Virtual Design and Curriculum Development

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The virtualization of design and construction has profound implications for architecture and architectural education. New physical scaffolds and a deeper understanding of human computer interaction are essential to accommodate a dramatically different approach to design but the greatest challenges will reside in the creation of conceptual architectures that facilitate virtualization across a wide variety of scales. Not the least of these challenges is the development of new pedagogical models/design methodologies such as "serious play" that can take advantage of the opportunities of virtualization.

Introduction

Virtualization occurs when a non-physical model is created that may represent real world components or be an assemblage of such components or an assemblage of other non-physical models. This last instance may be one of the most powerful applications of virtualization since its recursive potential would allow complex entities to be assembled from virtual building blocks.

Another essential characteristic of virtual models is that they are constrained by neither time nor space. A virtual model may represent a collection of resources that are distributed across a very large geographic area or a very small, microscopic one. In terms of time, not only can they be constructed and deconstructed on demand, but their performance can be run backwards and forwards as required.

The Virtual Design Studio Pilot Project

Taking very modest first steps, in February of 2015 the RAIC Centre for Architecture at Athabasca University virtualized the design studio as it launched a pilot project in collaboration with the Royal Architectural Institute of Canada (RAIC) to test the viability of a completely online studio.

In this pilot, 6 students - 2 from Edmonton, Alberta; 3 from Calgary, Alberta; and 1 from Mont-Tremblant, Quebec - met online weekly over the course of 3 months. The students were enrolled in a variety of different studio courses ranging from introductory design studies to the design of collective habitats. The studio was led by Coordinator Cynthia Dovell, Director of LGA West with assistance from Bobby Harris, Syllabus Student and BIM Manager with Dub Architects. It was also supported by Centre staff: Student Advisor, Emma Lowry, Program Administrator, Carole Mason, Associate Professor Dr. Ashraf Hendy and Chair, Dr. Douglas MacLeod.

The final report explains the objectives and constituent parts of the project:

The intent was to create a platform for virtual design that was economical but effective. In every instance an attempt was made to use off-the-shelf and freely available software. To this end, the Centre created a platform (Figure 1) with the following components:

- Adobe Connect for videoconferencing and the presentation of design work
- A teleconference line to ensure high quality audio
- Dropbox to submit assignments
- Trello – a project collaboration and management web-based application
- YouTube for sharing videos
- Survey Monkey to evaluate the student experience

Each participating student also required a computer with an Internet connection and a webcam and a phone line. At various times tablets were also used to connect to the system (MacLeod et al 5).

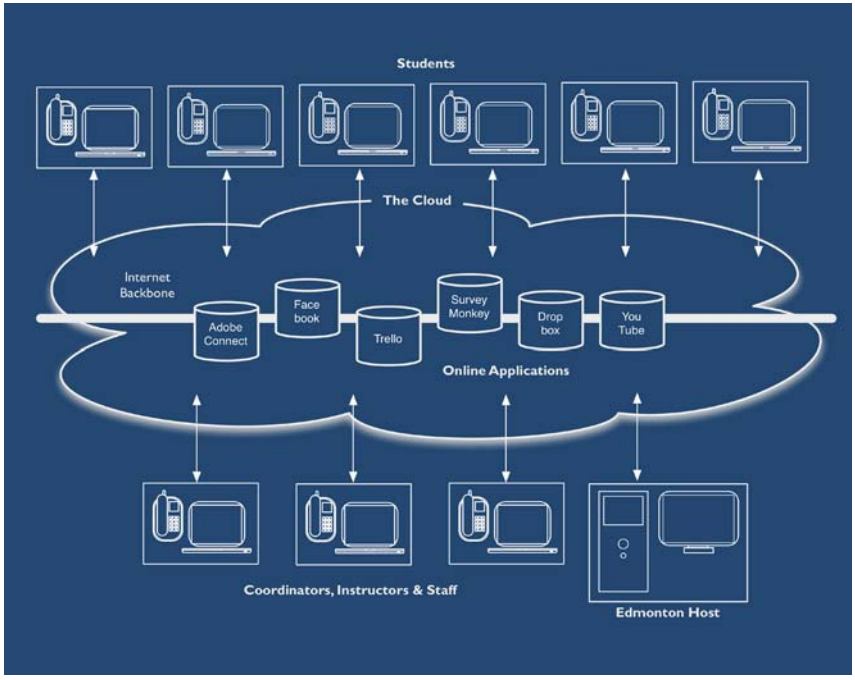

Figure 1 Schematic of Virtual Studio Pilot Project (MacLeod et al 5).

Building a Community of Practice

One of the key objectives of this experiment was to see if a community of practice could develop in a virtual environment. Social media was one obvious means of developing such an online community. As the final report notes, … a Facebook page was created for the virtual studio but

the students felt it was not a good means of organizing information and so a "Virtual Studio" project page was created in Trello. Trello is structured around a descending hierarchy of Boards, Lists and Cards. Boards were created for "General Resources and Information" and "Weekly Work." On the "General Resources and Information" board there were lists for "Weekly Agendas," "Course Information" and "References and Links" (MacLeod et al 5).

The Trello interface is shown in Figure 2.

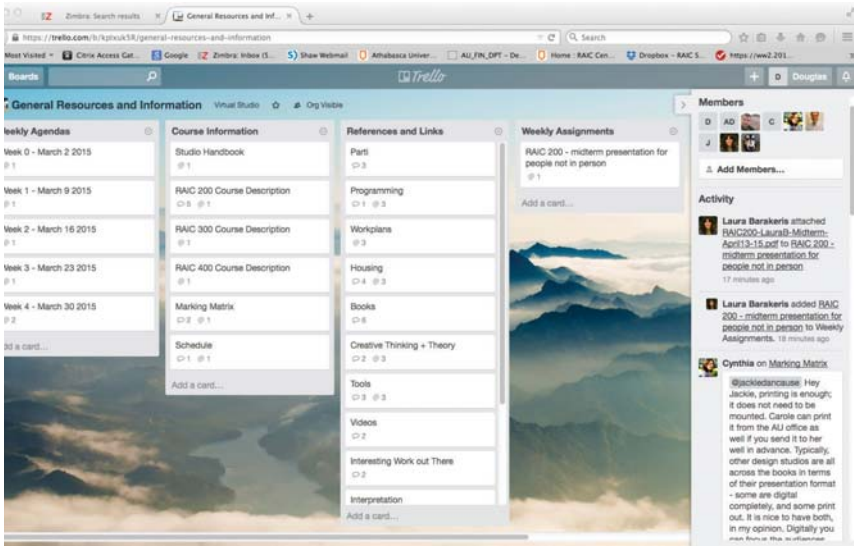

Figure 2 Screenshot of the Trello Interface.

Evaluating the Pilot Project

The context of the studio was also critical. The virtual studio met on the same day at around the same time as the face to face studio of the Edmonton chapter of the RAIC's Syllabus program and followed exactly the same curriculum as that provided by the RAIC. Students from both the virtual and face to face studios presented together (some in person and some online) at both the Midterm and Final Reviews held on April 13th and May 25th 2015 respectively. During each review, all students were asked to present for 10 minutes and

then they received 10 minutes of feedback from the critics who were both in the presentation room and online.

Having the face to face studio as a control group was an important component in evaluating the experience of the virtual studio. In addition, the students in the virtual studio were asked to complete 3 surveys during the studio.

An initial survey was completed within the first week in order to gain an understanding of their previous technical and educational experiences. A second survey was sent out after students received their marks from the Midterm presentations in order to gain an understanding of whether or not issues or problems had occurred. The Final Survey was sent out after the Final Reviews to determine the success or failure of the technology, teaching methods and student/coordinator interactions (MacLeod et al 6-7).

While a sample group of six should not be used to derive definitive conclusions regarding the success of the virtual design studio, the pilot project and the subsequent deployment of a complete suite of online studios have proven to be popular with the students.

In the Final Survey, as shown in Figure 3, 4 students rated the overall quality of the course as "Exceptional;" 1 rated it "Above Average;" and 1 rated it "Average. In terms of the quality of the work, the report concludes that:

> All students in the virtual studio received a passing grade but there was a range of abilities across both studios but – and this is crucial – the variation in ability was greater within the studios than between them. In other words, the work in both studios was comparable and it appeared that delivering the curriculum virtually did not compromise the quality of the work (MacLeod et al 15).

Sketching and Design Thinking

One of the identified weaknesses of the virtual studio, however, is the lack of effective tools to duplicate the experience of an instructor or mentor marking up, or drawing on top of, a student design in a "desk crit" or review. The drawing tools in Adobe Connect are awkward and clumsy. New developments, such as the iPad Pro with its pressure sensitive stylus, may go some distance to correct this deficiency.

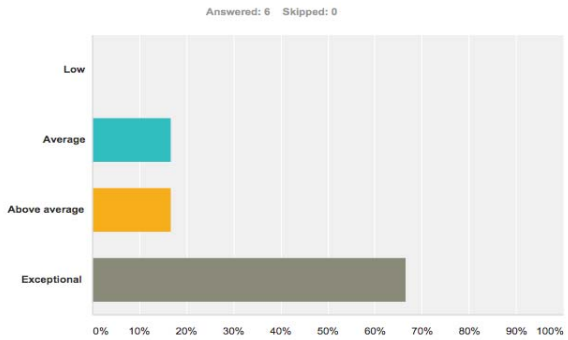

Figure 3 Results from the Final Survey.

This emphasizes that in moving towards virtual design, care must be taken not to lose critical, existing skillsets. To date, there is no hardware or software that can replace hand drawing and sketching. For this reason, students in the introductory virtual studios are required to complete their assignments by hand. This is not inconsistent with some of the ideas of virtualization. Virtualization suggests the idea of instant (not just rapid) prototyping as a design approach and this is what sketching by hand does very well. Virtualization is not solely the domain of digital technologies.

As an example, students in the virtual studios were encouraged to use Bill Buxton's 10 plus 10 method and quickly sketch 10 ideas for the design brief; reflect on those alternatives; and then produce another 10 variations on the best ideas (Greenberg et al 17-18). Essential to the method is the exhortation, "Don't try to judge the merits of these concepts; the important thing is to quickly generate as many as possible (17)."

Originally developed for user interface designers, the 10 plus 10 method suggests that designs can be conjured up through sketching and dismissed on the fly to quickly explore and even define a progressive winnowing of alternatives towards a preferred approach that is most in keeping with the design intent.

Essential to this approach – and another key concept that must be preserved in the move to virtualization – is the idea of design thinking or what Roger Martin, formerly of the Rotman School of Management at the

University of Toronto, has called abductive reasoning (Martin). Abductive reasoning can be thought of as following a hunch or making an educated guess. It identifies promising (but not confirmed) theories and explores them rigorously as a means of refinement.

Serious Play

Abductive reasoning, sketching, and the 10 plus 10 method all dance around the idea of serious play. Michael Schrage, a research fellow at MIT's Sloan School of Management, uses this term to emphasize that innovation requires improvisation and it is the inherent uncertainty of improvisation (and of abductive reasoning, sketching and design) that must be encouraged, protected and nurtured in the process of virtualization (Schrage 1).

As noted in an essay on the future of the design studio:

> The ACEBIM (Alberta Centre of Excellence for Building Information Modeling; see http://www.acebim.ca/) have suggested that the kind serious play described above could also be incorporated into design learning through "Crash Test Models." These are virtual models created in BIM software where the student can change various parameters of the design and assess the resulting change in the performance of the building. (MacLeod 16-17)

The next generation of the virtual studio is testing this approach. Students from four different design programs – Tecnológico de Monterrey, Mexico; Cardiff School of Art & Design, Wales; the University of the Witwatersrand, South Africa; as well as Athabasca University – will both share their designs online and work with the web-based MatchBox Energy software developed by Trevor Butler and Richard Kroeker. This software allows students to enter (albeit by text) the various parameters of their design (such as glazing, insulation and orientation) and receive a rough idea of its energy consumption and performance. They can then try alternatives to improve that performance.

The same essay also suggests:

> In effect, the speed and power of today's computer resources combined with the data structures allow students to "play" with their designs in a serious way. Mammals are hard-wired to play as their

> preferred way of learning and as Einstein maintained about his own thought process, " … combinatory play seems to be the essential feature in productive thought" (Einstein 25-26).
>
> While our educational institutions sometimes seem to constrain this tendency, with the capacities described here, a student can try many alternative designs quickly and simulate their real world performance. This ability to test their ideas in a playful, but still meaningful and realistic way, provides a powerful complement to the idea of abductive reasoning/design thinking described earlier. (MacLeod 15-16)

The Facebook of Buildings

These experiments with virtual studios are, however, only the tip of the iceberg in terms of the challenges and opportunities associated with the virtualization of design. The virtualization of the products and services associated with design and design education will have an even more profound impact on the practice of architecture.

The most provocative notion is the idea of data driven architectures as implied by Building Information Modeling or BIM. The science fiction writer, Bruce Sterling, has offered the clearest explanation of this development: "The physical object itself has become mere industrial output. The model is the manager's command-and-control platform … The object is merely hard copy" (96). Translated into world of architecture, the implication is that a bricks and mortar building is only an instance of its building information model.

This has immense implications for the physical scaffolds that would support virtual design and virtual design education. In this respect the infrastructure for virtual design comes to resemble the Internet of Things as it was recently described:

> Simply defined, IoT is about connecting objects, from trucks to refrigerators and hydro meters, to the Internet. Data gleaned from the sensors and systems applied to these objects can then be used to monitor, control or redesign business processes" (Dingman B8).

It is relatively easy to translate this description into the built environment where buildings and building components from window blinds to photovoltaics to thermostats communicate through the Internet and data gleaned from the sensors and systems applied to these components can be used to monitor, control or even create the building.

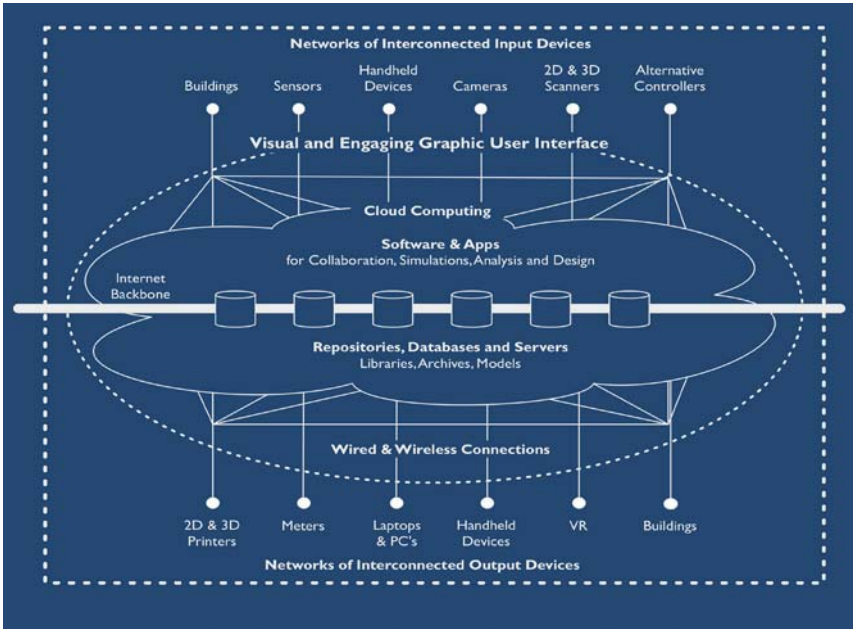

Figure 4 The Internet of Buildings.

In an Internet of Buildings, design would be supported by a suite of plug and play input and output devices connecting to, drawing from, and communicating through a cloud of apps and services. Combined with idea of Crash Test Models, this scaffold becomes an example of a recursive mechanism for prototyping prototypes through serious play. This is depicted in Figure 4.

This does, however, raise a multitude of questions but in particular: Who controls access to that cloud? Depending on its policy and economic structures it may be open or closed, proprietary or non-proprietary, inclusive or restricted. Despite the enormous economic success and innovative potential of the Internet with its open architecture, current initiatives seem to be tending towards a more restricted approach which could prove disastrous to the possibilities of virtual design and any associated efforts in curriculum development.

Instead, to enable all the possibilities of virtual design, this physical/virtual infrastructure needs to be free, open, modular, user generated and community-based so as to become a Facebook of Buildings.

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