DISCOVERING CONSTRUCTION THROUGH ARCHITECTURE

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Abstract. This paper discusses a digitally integrated educational programme wherein students discover construction through architecture from innovative and technologically diverse student projects using digital and physical media within a role-play environment. Student output is examined to determine engagement in a programme informed by ‘reflective making’. This redefinition of content is centred on priming graduates with the abilities and skills to lead the construction industry of the future.

1. Why Redefine Content for Construction Education?

According to a recent Australian government report, the construction industry in the 21st century is characterised by ‘evolving industry structures and new technologies driving change in the workplace’ (DIST, 1998) Public and private sector clients are more often seeking IT integrated packaged construction services, a significant move away from the traditional, adversarial nature of the industry. The overall goal is ‘an innovative, leading edge, and environmentally sustainable industry, well integrated into the Asia/Pacific region’. (DIST, 1998)

Key ways of achieving these aims include;

‘Wide uptake of information technology through all levels of the industry as an enabler of greater efficiency and competitiveness’ and ‘development of “seamless” and “virtual” organisations’ (DIST, 1998)

The construction industry is currently in a transition phase, with uptake of these technologies limited primarily to larger organisations. This university sees the immersion of students into information technology and digital media as a means of preparing graduates of for the industry of the 21st Century. (Deakin, 2000) It is contended that early years tertiary education is an ideal stage to prime students for the transition of the construction industry to IT-enhanced modes of operation.
This paper reports on the design, delivery and assessment of a digitally integrated educational programme for students of Construction Management and Architecture undertaken at Deakin University’s School of Architecture and Building in semester 2, 2001. This programme redefined content to help equip graduates with the skills to innovate and lead the future construction industry.

2. Programme Inspiration and Aims

The learning programme under discussion was inspired by the CUTSD (Committee for University Teaching and Staff Development) ‘Reflective Making’ project, an inter-institutional project involving Deakin University, Adelaide University and Victoria University of Wellington. The broad aims of the project were the creation of ‘a new learning culture which expects, encourages and rewards innovative and wise use of computers in student designing’ through a rich culture of ‘reflective making’. (Radford et.al. 2001) Learning material was developed with the assistance of later year students, (Woodbury 2001) embodying ‘reflection-in-action’, (Schon, 1987) design making and innovative use of computing, together known as ‘Reflective making’. The CUTSD project diversified to include ‘Technology Projects 2’, a core unit in the Bachelor of Construction Management at Deakin University. The content of the unit was re-defined to capitalise on earlier student initiation in ‘reflective making’ in their first semester construction unit. (Ham 2001)

The programme under discussion has five defining characteristics:
1. Electronic delivery, submission and assessment of all units involved in the project (refer Figure 1);
2. The immersion of students into a virtual and physical role-playing environment involving development teams, clients, architects and consultants
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as players;
3. ‘Learning construction through architecture’, through the collaborative development technologically diverse student architectural projects;
4. The use of the Internet and the electronic network as the primary form of communication of design and construction information.
5. The grounding of student’s immersion into virtual environments within the context of physical construction.

3. Programme Design

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Digital Project Transfer

| Tech. Projects 2 | | | |
| Stage 1: Site investigations; on-site feature survey; research; website development | Stage 2: Project development; technology research | Stage 3: model and website construction, presentation |

Figure 2. Integrated Project Timetable

3.1 ARCHITECTURE 2B

The second year architecture project, ‘Discovering Architecture’, was delivered over the Internet in the first 5 weeks of semester 2, 2001, (refer figure 2) accompanied by a series of lectures, workshops and industry guests. Within the design, architecture students were required to address design conception, social and environmental issues, brief development and form making. The presentation of the project was limited to digital media, based on a PowerPoint template downloaded from the unit website. Templating of the project ensured consistency of design information. Student architects were instructed think carefully about ways to communicate their design intent on their presentation. Elements of the template included site and floor plans, building form and construction concept. (Refer Figure 3) Reviews were held directly from the electronic network in design studios.
3.2 TECHNOLOGY PROJECTS 2

The Technology Projects 2 unit was re-defined to reinforce understandings of construction theory within a practicum of the construction industry. The use of a digital submission system through the school-based server and electronic network enabled Architecture 2b projects to be assessed digitally and a selection of eight projects to be transferred to network folders maintained by eight teams of six Construction Management students.

These students then assumed the role of developers charged with the task of researching construction issues and delivering a constructed representation of the architect’s design concept. The developer teams were provided with a basic web template to be used as the primary form of communication of the developed concept. Regular project update meetings consisted of a team web-based presentation to staff at key stages of the project. Staff visited websites weekly for formative assessment of the project.

The final review consisted of a team presentation including the website, model and developmental work attended by staff and the student architect author of the project whose role it is to judge of the delivery of design intent (refer figure 6). Essential construction management skills such as team building and teamwork, research, site surveying and analysis, and connectivity with the industry were counterpointed by the use of information technology to enhance the development process. This virtual component was balanced by the use of physical models to represent the finished building. This dialogue between the real and the virtual is seen as a key component of the programme that enables students to explore the real world of construction using the tools of their generation.
4. Evaluation of Student Responses

4.1 ARCHITECTURE 2B: ‘DISCOVERING ARCHITECTURE’

Examination of student responses to the project found that they had undertaken considerable advancement in their mastery of digital media. Earlier initiations into the use of MicroStation, Rhino3D, PowerPoint and PhotoShop led to a high level of sophistication in the presentations relative to paper-based media. (Refer Figure 4) Some students in the cohort, however, encountered the usual problems of appropriate construction systems selection, brief development and the formulation of 3D concepts.

The theme of ‘discovering architecture’ gave students licence to explore new ideas, facilitated by the Internet as a source of inspiration. This led to an interesting array of design concepts selected for development, including stylised phytoplankton, a deconstructed shipwreck, a subterranean labyrinth and a design inspired by the chiaroscuro of a forest canopy.

Diverse construction technologies represented by the selected projects included, laminated portal frames, complex curved panel construction, straw-bale, timber and steel framed construction, tilt-panel and in-situ concrete and teratecture. This provided fertile material for the construction management students to ‘discover construction through architecture’. The project brief required not elevations but a 3 dimensional visualisation of the building form. This led to the wide usage of 3D CAD models as a faster alternative to traditional hand-drawn perspectives and axonometric drawings. The most successful outcomes however were presentations that utilised a composite of media including scanned images of hand-rendered drawings and models that captured the essence of the design and the individual style of the author. Experience shows that CAD-based representation, in the hands of early years students, is rarely used in a way that positively informs the essence of the design concept.

Figure 4. CAD model of Construction Concepts for a scheme selected for development (left.)
Flash utilised in presentation. (right)
4.2. TECHNOLOGY PROJECTS 2

Student engagement was very high, with teams taking ownership of the project, organising themselves, and meeting deadlines. A student feedback survey included comments that the project helped with ‘teamwork-problem solving’, ‘the importance of group consultation’ and ‘exploring alternatives’. Several students felt that ‘its been an enjoyable unit’. Students generally felt that they had advanced both their digital skills and understanding of the workings of the industry.

4.2.1. Construction Models

For second-year students, the level of attention to construction issues was generally high, considering the difficulty of some of the schemes. Physical models were accompanied in some instances by CAD models, drawings and 1:1 detail models. Images of models were successfully integrated into all team webpages to represent the finished scheme. (Refer figure 6)

![Figure 5. Final construction model for the architect’s scheme in Figure 4](image)

4.2.2. Web Pages

Students very quickly engaged with the use of Dreamweaver, Flash PhotoShop and MicroStation to communicate the development of their projects. A template was provided as a scaffold, however all eventually teams developed their own web page identity. (Refer figure 6) After an initial learning curve, students quickly engaged with the media and extended their websites to gain a competitive advantage.
4.2.3. Presentations

At Project Update Meetings, student teams quickly adapted to the use of websites to accompany verbal presentations. Some teams demonstrated near professional presentations with delegated speakers, coordinated uniforms, business cards and follow up letters. For others, this was a mask to deflect attention away from poorly developed schemes. The original design architect was present in most reviews to pass judgement on the way in which the developers delivered their design intent. (Refer figure 6) In this process, some teams were subject to intense scrutiny about the way they developed design concepts. Some teams chose to extend and modify concepts, because of constructability or other issues, whilst others followed design intent closely. Presence of architects in reviews also encouraged peer learning and reflection on their developed designs. The final presentation was the culmination of a semester’s work; bringing together the website, physical and CAD models, 1:1 details, CAD drawings, reports and verbal presentations. Several teams achieved a balance between the real and the virtual; using appropriate digital and physical means to communicate their development of the scheme. It is the confluence of these modes of communication wherein the strength of the project lies.
5. Conclusion

The educational programme under discussion is an exemplar of a way in which IT may be used to facilitate integration between units in a practicum based on role-play. ‘Discovering Construction through Architecture’ is a means by which can learn about construction from innovative and technologically diverse projects using a balance of digital and physical tools to enhance the development process. Significant peer learning opportunities are provided through collaborative work, peer review and online websites.

The high level of student engagement with reflective making provides evidence of a successful redefinition of content centred on priming graduates with the abilities and skills to lead the construction industry of the future.

6. Future Directions

A Memorandum of Understanding with Bentley Systems will enable the use of Project Wise to facilitate secure web-based submission of 2002 Architecture 2b project as well as providing a platform for integrated project development.

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