Can utilising blended learning help achieve academic success for architecture and engineering students?

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ABSTRACT: Understanding how students utilise any element presented in teaching for their learning is important, particularly with increasing enrolments and resource limitations. This paper explores the ways in which design studies and architectural engineering students utilised digital learning elements alongside face-to-face teaching in a (so-called) blended learning environment when learning about the tectonics of designed construction.

Methodologically, a case study of five successive iterations of one construction course taught from 2006-2010 was examined. The analytics which sit behind any Learning Management System (now ubiquitous in Universities) were harnessed to reveal students' patterns of access to the digital learning elements in 2009, and 2010. These usage patterns were tracked throughout a Semester, and compared with students' assessment outcomes to ascertain whether a relationship between usage and assessment outcome existed. The results revealed that students' access to the digital learning objects was related to both assignment and overall grade outcomes. Analysis of Variance (ANOVA) method was used to reveal that responses to the student evaluation question "The learning resources (e.g., handouts, web resources) are valuable for my understanding of the subject" revealed a significant result across the years 2006-2010 as students reported increasingly greater satisfaction with the available learning resources.

Conference theme: Architectural education
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INTRODUCTION

Utilising best practice in teaching the construction theory and practice (tectonics of design) to design studies and engineering (architectural) students is the topic of this paper. In a resource-constrained University environment, where class size has doubled from 2006-2010 (including the enrolment of non-traditional students) and teaching resources for sessional staffing have declined by 18% (in real terms), staff were driven to investigate whether utilising elements of online learning within a face-to-face course could assist students achieve academic success. In a stable, first year, compulsory Semester 2 course Construction and Design: Theories and Practice (CDTP) comprising half the Semester full-time load, digital learning elements were introduced in 2009 and 2010. The principal goal for the introduction of digital elements was the augmentation of face-to-face teaching in a way which improved student learning outcomes – specifically academic success. When digital learning elements for online study are incorporated into face-to-face courses, these courses are then termed blended learning courses – also referred to as hybrid courses (in U.S.).

Dykman and Davis (2008) suggest that Universities are responding to multiple 'push' factors in proposing online education which is a "complex issue that involves questions of educational access, paradigms for teaching and learning, competition and globalization among universities, the development of new and better online technologies, and the financial pressures facing higher education" (p. 11). The prospect of being able to optimise time and/or make schedules flexible is an advantage of the shift for both students and academic staff. They conclude:

> [t]eaching online is very complex. It is complicated by the need to adapt what has been a highly social process, that of educating students in a traditional school and classroom setting, to an online computerized setting with limited social interaction. The biggest challenge for online educators is to make this adaptation work effectively. (Dykman & Davis, 2008, p. 162)

Kelz (2009) relates that student motivations for utilising electronic learning include the accommodation of work and family commitments, whereas Le, Joordens, Chrysostomou, & Grinnell (2010) found students could benefit from the qualities of self-paced learning, reiteration and revision from interacting with online lectures.

1. WHAT MAKES A GOOD BLENDED LEARNING ENVIRONMENT

Whilst much research has been published on the shift from face-to-face to online learning, little research explores blended learning in any context, and almost none in the context of teaching tectonics of design to architecture, design and engineering (architectural) students. Speculation thus arises that in architecture schools that situation arises due to the predominant mode of teaching technical topics being face-to-face lectures and tutorials alongside design teaching predominantly happening in Beaux Arts-style one-on-one studio teaching. There may be resistance to incorporating any aspects of online learning confused with a desire to maintain a resource-heavy style of studio teaching fearing that this may be under threat if undermined. Another speculation is that the creative staff who are engaged as designers to teach in design studios are unable to conceive how digital learning objects could be assimilated into their teaching conception. In Engineering schools, "how to" literature is more accessible (for instance Chang et al 2009, Blackmore Compston, Kane, Quinn and Cropley 2010): this broader take up may be related to a historical acceptance of more transmissive modes of teaching.

Blended learning is defined as per Beer, Clark and Jones (2010) and Blackmore et al. (2010) as the seamless amalgamation of traditional face-to-face interaction augmented by carefully considered modules of online learning. Internationally Wu, Tennyson and Hsia (2010) found that learning climate and performance expectations significantly affect learning satisfaction with blended learning scenarios, whereas Fang (2007) suggested that students' culture at the national, ethnic and cyber levels could influence what they consider useful, enjoyable and effective. Effectiveness and learning efficiency are key drivers for student adoption of any style of learning. Stricker, Weible and Wissmath (2011) state that "[a]ccording to the student's point of view, learning is probably considered efficient if good grades can be achieved in short time and under little effort" (p. 495). They found that students who learned through a virtual learning method complementing face-to-face teaching outperformed (in exams) those who did not. Paraskeva, Mysirlaki and Choustolakis' (2009) indicated that "significant positive relationships between learner characteristics, such as self-concept (academic achievement and job achievement), Computer Self Efficacy (CSE) and Self-Regulation (SR) constructs which acknowledge the requirement for a strong shift of students towards developing self-regulated scenarios and strategies" (p. 42) are a feature of satisfactory student engagement with blended learning.

Students will need to adapt their learning style to succeed in this new learning environment, just as will staff need to adapt their teaching style. Kember, McNaught, Chong, Lam and Cheng (2010), caution that "using the Internet [namely Learning Management System websites, so ubiquitous in Universities] for presenting information in a blended environment does not seem to effectively help students achieve learning outcomes" (p. 1183). They speculate that a predominant face-to-face teaching environment means that teachers may have dealt with the learning functions in class instead of trying to operationalise them on their course websites (Kember et al., 2010, p. 1190). However Thor (2010) reported a US Department of Education meta-analysis of research using online learning, which concluded that students in hybrid (blended) and fully online subjects outperformed those who received only face-to-face instruction (p. 39). This may be because, as Vernadakis, Antoniou, Giannousi, Zetou and Kioumourtzoglou (2011) found, when comparing computer science subject delivery in hybrid (blended) learning and traditional lecture settings, the former approach encouraged undergraduate learners to adopt a strongly acquisitive mode, allowing them to outperform those in traditional lectures (p. 196).

In conclusion, while there is much interest in blended learning and the evaluation of learning outcomes in online environments, there is little research that evaluates learning outcomes and student satisfaction with online learning in the teaching of the tectonics of designed construction to architectural engineering and architecture/design students. That is the gap for this research paper.

2. BLENDED LEARNING IN CONSTRUCTION AND DESIGN: THEORIES AND PRACTICE

We proposed a blended learning environment for CDTP having understood the determinants for a positive student learning experience in more generalised blended learning environments. The goal of CDTP was to introduce construction theory and practice to students who had already been studying for one semester of their four-year tertiary architectural engineering or five-year architecture courses. The CDTP curriculum demanded that building and landscape constructions were investigated in relation to the cultural, technological and historical contexts in which they appear. It introduced students to materials and materiality, structural behaviour and construction techniques. CDTP was an integrated project-based subject in which students demonstrated their increasing knowledge and skills through the development of a small-scale, site-specific project. Assignments included:

- Site analysis, precedent study and concept design
- Final design (sketch and developed design)
- Working drawings in AutoCAD
- Construction model and process
- Detail diary

The assignments had multi-faceted aims and were sequenced to develop skills and knowledge of the design and construction process: skills in manual sketching, physical model making, manual and digital drafting and graphic communication (representation, presentation and layout). The subject comprised up to six contact hours per week in lectures, tutorials, site visits and workshops, as well as 18 non-contact hours per week for online activity, group-work, individual study and assignments.

From 2006 to 2008, CDTP delivered the curriculum through face-to-face lectures, tutorials, workshops and site visits with a Learning Management System (LMS) - Blackboard - for promulgation of subject information and resources. From 2009 to 2010, the curriculum was reconsidered through a variety of learning and teaching environments to set up a culture where student engagement in all of the delivery modes was necessary for successful learning outcomes. Face-to-face sessions (site visits, lectures, studio/tutorials and workshops) referred to and utilised online elements—a subject website, model making and detail diary learning objects (mini-videos), an online lecture, online availability of lecture recordings, and a discussion board (Fig 1).

FACE-TO-FACE	CURRICULUM COMPONENT	ONLINE
• Subject profile distributed • CAD hand-out distributed	**Subject Material & Information**	• All subject material & information
• 23 x 1-hour sessions (including 4 x 1-hour CAD lectures) • Collective assignment feedback	**Lectures**	• 1 x 2-hour special online lecture • AV recordings of lectures posted for revision
• 9 x 2-hour sessions • Weekly Detail Diary pin-up	**Studio / Tutorials**	• Outlines & additional material
• 2 x 2-hour sessions • Staff available for assistance but led by self-directed task • 1 x exhibition of exemplars	**Model Making Workshop**	• Skills "video tutorials" posted • Outline, hand-out & additional material • Exemplars of past student work
• 4 x 2-hour sessions • Staff available for assistance but led by self-directed task	**CAD Workshop**	• Outline, hand-out & additional material posted • Discussion Board: student queries
• 3 x 2-hour sessions	**Site Visits**	• Background information: images, itinerary, drawings
• Detail Diary "what to look for" in weekly lectures • Assignment feedback (rubrics) distributed • 2 x physical submissions • Student presentations (of digitally submitted work) • Oral feedback / critique by staff & peers • Student evaluation (SELT)	**Assignments**	• Assignment hand-outs & marking rubrics • Detail Diary Approach video • Exemplars of past student work • 3 x Digital submissions (via Show Off gallery) of student work • Grades made available
• In-lecture reference to content/issues	**Discussion Board**	• Lecture "Muddiest Points" • Student queries

Figure 1: Subject Components 2009-2010—Face-to-face & Online
Based on Biggs (1999, figure 2.2, p. 27)

The curriculum objectives, teaching methods and assessment methods were integrated. The acquisition of core knowledge and skills in CDTP was achieved through the students' engagement in lectures, site visits and other components, which were further broken down into face-to-face and online elements. .For students to remain engaged they must have perceived the benefits of attending the face-to-face elements as well as utilising online elements.

3. METHOD AND RESULTS

Three key components of the CDTP were evaluated in turn: "Working Drawings," a "Detail Diary" and "Model-making Workshops."

3.1 WORKING DRAWINGS - INTRODUCTION, METHOD AND RESULTS

To create a set of Working Drawings students must envision how materials would come together to achieve construction details that express the language and concept of their designs. While the face-to-face teaching sessions addressed a substantial portion of the required information, it was felt that a different approach to conventional lecturing was required to give students more time to grasp the concepts and enable them to return to this new material. A two-hour online lecture, which was discussed and referred to as a resource in face-to-face teaching sessions, was developed and disseminated through the LMS

Students' access log-ins through the LMS to the "Working Drawings" lecture were plotted against their outcomes for the "Working Drawings" assignment. Figure 2 shows that students who viewed the online lecture out-performed students who failed to view it in all grade bands besides "fail." At the subject level, a similar relationship emerged between activities of students who performed well and of those who viewed the online lecture (Fig 4). Students who used the online resource more than three times performed better that those who viewed it once or twice, which

highlights the importance of presenting dense, new, technical material as an online element that students can return to and reflect upon as they develop their technical drawings.

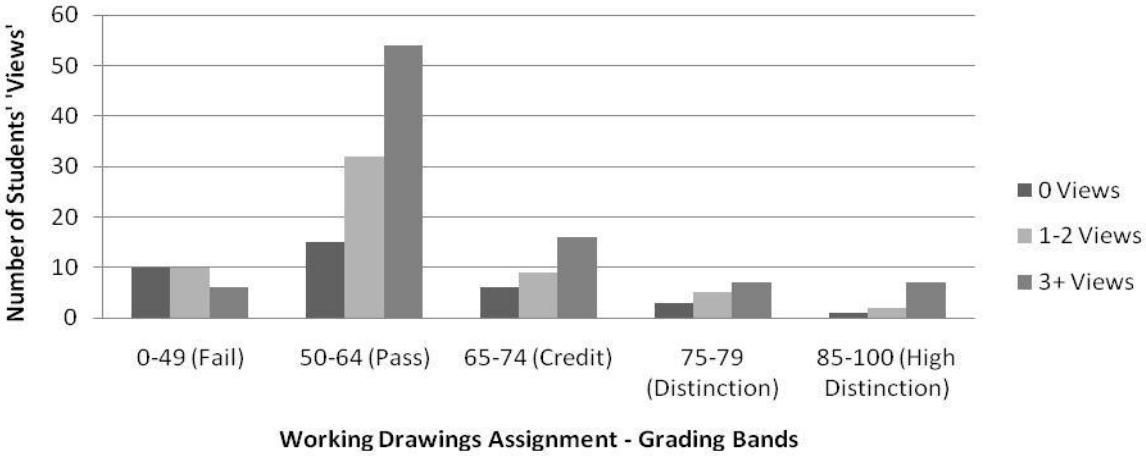

Figure 2: Working Drawings Assignment—Number of Views vs. Grades

3.2 DETAIL DIARY – INTRODUCTION, METHOD AND RESULTS

To prepare for the production of technical (construction) drawings, students needed to be immersed in the process of construction detailing. A weekly (assessable) "Detail Diary" was conceived to scaffold this learning. Through observations and investigations of actual buildings, students analysed and produced details. Weekly face-to-face lectures briefly addressed "what to look for" and how to approach that week's detailing task (stairs, awnings, etc.). In previous years (2006–2009), many students struggled with *how* to approach the task. In 2010, a new digital learning element was added: the task-specific "Detail Diary Approach" video clip available on the LMS, which demonstrated and modelled the behaviour, skills, line of inquiry and method needed for the task. Figure 3 plots students' LMS access log-ins to this clip against their assignment requirements (deadlines) for the "Detail Diary" assignment (one detail was required each week with a final submission in Week 12). Students heavily viewed the video at the beginning of the assignment (even in Orientation Week), and those who were not yet confident with their approach were able to continue to revisit and revise (Fig 3). Usage diminished as the semester progressed and students gained confidence in their ability, skills and knowledge, but there was an end-of-semester spike with the impending submission deadline.

3.3 MODEL MAKING – INTRODUCTION, METHOD AND RESULTS

The 2009 presentation of CDTP first established "Model-making Workshops" that introduced and explored materials and modelling techniques that were relevant to the development and expression of design ideas, as well as the development of skills in 3D communication and an understanding of scale. While these staff-led workshops were successful in improving students' skills, it was felt that they did not optimise the use of the staff time and there was little opportunity for student clarification or revision once they were over.

With further staff resource constraints in 2010, a new approach was refined for the two-week workshops at the beginning of semester. Prior to the workshops, the skills were introduced through eight video tutorials available through the LMS. The workshops were run in a Computer Aided Design (CAD) suite, a space where each student had access to a computer immediately adjacent to their model-making workspace. During the workshop, students were able to revisit and review the video tutorials at any time while working on the "practice" of the skill with senior student mentors (in lieu of staff) to refine/re-direct as called upon. The videos remained accessible throughout the semester. Students' access log-ins through the LMS to the video tutorials were plotted on Figure 3 against the requirements (deadlines) for their model-making assignment, which was due in Week 2. Students made the most substantial use of the tutorials during the first week of the workshops (Fig 3) with only a few accessing them for revision afterwards, coinciding with other model-making assignment deadlines.

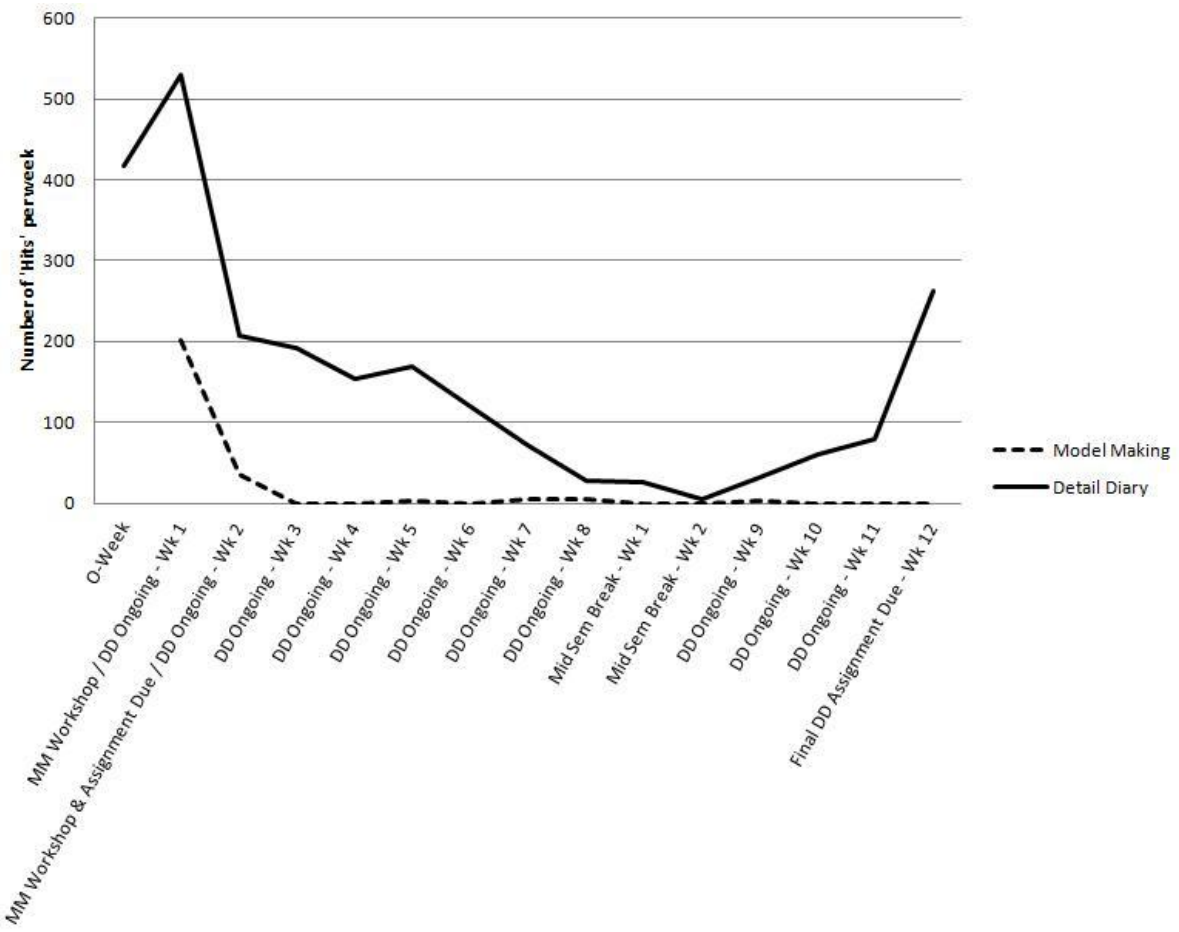

Figure 3: Combined Student Usage—Detail Diary Approach & Model Making Videos

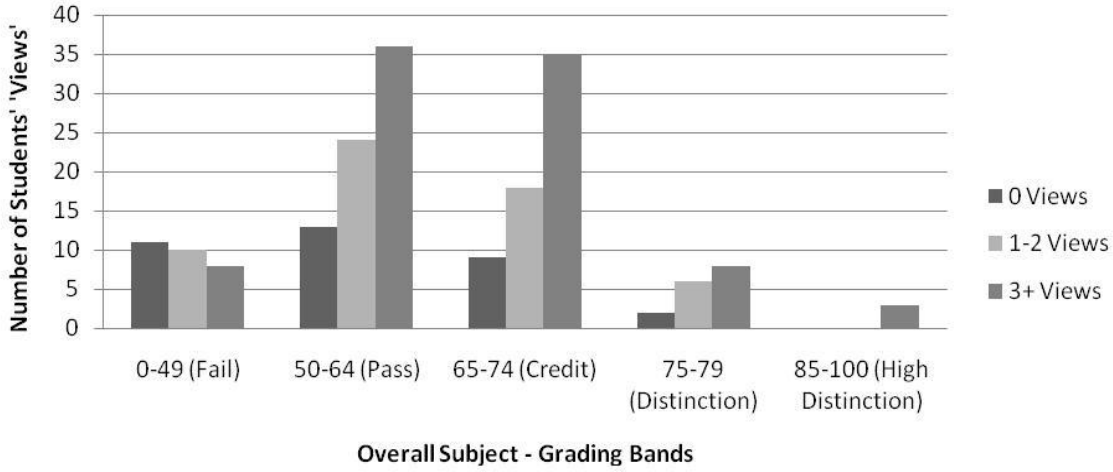

Figure 4: Number of views vs overall grades for the Overall Subject

4. STUDENT EVALUATION

Every year from 2006 – 2010 anonymous, voluntary Student Experience of Learning and Teaching surveys were conducted. Longitudinal results are shown in Table 1. The numbers of enrolled students increased from 95 in 2006 – 186 in 2010 (X axis header). The anonymous questions are listed (on the Y axis). Each year the Mean (average) Likert Scale response on a 7 point Likert scale is given (MLS score); anything above 3.5 is better than average. Then the Standard deviation (SD) is given. Below the number of valid responses as a fraction of the total number of survey responses is given. At the end of each row a significance score is recorded – whether over 5 years the difference in results is significant.

The results indicate that the introduction of integrated online components in a blended learning environment maintained students' motivation, assessment satisfaction, thinking skills development, ability to work independently and understanding of the concepts presented (Table 1). Analysis of Variance (ANOVA) method is used to test for significant differences in the mean Likert scores for a question across the five years (2006–2010). At a significance level of 0.05, the question "The learning resources (e.g., handouts, web resources) are valuable for my understanding of the subject" showed a significant result ($F=4.926$, $p<0.01$). From 2006 to 2010, the students reported increasingly greater satisfaction with the available learning resources, with 92% satisfied with the resources in 2010. For all other questions reported, no significant differences were found in the mean Likert scores. This indicates that despite a doubling of student numbers and a reduction in face-to-face teaching resources and space, students relied increasingly upon a rich array of blended learning resources.

Table 1: Summary of Longitudinal Student Evaluation of Learning and Teaching (SELT)

Year:	2006	2007	2008	2009	2010	SIGNIFICANCE
Enrolled Students (number):	95	102	131	159	186	
Question (Q):	MLS SD	MLS SD	MLS SD	MLS SD	MLS SD	
6. I am motivated to learn in this subject.	5.3 1.4 N=60/60	5.4 1.0 N=65/65	5.6 1.3 N=88/88	5.4 1.4 N=82/82	5.2 1.2 N= 132/132	no significant difference
7. The assessment allows me to demonstrate what I understand.	5.2 1.1 N=60/60	5.7 1.4 N=65/65	5.4 1.1 N=88/88	5.3 1.4 N=82/82	5.4 1.0 N= 131/132	no significant difference
8. This subject helps me develop my thinking skills (e.g., problem solving, analysis).	5.5 1.0 N=60/60	5.7 1.1 N=65/65	5.8 1.1 N=86/88	5.5 1.3 N=82/82	5.5 1.0 N= 131/132	no significant difference
9. The learning resources (e.g., handouts, web resources) are valuable for my understanding of the subject.	5.2 1.4 N=58/60	5.5 1.2 N=64/65	5.8 1.2 N=88/88	5.9 1.1 N=82/82	5.9 1.0 N= 131/132	significant f=4.926 p<0.01
10. I am satisfied with the subject information provided (e.g., subject outline, assessment details, timetables).	5.6 1.2 N=60/60	6.0 1.0 N=65/65	5.8 1.2 N=88/88	6.0 1.0 N=81/82	5.8 1.1 N= 132/132	no significant difference
12. My ability to work independently is being increased.	5.7 0.8 N=60/60	6.0 0.9 N=65/65	5.8 1.1 N=88/88	5.9 1.0 N=82/82	5.8 1.1 N= 132/132	no significant difference
13. I understand the concepts presented in this subject.	5.7 0.9 N=60/60	5.8 0.9 N=65/65	5.8 1.2 N=88/88	5.7 1.1 N=82/82	5.5 1.1 N= 132/132	no significant difference

MLS = Likert Scale (Mean Response) | SD = Standard Deviation

The learning and teaching goals of CDTP and the means to achieve them (as represented in the SELT questions) are presented in Table 2. The relationship between goals and means was investigated using stepwise multiple linear regression (Table 3).

A student indicating agreement with "I feel part of a group committed to learning" (Q. 3) was likely to strongly agree with the statements (goals), "Overall, I am satisfied with the quality of this subject" (Q. 1) and "This subject stimulates my enthusiasm for further learning" (Q. 2). The statement "It is made clear what is expected of me" (Q. 4) can be seen as a significant predictor of the goal "I understand the concepts presented in this subject" (Q. 13). Agreement with the statement "I am satisfied with the subject information provided" (Q. 10) was a predictor of a key goal "My ability to work independently is being increased" (Q. 12). Receiving adequate feedback (Q. 5) was a predictor of the goal of overall satisfaction (Q. 1). The results may further underline that students who clearly understand the relationship between the online components and the face-to-face learning and teaching through the provided subject information are also increasing their ability to work independently, which is a core graduate attribute. Clear understanding of what is expected (through the subject information) also positively correlates with and predicts understanding of the concepts presented in the subject.

Table 2: SELT Questions Divided into Learning and Teaching "Goals" Achieved Through Learning and Teaching "Means"

Q 1. Overall, I am satisfied with the quality of this subject.	Goal
Q 2.This subject stimulates my enthusiasm for further learning.	Goal
Q 3. I feel part of a group committed to learning.	Means
Q 4. It is made clear what is expected of me.	Means
Q 5. I receive adequate feedback on my work.	Means
Q 6. I am motivated to learn in this subject.	Goal
Q 7. The assessment allows me to demonstrate what I understand.	Means
Q 8. This subject helps me develop my thinking skills (e.g., problem solving, analysis).	Goal
Q 9. The learning resources (e.g., handouts, web resources) are valuable for my understanding of the subject.	Means
Q 10. I am satisfied with the subject information provided (e.g., subject outline, assessment details, timetables).	Means
Q 11. The learning environment takes into account the diversity of students' backgrounds.	Means
Q 12. My ability to work independently is being increased.	Goal
Q 13. I understand the concepts presented in this subject.	Goal

Table 3 Correlations Summary

		Means							Correlation
		Q3	**Q4**	**Q5**	**Q7**	**Q9**	**Q10**	**Q11**	
Goals	**Q1**	■		■					r2=1,p=0.01
	Q2	■							r2=0.815,p=0.036
	Q6								No significant correlation
	Q8								No significant correlation
	Q12						■		r2=0.89,p=0.016
	Q13		■						r2=0.83,p=0.03

5. SUMMARY

Despite a doubling in student numbers putting pressure on the subject delivery within a resource-constrained environment, 86% of 2010 respondents agreed that they understood the concepts presented in the subject. This is a compelling argument for the introduction of blended learning, where students are able to learn both in a group (Kelz, 2009) and independently and effectively in a well-supported environment or "climate" (Fang, 2007) when provided with clear subject information and adequate feedback. Learner self-direction (independence) and the ability to develop thinking skills were valued by students in this study and others (e.g., Mosca et al., 2010; Paraskeva et al., 2009; Vernadakis et al., 2011). However, the preparation and support of online elements and the integration with face-to-face elements are time and resource intensive. Well-supported teaching staff may be able to accommodate resource decline over a period, as students adapt to blended learning. However, initially, students and staff are being asked to make major accommodations to the way they have previously learned or taught successfully. Thus, forbearance is required from staff and management to support blended learning (Dykman & Davis, 2008; Macdonald, 2008) to avoid the temptation, described by Kember et al. (2010), to load the predominant familiar face-to-face teaching role with all learning functions, relegating the online elements redundant. We maintain that integrated curriculum design is paramount (supported by Le et al., 2010), as is well-conceived longitudinal evaluation that links the contribution of online elements to overall performance (also demonstrated in Thor, 2010).

6. CONCLUSION

The evaluation of this case study highlights the impact of the introduction of blended learning in teaching the tectonics of designed construction to architecture/design and architectural engineering students. It confirms the judgment of experienced technology and construction instructors that online elements are valuable where independent learning, revisitation and reiteration is essential for acquisition of construction technology skills, knowledge and understanding. The study reveals that the number of LMS views students undertook correlates with grades for the related assessment (Fig 3), replicating the outcomes of Beer et al. (2010) in this technical learning environment. It also revealed (Fig 4) that there was a general correlation between the "number of student clicks on learning management system [LMS] courses [subjects], and their resulting grades" (Beer et al., 2010, p. 81). One lesson of this case study is that students are at risk of failure if they disengage from the subject either face to face or online. The constant pressure from university management to move face-to-face elements online must not be viewed

by students as an “opt-out-of-attending clause.” This case study indicates that, in an integrated blended learning environment, students prosper academically when engaged with the face-to-face *and* online components.

7. RECOMMENDATIONS

We make four main recommendations for broader adoption of the case study principles if proposing adoption for successfully learning technical material. We recommend provision of:
1. very clear subject information about what is required to succeed working independently;
2. a balance between independent learning (often online modules) supported by group learning in face-to-face encounters to increase satisfaction with the subject and stimulate enthusiasm for further learning;
3. a statement of clear expectations to promote conceptual understanding;
4. adequate feedback to promote satisfaction with the quality of a subject. No feedback was solely provided utilising online elements. Understanding this potential is a worthy exploration.

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REFERENCES

Beer, C., Clark, K., & Jones, D. (2010). Indicators of engagement. In C. H. Steel, M. J. Keppell, P. Gerbic, & S. Housego (Eds.), *Curriculum, Technology & Transformation for an Unknown Future: Proceedings ASCILITE Sydney 2010* (pp. 75–86). Retrieved 12-7-12 from http://ascilite.org.au/conferences/sydney10/procs/Beer-full.pdf

Blackmore, K., Compston, P., Kane, L., Quinn, D., & Cropley, D. (2010). The engineering hubs and spokes project: Institutional cooperation in educational design and delivery. In C. H. Steel, M. J. Keppell, P. Gerbic, & S. Housego (Eds.), *Curriculum, Technology & Transformation for an Unknown Future: Proceedings ASCILITE Sydney 2010* (pp. 90–94). Retrieved 12-7-12 from http://ascilite.org.au/conferences/sydney10/procs/Blackmore-concise.pdf

Chang, R. L., Richardson, J. C., Banky, G. P., Coller, B. D., Jaksa, M. B., Lindsay, E. D., & Maier, H. R. (2009) Practitioner reflections on engineering students’ engagement with e-learning. *Advances in Engineering Education* (Winter), 1–31

Dykman, C. A., & Davis, C. K. (2008). Online education forum: Part one—the shift toward online education. *Journal of Information Systems Education, 19*(1), 11–16

Fang, L. (2007). Perceiving the useful, enjoyable and effective: A case study of the e-learning experience of tertiary students in Singapore. *Educational Media International, 44*(3), 237–253

Kelz, A. (2009). E-learning strategies in technical part-time studies at Campus Pinkafeld: A moderate constructivist approach to learning and teaching. *International Journal of Advanced Corporate Learning, 2*(1), 25–30

Kember, D., McNaught, C., Chong, F. C. Y., Lam, P., & Cheng, K. F. (2010). Understanding the ways in which design features of educational websites impact upon student learning outcomes in blended learning environments. *Computers & Education, 55*(3) 1183–1192

Le, A., Joordens, S., Chrysostomou, S., & Grinnell, R. (2010). Online lecture accessibility and its influence on performance in skills-based courses. *Computers & Education, 55*(1), 313–319

Macdonald, J. (2008). *Blended Learning and Online Tutoring: Planning Learner Support and Activity Design.* Aldershot, Burlington, VT: Gower

Mosca, J. B., Ball, D. R., Buzza, J. S., & Paul, D. P. (2010). A comprehensive student-based analysis of hybrid courses: Student preferences and design criteria for success. *Journal of Business and Economics Research, 3*(5), 7–21

Paraskeva, F., Mysirlaki, S., & Choustoulakis, E. (2009). Designing collaborative learning environments using educational scenarios based on self-regulation. International Journal of Advanced Corporate Learning, 2(1), 42–49

Stricker, D., Weible, D., & Wissmath, B. (2011). Efficient learning using a virtual learning environment in a university class. *Computers & Education, 56*(2) 495–504

Thor, L. (2010). The right mix. *Community College Journal,* (August/September), 39–43

Vernadakis, N., Antoniou, P., Giannousi, M., Zetou, E., & Kioumourtzoglou, E. (2011). Comparing hybrid learning with traditional approaches on learning the Microsoft Office Power Point 2003 program in tertiary education *Computers and Education, 56,* 188–199

Wu, J. H., Tennyson, R. D., & Hsia, T. L. (2010). A study of student satisfaction in a blended e-learning system environment. *Computers & Education, 55*(1), 155–164