table 2 presents the results of the post e-learning surveys over three years. On average over the three years, amongst the 130 students, 69% considered that it was feasible to teach 'Construction Technology' using e-learning and about 65% of students considered that e-learning was an effective method to teach and learn 'Construction Technology'. Compared Table 2 to Table 1, there are clear increases in both the feasibility and effectiveness of e-learning in construction education (38% to 69% and 48% to 65% respectively).

Preferred learning and teaching method for construction courses

Face-to-face only -- The percentage of students that are in favour of the traditional "face-to-face teaching and learning only" remained quite static – 20%, 24% and 26% for 2002, 2003 and 2004 respectively, with an average of 23%. One must say such percentages were not high and it delivered a message to the lecturers to consider alternative course delivery manner.

E-learning only -- As shown in Table 2, if given a choice, on average, only one quarter (24%) of students reported that they were willing to enroll if this course was delivered by total e-learning. Such figure was just comparable to the "face-to-face" preference. But the good sign was that the preference has increased from 16% to 20% and 37% over the 3 years. Further to this, the preference of "e-learning only" has also increased from 6% to 8% and 16% over the three years. (One may argue the percentages are still very low which is true at this moment, however if one were to look at the trend then the increase is quite significant).

These figures indicate that e-learning has its merit but students are still in the stage of getting used to this new learning methods and the "e-learning culture" may be developed with time to come. The other to explain these results would that e-learning could not be used to totally substitute the traditional face-to-face lectures.

Combined face-to-face teaching and e-learning – at the moment, on average, the majority of students (67%) preferred combining face-to-face and e-learning together. But there was a drop in this preference over the last three years, from 74%, to 68% and 58%.

Table 2 Students' perceptions and attitudes to e-learning (post e-learning surveys)

	2002	*2003*	*2004*	*Average*	*p*
Feasible to teach construction courses using e-learning (percent)	70	65	72	69	0.8
Effective to teach construction courses using e-learning (percent)	62	65	70	65	0.7
Would enroll in construction courses that use e-learning if given a choice (percent)	16	20	37	24	0.04
Preferred method of teaching and learning construction courses					
Face to face only	20	24	26	23	0.4
e-learning only	6	8	16	10	
Combination/blended face-to-face and e-learning	74	68	58	67	

Course satisfaction and mastery

Based on the e-learning students had experienced, 66% of students reported satisfied, and 65% reported that they mastered the course of 'Construction Technology'. It is interesting to note that there were no significant differences between e-learning and face-to-face in terms of learning satisfaction and level of mastery of the course contents. This finding was similar to Hiltz et al (1999). Overall, 21% of students reported that the e-learning experience was excellent, 53% reported good, 18% reported fair and 8% reported poor.

Attitude changed after having experienced e-learning

Compared the post e-learning survey results to the pre-e-learning ones, the feasibility of e-learning considered by the students increased significantly from 50% to 69% after experiencing e-learning ($p=0.001$). The proportion of reporting that e-learning was an effective teaching and learning method also increased significantly from 44% to 65% ($p=0.001$). Haven experienced e-learning, the students were more likely to enroll 'Construction Technology' delivered by e-learning (18% versus 24%, respectively for pre-e-learning and post-e-learning surveys, $p=0.2$). However, the difference is not significant. Interestingly, the proportion of preferring face-to-face teaching decreased from 35% to 23% and more students preferred a blended or combined method of face-to-face and e-learning together after experienced e-learning (53% versus 67% for pre-e-learning and post-e-learning surveys respectively).

Conclusions

Based on this e-learning study through pre-e-learning and post-e-e-learning surveys, the following four conclusions can be made: E-learning is a suitable, feasible and effective method for undergraduate construction education. There is an increased trend in the acceptance of e-learning by the students. There may be little difference in the level of content mastery obtained by e-learning compared with face-to-face delivery method. To maximize the advantages of e-learning and achieve the best learning outcomes, an integration of face-to-face and e-learning is recommended.

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