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BUILDING SYSTEMS INTEGRATION, DESIGN STUDIOS AND A SOCIAL LEARNING CLOUD

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Abstract. Building Systems Integration (BSI) within architectural design studios are often seen secondary, as side task, or unnecessary. This is due to the overall perception that does not relate to the design activity and hence is a desired learning outcome. Akin to this a continuous and relevant integration of Learning Management Systems and blended learning environment is not employed in many design studios. This paper describes how BSI can be connected and integrated to design activities that offer a holistic view of architectural design learning. The presented studio includes various online and blended learning activities, social communication platforms, cloud-based instruments and evaluation tools with the goal to enhance the learning outcome and the collaboration between peers, studio instructors, research staff, and outside practitioners.

Keywords. Design studio; pedagogy; social networks, building systems integration;

1. Building Systems Integration

In an effort to better understand the planning, function and design of technology in buildings, Rush (1986), developed a diagnostic approach. Several other architecture scientists and practitioners endorsed this process at that time contributing to his work. The uniqueness of categorising an architectural project into four distinctive systems; *envelope, structure, mechanical* and *interior* was quite progressive in the beginnings of diagnosing the roles of technology in building construction.

Building Systems Integration (BSI) theory provides an informative method of understanding the role and assembly of technology in buildings. Rush defines a system as “a coherent set of physical entities organised for a particular purpose”. And that systems work or are successful, “when their results correspond to the intentions or goals based upon identified needs, established for it”. Rush continues this diagnostic approach to explain that the four systems have five distinctive attributes in how they relate to one another. A system and its technology have several levels of integration that can either be; *remote, touching, connected, unified or meshed* with each other. In a sense, BSI theory provides a mechanism towards understanding the relationship and roles of technology in building. Examples are used of existing projects to test the theory within itself and to demonstrate its validity as a means of better understanding the complexity of a particular design (see Figure 1).

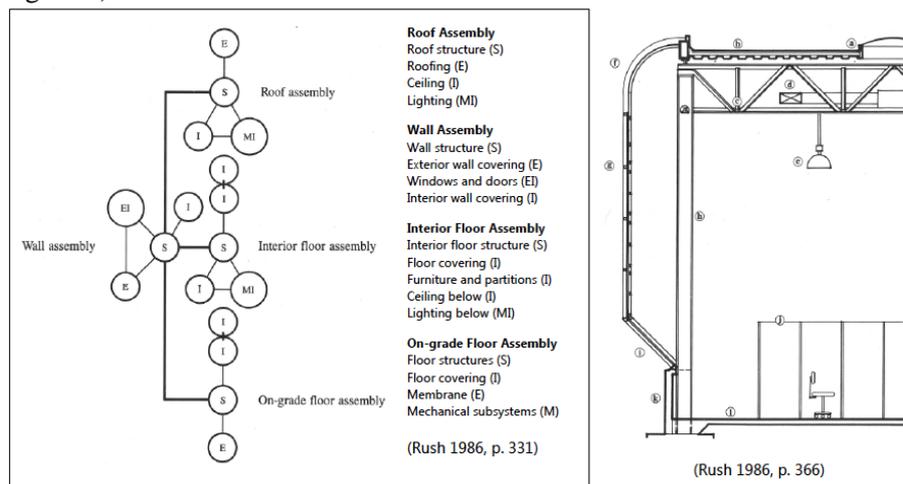


Figure 1 Typical building section and BSI diagramming method (source: Rush, 1986 pg.366)

In retrospect, BSI theory is absent of site and climate analysis, although it could be argued that it is somewhat embedded in a later diagnosis on environmental quality (IEA) and technology systems: lighting and acoustics. Nevertheless, what is probably most important is that this analysis serves as a primer and gives recognition to the relationships and roles of services in a building.

2. BSI in the Design Studio

Kvan (2004) brings it clearly to the point: “Computers are a problem”. Akin to this, in most design studios BSI, simulations, and other computer support-

ed technical issues are considered as the ‘problem’. However, the real issue is that we need to address is how we teach and, behind that, why we teach BSI.

Most approaches to studio or more generally problem-based learning (PBL) are sequential following the conventional method of Albanese and Mitchell’s (1993) seven steps model. Yet, this linear format is limiting and imposes a structure that does not fit with an iterative and reflexive processes facilitating deep learning. Flexible interplay between the seven steps improves the social engagement of students of the ‘Net-generation’ (Oblinger and Oblinger, 2005), especially where social networking sites are used to replace or augment the PBL tutorial or studio. Integration of various aspects of architectural design, services, structure and technologies into the design studio has to follow a non-linear learning.

In a modification of Salmon’s (2000) model of learning, the experience is the context surrounding the process of knowledge construction, which is a interlinking of concepts and actions spanning two broad areas of endeavour: educational/technological scaffolding and social interactivity (Figure 2). Access to resources and problem development inform the scaffolding while social interaction and information exchange are facilitated by the potential for interactivity of the learning tasks. All components of the process are inter-linked. Since all members of the learning community (teachers, students and other relevant stakeholders) contribute to knowledge construction, they are not represented as disparate entities in this model. The traditional steps of PBL are subsumed in the educational scaffolding but are modified to suit the learning of core building technologies, BSI, structure within the context of architectural design.

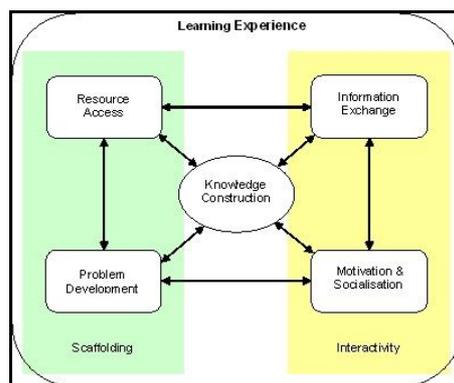


Figure 2: A social interaction model of e-learning by Howe and Schnabel (2011)

2.2. HONG KONG AND AUSTRALIAN PERSPECTIVES

In Hong Kong, akin to many other Asian cities, space comes with a premium. Hence an efficient integration of BSI is crucial for successful architectural design and its realisation in its built form. Subsequently architectural curricula pay special attention to include BSI throughout the various design studios on the undergraduate programme. For example at the Chinese University of Hong Kong one design studio (in Year2, Term2) addresses architectural issues with a particular focus: to examine the role of building technology in architectural design. More comprehensively, studio projects engage design in ways that relate to architectural theories, design technologies, building services, critical innovations, and pragmatic processes. Hereby the studio employs a systematic approach that begins with identifying real or perceived potentials latent in the physical environment, developing them as an architectural strategy, and lastly evaluating performance through either simulation or physical testing.

In another studio in Year 3, Term2 students develop a comprehensive building design that has at its core BSI, structure and 'buildability'. The design proposals have to satisfy these fundamental requirements while also expressing a design concept that has clarity and a consistent formal order.

The Australian perspective of BSI in the design studio appears very different to that of Hong Kong. Design studios in the undergraduate degree at Deakin University have a predominant focus on smaller scale, low-rise building typologies. First and second year projects are focussed on basic design studies, housing and teamwork design processes (Tucker, 2013), small-scale pavilions (Ham, 2003) and low-rise building types (Ham, 2002). By the third year of the degree, students have not been exposed to multi-storey, complex building briefs that require the consideration of commercial building systems. Services are largely left out of the design equation. Parallel to design studio education is teaching of communications, design theory and construction technology in separate units. There are relatively low levels of integration of other units into the design studio, particularly in the area of construction technology and services design.

The low urban, suburban and rural density of sites in Australia and excess of available space significantly decrease the urgency through which BSI needs to be considered in the design studio. Consequently, most projects are either of a typology or scale, or a brief type that does not assess students' consideration of BSI in their design work. If it is not assessed, then it is often left out and not given detailed consideration.

The differences between Hong Kong and Australia in this context are noteworthy. Because of the constraints on space within the dense urban con-

text of Hong Kong, there is a greater urgency for students to consider BSI in the design studio and develop basic understandings of the space that services require within the building volume. There appears to be a direct relationship between the urban context within which the University exists and the nature and scope of design projects.

Through the findings by Schnabel and Ham (2012) studios at both CUHK and Deakin University now include various online and blended learning activities, social communication platforms, cloud-based instruments and evaluation tools with the goal to enhance the learning outcome and the collaboration between peers, studio instructors, research staff, and outside practitioners. By providing a degree of self- and collaborative-learning the studio setting integrates the construction of knowledge of building technologies, testing and prototyping, and prepares students for professional working environments.

The focus of this paper is a design studio at Deakin University that inverts the relationship between the home University's urban context, the scale of the design studio and the requirement for students to consider BSI in their design work.

3. A case study of BSI-integrated design studio

We outline a third year design studio at Deakin University. Architecture 3B is a capstone unit in the last trimester of the Bachelor of Design (Architecture) course. The unit explores the international context of sustainable design, in relation to the cultural and climatic conditions of overseas sites. The commercial context of architectural design also forms the basis of design projects within the unit. These are considered in relation to the need to balance commercial factors within the context of positive contributions to the city.

The unit guide defined the unit learning outcomes that included integrate structure, envelope and interior systems into the design of buildings, the integration of basic aspects of the integration of building services into the design of buildings and designing within an international context- in consideration of climate, site, urban context and culture.

Students were introduced to of the concept of RARE (Renewable, Adaptive, Relocateable and Environmental) Architecture (Altomonte and Luther 2006). RARE Architecture considers site & climate analysis, flexible & adaptive structural systems, renewable materials, modular building systems, adaptive building envelopes, and non-conventional energy, HVAC and water collections systems.

The unit is delivered through two projects and a digital reflective folio. Project 1, worth 20% involved the design of a modular, mass-produced Fab-PreFab Cell for use in a multi-storey building. For this project, groups of four students were asked to consider themselves to be creative idea generators charged with the task of researching and exploring design issues related to RARE architecture, mass production, modularity and prefabrication. They were asked to design a RARE mass-produced prefabricated building “Cell” for potential use in multi-storey buildings and present this in the form of a brief video to be hosted online.

The second project, worth 50%, purposefully places students outside of the ‘comfort zone’ of the Australian low-rise urban context through the design of a mixed-use multi-storey building for a site in Hong Kong. The building design brief is founded on the application of the principles of R.A.R.E. Architecture in relation to addressing the factors of environmental, social and economic sustainability. Critical to the success of integration of BSI into the design studio is the addition of these criteria into marking schemas. Students are assessed on their ability to integrate BSI into their design processes.

3.1. A SOCIAL LEARNING CLOUD

The third year design studio operates within the model of the Social Network Virtual Design Studio (SNVDS). This model utilizes Social Networks (SN) and Web 2.0 technologies, including FaceBook, Skype, Flickr, YouTube in addition to University LMS-based cloud learning tools. BSI knowledge is integrated directly into lectures through Skype-based presentations on robotics, high-rise building design from offshore participants in Hong Kong, China and Germany.

Schnabel and Ham (2013) anticipated the re-conceptualisation of the current model of SN integration at University to increase linkages between the Social-Physical, Social-Digital, Learning-Physical and Learning-Digital networks. This is achieved by developing a student-centred approach that attempts to break down the barrier between the University LMS and other aspects of the students’ SN’s and integrates social networking to the core of the curriculum (Figure 3).

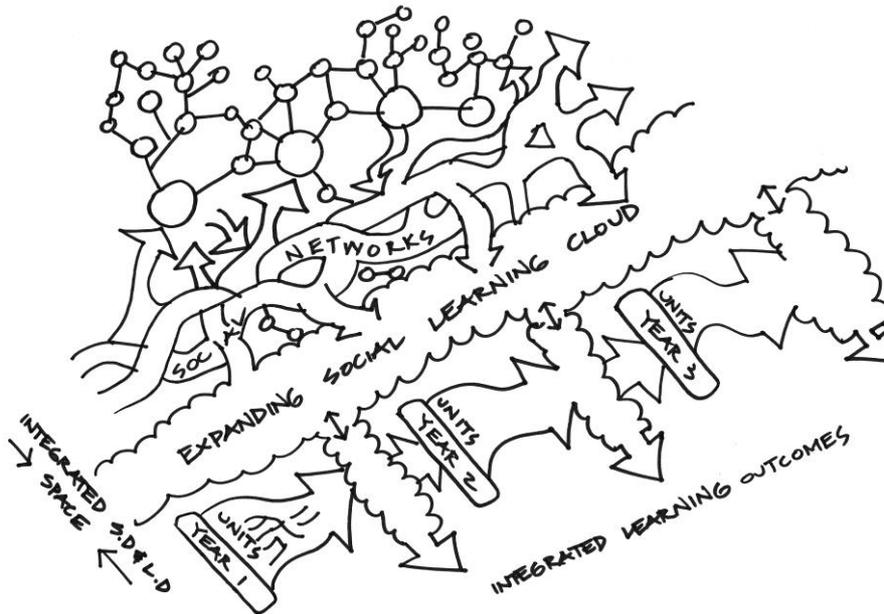


Figure 3: Re-conceptualising SD and LD networks around a SLC learning environment

Through the creation of online virtual galleries of student work (refer Ham, Schnabel and Datta, 2012) and student engagement in a Facebook ‘Social Learning Cloud (SLC)’ a vast body of project resources are crowd-sourced. Given the issues of complexity of the brief, operation outside of the cultural and environmental context and the requirement to integrate BSI into the PBL environment, the SLC proved a valuable resource.

A SLC system forms the core of a blended learning environment that intersects on- and offline learning and social networks and has the potential to blend the boundaries of individual units, courses, years and the lifelong learning in authentic contexts, subsequently greatly enabling and enhancing students’ learning experiences.

Hence the SLC facilitates ‘cloud learning’ – the interaction of particles within cloud; flow – the seamless acquisition of knowledge; synchronous and asynchronous learning modes –enabling of Just-In-time Learning; ‘knowing is there’ and ‘knowing it’ – both access to knowledge and deep learning; and identity – the need of learners to belong to an environment that matches the level, skills and communication of the individuals.

The social engagement of learners is vital to successful learning. Students and professionals alike engage within their activities also socially. Current online social communication system can become devices to facilitate the learning. Subsequently all aspects of architecture, including BSI can become

a central to design activities. Blended learning environments, social communication platforms, and cloud-based instruments make a substantial contribution to the learning outcome and the collaboration between stakeholders, yet they is still some more development needed to integrates such systems into other aspects of the architectural education. Building information management systems employed in the professional praxis move already into the direction of more integrated and holistic collaboration within the construction industries.

5. Conclusions

Architectural practice has evolved from Rush's (1983) initial analysis of relationships between envelope, structure, mechanical and interior towards the implementation of BIM systems to manage the integration process. Approaches to both BSI and BIM widely differ across Universities around the world. A snapshot of Australia and Hong Kong provides an insight into two very different approaches that are dependent on a number of factors, including the architectural context within which the University operates. The dense, high-rise nature of CUHK in Hong Kong requires early knowledge of building services and their integration into complex multi-storey buildings, whereas the low-rise urban environment of Deakin University may have contributed to a minimal consideration of BSI in the design studio.

BSI and building science integration into the design studio faces many difficulties within a tightly constrained curriculum. The nature, scale and complexity of design projects set by Schools largely determines whether, and how BSI will be considered as a design issue for students. We provide a case study of a third year design studio founded within a Design studio culture that largely ignores BSI. By setting a major design project in Hong Kong and utilising a pilot Social Learning Cloud as a means of gathering, retaining and sharing resources to support students' detailed consideration of BSI within a design context, we anticipate an engagement in the issue that will enhance students learning.

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