ARCH-APP | AN APPLICATION FOR ARCHITECTURAL DESIGN PEDAGOGY

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ABSTRACT:

If architecture is such a dynamic discipline, then it its pedagogy must also embrace change, current technologies, and real-world precedent showcasing concepts as real buildings. Unfortunately the conventional paradigm of design studios and lectures does not capture this mandate. Without connections from the ideas and precedents in the classroom to the real world examples surrounding them in their built environment, architecture students are denied a critical dimension in their design education – tangible application. In response to such a context, faculty members from Ryerson University in Toronto, Canada developed an architecture application, *Arch-App*, that seamlessly bridges design discourse in the classroom and studio into the real world via a combination of global positioning, internet connectivity, and augmented reality technologies found in current models of smartphones. The adoption of the *Arch-App* in Canada's largest architecture program has been met with successful integration into a range of architecture-related courses.

1. SHIFTS IN PEDAGOGICAL MEDIA

Architectural design is neither static nor solely conceptual; rather it is ever-changing and often delves into explorations of manifesting into built reality. Educators have constantly sought better pedagogical tools for cultivating greater student engagement, encouraging knowledge application, and building upon a legacy of material without compromising convenience and accessibility. From clickers to service-learning, contemporary educational tools offer students varying levels of addressing these demands by educators and students alike. Though the robustness of the media available via online sources (ranging from videos, imagery, text, and other interactive formats)

is undeniable, it neither adequately serves as a thorough simulation of "being there" nor does it encourage sincere critical thinking in design. Unlike some disciplines which in academic contexts can only rely upon the hypothetical and theoretical, architectural design education is incumbent upon at best real-world application and at worst representation and simulations.

As design students continue to not only become increasingly technologically mobilized but also virtually connected, it is inevitable that ubiquitous computing devices such as smartphones become teaching tools. With the near-limitless access to information via the internet, current students demand a greater connection with their education beyond regurgitation of concepts; they seek the application of in-class material outside in the real world. This condition is most notable in the study of architectural design. A commonplace condition in architectural education is the preoccupation of the rhetoric of design sensitivity and architectural experience yet at best educators may provide images or videos of these concepts rather than ensure students truly experience these notions in direct application. Any student of architecture can attest that physically being in a building project has greater pedagogical value than any amount of representational media currently available. Rather than provide yet another method of pedagogical representation, the *Arch-App* is a tool that encourages students to explore their surrounding built environment to experience the real-world architecture with supplemental data provided via online sources.
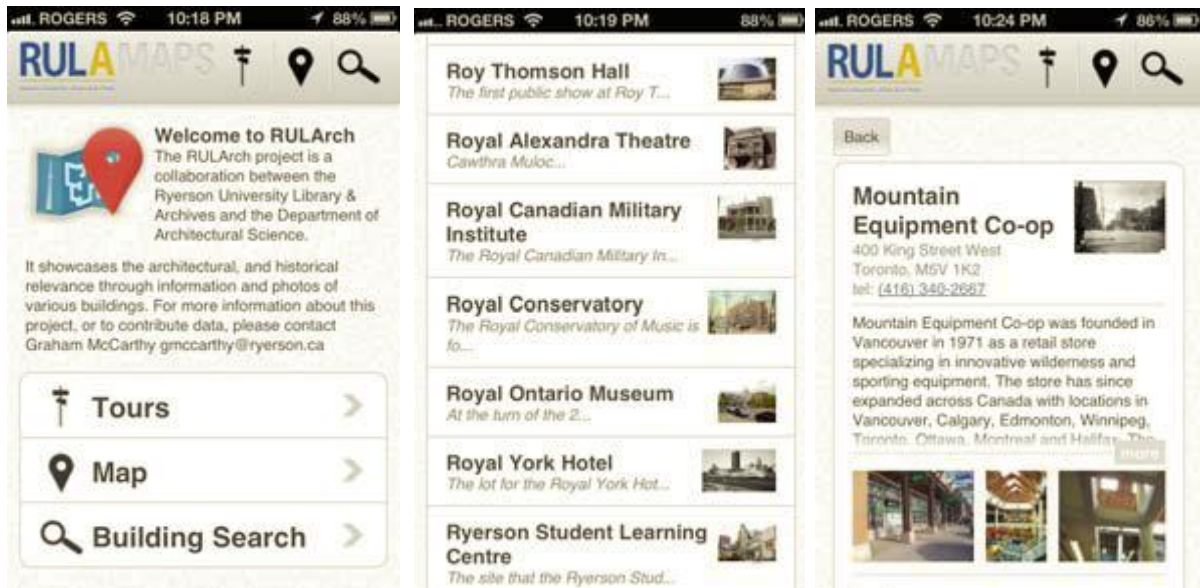
Figure 1: Sample screenshots of the Arch-App (RULA Maps) on an iPhone

2.0 THE ARCH-APP AS A RESPONSE TO ARCHITECTURAL EDUCATION CHALLENGES

In response to the nominal connections between architectural education and its real-world application, faculty members within Ryerson University's Department of Architectural Science in Toronto, Canada developed the *Arch-App* (originally entitled RULA Maps) which effectively uses the technologies found within students' ubiquitous smartphones to better connect in-class material to real-world reality.

That smartphones are increasing their technical capacities with internet connectivity, global positioning, and an ecosystem of applications ranging from augmented reality browsers to banking tools, while simultaneously becoming smaller and widely adopted by current students makes using these devices in an educational context an appropriate advance in contemporary pedagogy. An additional hurdle to the Architectural Science program at Ryerson University was despite its presence in the centre of the country's largest city, it draws upon a large commuter population largely unfamiliar with the architectural works surrounding the downtown campus. In response to this unawareness the fundamental infrastructure of the *Arch-App* was initially developed as a simple online database of building information on the names, construction dates, architects, and locations of projects ranging from historic residences to new museum additions (Fig. 1).

Gradually this database grew not only in terms of the number of entries but also the level of detail in the content. Specific headings emerged including architectural relevance, history, and relevant imagery and became components of the online database. The premise of creating this infrastructure was to allow students to have a quick reference guide to notable buildings around the Ryerson University campus available to them through their smartphones, laptops, and tablet computing devices (Fig. 2). The enthusiasm shared by the students using the web database spurred the architectural science faculty members and Ryerson University library staff to conjecture ways to improve upon this basic database system. The next step in the *Arch-App*'s evolution would be driven by more innovative technologies that are currently available to anyone with a smartphone, most notably the integration of augmented reality.

Unlike virtual reality which is exclusively a computer-simulated environment to represent real and imagined worlds, augmented reality is the superimposing of data or computer-generated information (including video and sound) over real-world conditions. Though the term augmented reality, coined by Thomas Caudell, may only be merely a couple of decades old, the concept is neither new nor is it a rare occurrence in daily life. A commonplace example of AR would be the layering of scores, remaining time, sporting commentary, and player statistics atop footage of a sporting event.

The real-world events are supplemented by overlaid data that allows the audience to gain greater insights on what they are witnessing.
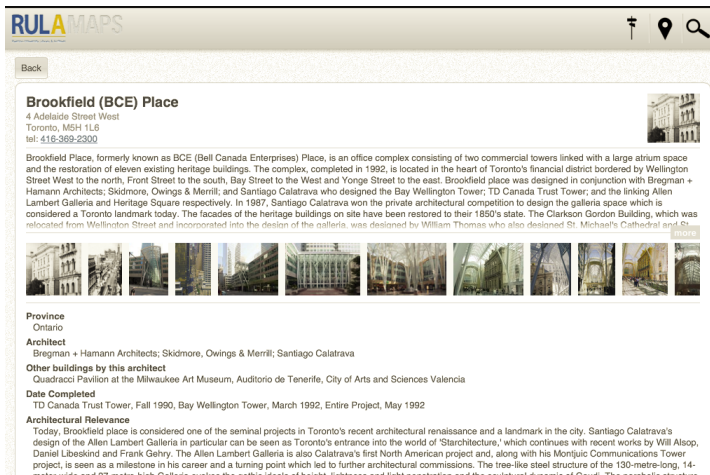
Figure 2: An example of the Arch-App content including historic and interior imagery

Augmented reality is yet another pedagogical tool that enhances users' engagement between the course material and the built world. That smartphones also have the capacity to send global positioning data also provides current students another dimension of selfdirected navigation in the built world. The combination of hardware (including cameras, computing capacity, and touchscreens) and software (such as the app ecosystem, multimedia support, and telecommunications features) in smartphones has effectively integrated into many daily live, work, and play tasks into a single consolidated device (Fig. 3). Rather than simply providing a mobile database, the integration of geo-location and augmented reality components of conventional smartphones allows students to explore their designed built environment and investigate buildings on their own (Fig. 4). As a number of progressive institutions have begun integrating the platform at an educational capacity, a shared belief among all adopters has been that the interactive, exploratory potential of augmented reality "can activate knowledge stored in long-term memory and cause the brain to integrate it with incoming information. Students who interact with the content can remember more than students who receive information only passively and better transfer what they have learned to new problems" (Billinghurst and Dunser 2012). One of the driving factors behind the integration of augmented reality into the app was to go beyond simply encouraging students' exploration of their designed environment and reap the pedagogical benefits that many published studies have demonstrated. Aside from criticisms that such "tools need more development" (inherently tied to a relatively nascent pedagogical tool), applications of augmented reality in

learning environments have been universally positive for a range of reasons including its "ease of understanding", "visualization of the invisible", and "interactivity" (Larsen, et al. 2011).
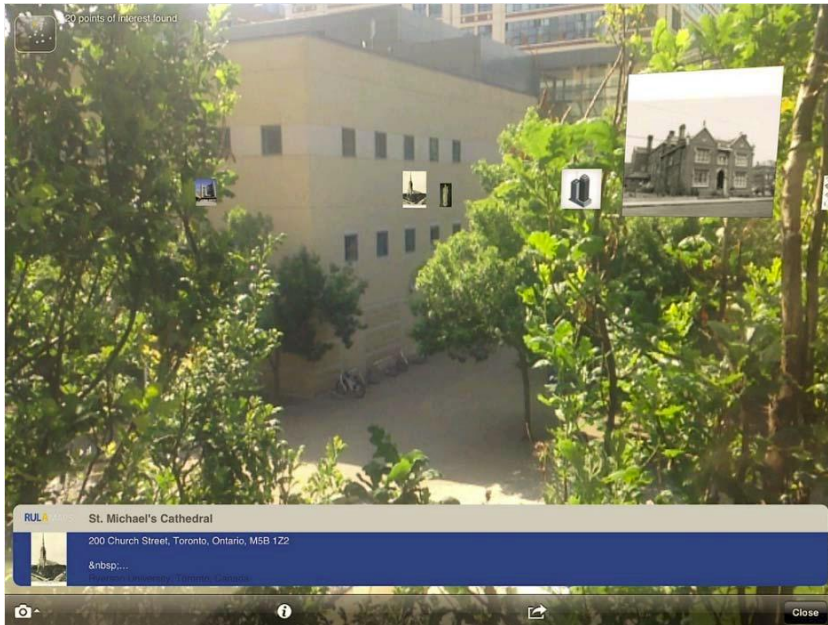

Figure 3: An example of the augmented reality interface of the Arch-App

Figure 4: The Arch-App in use by students exploring Toronto's architectural landscape

2.1 HOW THE ARCH-APP WORKS

The evolution of the original, basic online architecture database adopted many of the features available in contemporary smartphones. Within this framework, the content available for publication on the *Arch-App* expanded to include specific categories of imagery (ranging from historic archival photos to construction details), course-specific text (such as "Structural Relevance" and "Historical Significance"), diagrams and visualization imagery

(ranging from concept sketches to structural diagrams) , and videos (most notably interviews with architects). With this robustness in media, instructors within the Architectural Science program were able to find interesting ways to integrate the tool into their coursework.
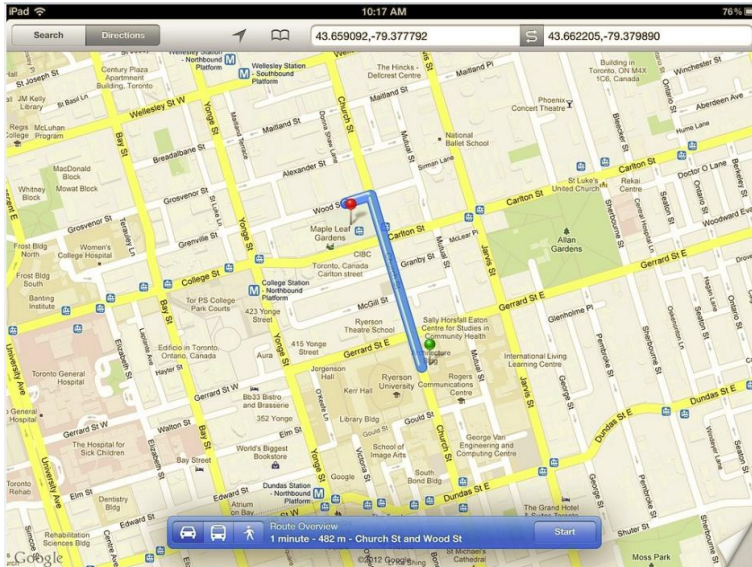

Figure 5: The Arch-App uses Google Maps to direct users to specific built projects

At a very basic level, the *Arch-App* allows users to look up a notable architectural project by name, architect, era, or typology and access the associated design imagery, text, and videos that has been uploaded onto the servers. Most phones with internet connectivity are able to accomplish this fundamental task. It is the adoption of smartphone technologies that truly begin to demonstrate the full robust capacities of the *Arch-App*. With the geo-location technologies available in current smartphones, *Arch-App* users are able to go beyond looking up relevant design projects and finding their addresses by integrating mapping tools (such as Google Maps) to direct them to a specific location (Fig. 5). Even more academically useful is the ability to create tours for students to take throughout the city and visit buildings of a particular milieu (for example a tour of several nearby churches or a series of notable Brutalist projects). Supplemented with the online database of materials and the geolocation capacity of smartphones, the *Arch-App* becomes an architectural tour guide throughout a city.

Similarly, the augmented reality capacity of smartphones brings to the forefront a wealth of information on any project a user is nearby. Rather than rely on knowing a specific notable building project, users of the

augmented reality feature of the *Arch-App* can simply hold their smartphones up to an interesting building and access the building information based upon proximity. The current application (app) ecosystem of programs for smartphone users continues to grow and is incredibly vast covering the spectrum from games and entertainment to productivity and social networking. With over 600,000 apps available for the Apple's iOS operating system and approximately 400,000 in the Android marketplace, apps have become the currency in ascribing personal value to phones (Kingsley-Hughes 2012). Among these are apps that serve to uncover layers of information in an augmented reality environment including Junaio and Layar. Adopting the infrastructure of these free augmented reality browsing platforms, the *Arch-App* content seamlessly integrates AR support. With support from the innovative technologies librarian at Ryerson University, the prototypical building information database, including images, texts, and videos, became accessible via an augmented reality interface (Fig. 6). The wondrous potential of the *Arch-App*'s augmented reality feature is that it empowers users to discover the abundance of architectural design surrounding them in their daily lives.
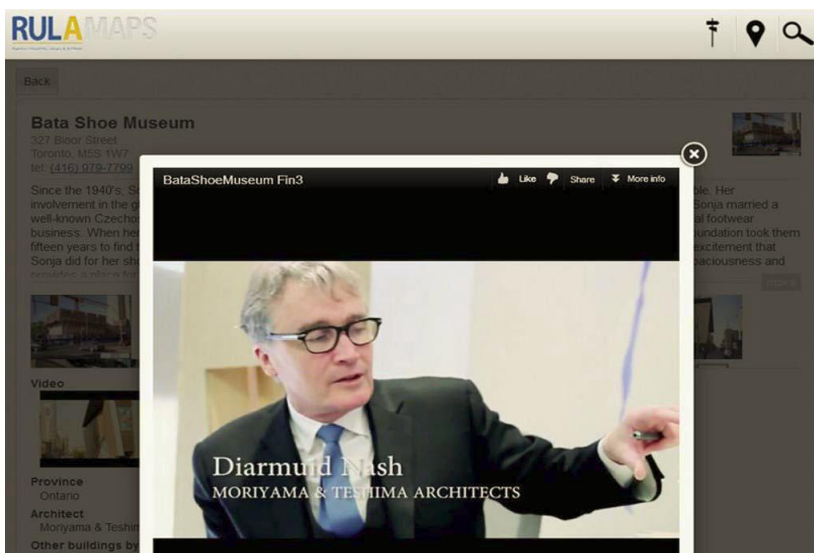

Figure 6: A sample of the Arch-App's integration of video interviews with architects

2.2 INTEGRATION INTO COURSES

The *Arch-App* infrastructure serves as a database of content on any given landmark in the built environment that may be accessed via students' smartphones or tablet computers. Whether via educators' preordained tours or an augmented reality interfaces, the *Arch-App* reveals the incredible world

of architectural design information often neglected in daily life. Content ranging from design drawings and interviews with architects to historic and technical information are made available to students conveniently in the palm of their hands when visiting a built project. Its adoption into Canada's largest architecture program has been met with successful integration into numerous courses in architectural science including design studio, structures, history/theory, digital tools, and detailing. The critical and common component to the *Arch-App*'s adoption in the range of courses is the fact that its use encourages students to visit real and local architecture projects (Fig. 7). Studies have shown that despite the increasing reliance on virtual representation in architectural programs, real-world site visits are far more effective in ensuring students understand concepts raised in the classroom (Mills, Ashford and Wilkinson 2006). The *Arch-App* reinforces this critical component in architectural pedagogy.
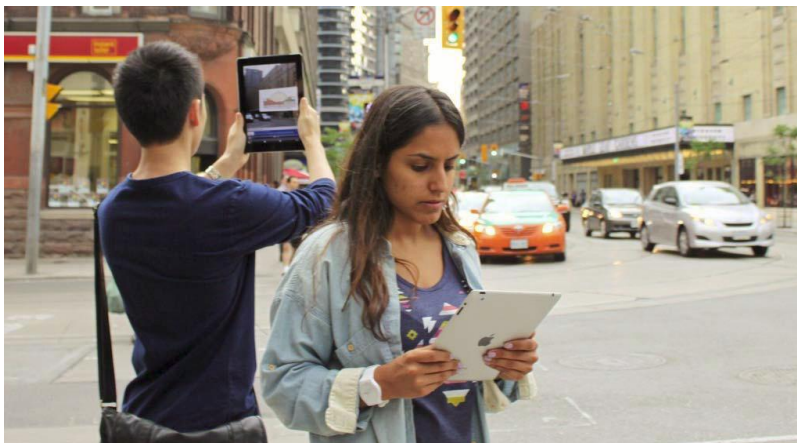

Figure 7: Students mobilized with ubiquitous computing devices using the Arch-App

Initially conceived of as a side project by a digital design faculty member, the original *Arch-App* database was populated and piloted by students enrolled in ASC755: Digital Tools (a fourth year digital design elective). Tasked with developing the basic infrastructure, headings, interface, and navigation, the *Arch-App* was an excellent tool for students to literally reconnect and explore their built environment despite having walked all around the downtown Toronto campus during their undergraduate careers. The development of the *Arch-App* within this course served as a feedback loop whereby students were asked what building information would be relevant and how such information should be displayed to a casual and undergraduate architecture audience. Pedagogically, this exercise brought to

the surface a variety of notable aspects of architectural design that students believed were needed for dissemination to a contemporary audience including relevant website(s), design concept sketches, and similar buildings. For educators, this demonstrated that students valued critical design components including fidelity throughout the design development phase as well as relevant precedents that resonated with any given project. As many of the issues raised within this class pertained to the relationship between the built designed world and the digital realm, the *Arch-App* served as an excellent medium to catalyze critical discussion on design responses between the physically and digitally designed worlds. The final project of the course required students to design and construct installations as a response to the design relationship between these environments. Familiar with the information-driven context of digital environments and the value of physical design as a catalyst for social engagement, students developed sophisticated projects such as the *Pentaglow* project. In this design, students used an illuminated, reconfigurable seating condition that allowed users to not only arrange the seats to suit their social dynamic, but it would also document the configuration and post photos of the users online.

Figure 8: Pentaglow, a design project bridging the built and virtual environment

Though the *Arch-App* initially began with a limited amount of historic and theory-based information, it was well suited for integration into the architectural history curricular stream, most notably in ASC306: Ideas, Technologies, and Precedents II. As a method of expanding students' local architectural vocabulary and awareness of what distinguished projects as

great design, the instructor within the course created an assignment whereby students created a report on a building which included images and text that could be concisely uploaded to the *Arch-App*. Not only did this encourage students to actually visit project sites, document notable design conditions, and investigate archival resources, but the assignment mandated that they could critically edit what would be best displayed to a wide audience. The combination of being situated in Toronto's downtown core with access to a wealth of city archival information as well as Ryerson University's stewardship of *Canadian Architect* magazine's archives, allowed students to examine the design works within a specific context thereby allowing students to better understand design responses, constraints, and relationships. Within this course students were also directed to document the buildings' historic legacy, design intentions, and architectural significance through images and text. Additionally, students had to visit the projects in order to provide supplemental imagery to address the current state of the project and any conditions that may not have been documented already such as interiors, renovations, and ornamental details. The pedagogical value of this project not only steeped students in architectural history and made them aware of local architectural gems, but by examining the historic and theoretical contexts of the projects, better understood the zeitgeist and design response presented by the designers. This dimension is often lost in young designers' educations as the historic and theoretical background of the built environment is often diminished in the interests of proposing spectacles of architecture. This cascaded into the design studio where the students were able to translate such sensitivity into their own designed urban interventions.
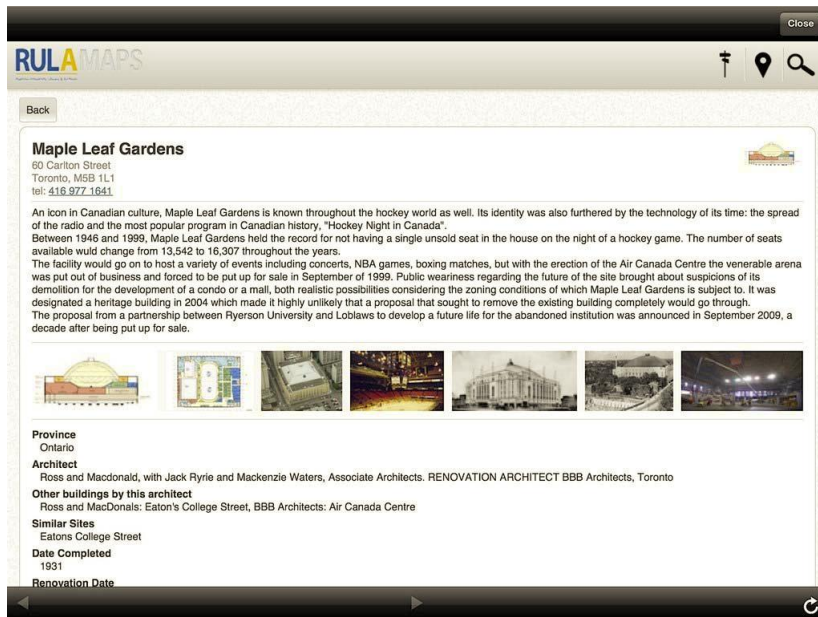
Figure 9: The Arch-App integrates renovation and historic information on key buildings

As a platform for additional courses, the *Arch-App* became a useful resource for two technical courses: ASC206: Structures I and ASC623: Principles of Detailing. Similar to the integration of the app in the architectural theory course, the instructors leveraged its content creation opportunities to engage students with the designed environment through specific lenses. Within the ASC623 Detailing course, each student was instructed to find a construction site and document as much as possible about the renovation or new construction. Beyond mandating projective renderings and site photos of a project under construction, students were also asked to isolate specific details currently under construction and reconcile what was in-progress and the design intent. This effectively mandated that the students applied their knowledge and learning from the detailing course to a real world context. At the very least students would be well-versed with assembling conventional details properly, but in some instances, students were able to gain a great deal of insights in proposing solutions to more innovative detailing conditions unique to a specific project. The pedagogical outcomes of the project went beyond documenting archival material for the *Arch-App*, and encouraged students to apply their awareness of detailing to new projects. It is that application of learning which demonstrates students' understanding of detailing while also bringing an awareness of the technical and creative aspects of design work.

Within the context of the ASC206 Structures course, the *Arch-app* was integrated as a tool for students to visit existing architecture projects in order to understand the structural elements that hold a building up. Unlike the ASC623 Detailing exercise where students had to conjecture how a detail would work based upon renderings and existing construction site work, the ASC203 Structures assignment presented students with existing buildings which called for students to document, conjecture, model, and analyze a typical structural bay of a building. What was remarkable about this particular assignment was that it was integrated in a first year structures course yet mandated a relatively sophisticated level of understanding of structure, computer modeling and rendering, and construction knowledge. The general quality of assignments were sophisticated as students not only wanted to ensure that their assignments were correct, but also due to the fact that the material would be posted up for the world to see via the *Arch-App*. As with the previous projects, the app brought a greater level of design sensitivity to students as it uncovered the critical components of structure that not only held buildings up but also served as essential components of design such as Santiago Calatrava's Brookfield Place (Fig. 10) or the structure required to support one of the city's first green roofs in Toronto's Mountain Equipment Co-op headquarters (Fig. 11).

2.3 A WEB 2.0 PLATFORM FOR EDUCATION

The success of the *Arch-App* goes beyond its ability to serve as an accessible, online building design resource; it serves as a platform for students to contribute and participate in a larger production of knowledge. Unlike conventional models of education where students perform basic research tasks which culminate in an insular assessment (such as an exam, paper, or presentation), the *Arch-App* allows students to put their content on a public platform which may be viewed by colleagues and the general public. Current paradigms of integrated online pedagogy have begun this model of "collecting information, processing the recommendations, and presenting them in an attractive way" for widespread consumption such that excellent student submissions are effectively rewarded by going online (Dingli and Seychell 2012).
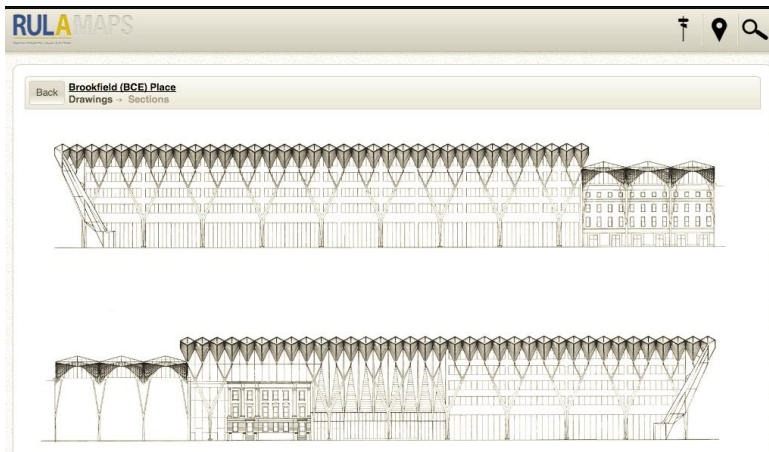
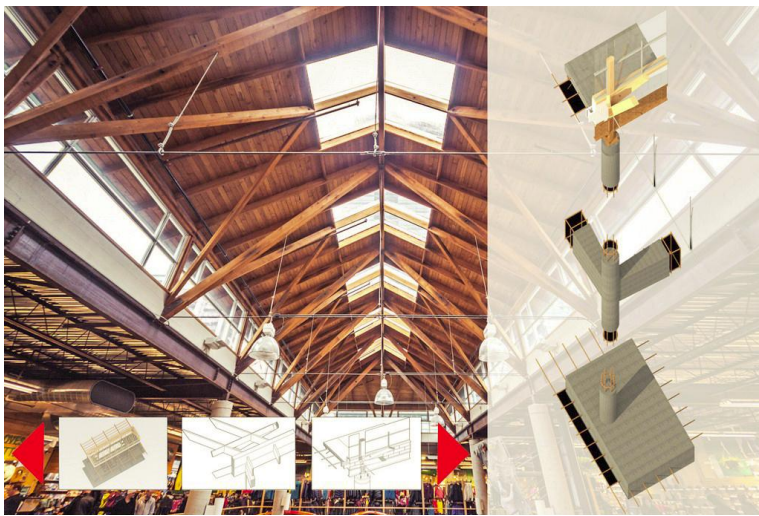Figure 10: The *Arch-App* includes orthographic drawings for projects

Figure 11: Students' 3D models of the structure are incorporated into the *Arch-App*

Rather than serve as a one-way repository of information, the *Arch-App* has become a platform for students to upload notable assignments within their courses to ensure content is current and relevant. This Web 2.0 paradigm has rendered the *Arch-App* an indispensable tool in not only creating a pedagogically relevant database, but also providing a platform for students to understand all the facets of their design education in real-world application in order to make a design feasible. Currently the model of operation relies upon a great deal of student-generated content getting processed and mounted through a faculty member or a research assistant. For various reasons including limited resources and time constraints, this bottleneck is not sustainable. The future of the *Arch-App* is reliant upon the dominant Web 2.0 model – the wiki. Though security and editing protocols are currently being finalized as of the writing of this paper, the next iteration of the *Arch-App* will be driven by user generated content coming from

individual users as opposed to a consolidated source. The intention would be a reliance upon content persisting only if it is valid and uncontested. Though leaving the responsibility to the greater online community as an authority on content, the net value of wiki models of operation is positive where the vast majority of accurate and correct information far outweighs anomalous and erroneous entries (Xiao 2012).

3.0 PEDAGOGICAL BENEFITS

The aggregate effect of adoption of this platform has resulted in improved student performance and engagement in all courses, most notably the enhanced design sensitivities that have emerged in design studio. Though the *Arch-App* was used directly in the survey of courses outlined in the first year of integration into the Architectural Science program, rather than in a design studio, the relevant applied understanding and design adoption resonated and had clear impacts on improving students' design work. From discussions on theoretical implications of virtual and built environments to more explicit connections with design criteria including historical contexts, structural implications, and detailing challenges, there is clearly a strong relationship between the app's adoption and design awareness.

Beyond the integration of the wiki model of content management, future directions the *Arch-App* has already begun exploring include adoption by other universities in North America, partnerships with local architecture associations (including the Toronto Society of Architects and Ontario Association of Architects), and supplementing content with other departments including Ryerson University's School of Interior Design. New categories for content including architect interviews and commentaries, general interest architecture tours, and interior design data make the *Arch-App* a great database for not only academics and industry but the general public as well. The net benefit of this greater adoption is a more robust database of content that ultimately ensures students have access to more insights on their own design work both locally and beyond. That professional agencies have begun coordination of data with their membership for the *Arch-App* lends not only greater credibility and integrity of content, but further bridges the gap between ideas raised in academic contexts and the real world of professional practice. The *Arch-App* holds a great deal of

potential in its robust quality of content, its pedagogical accessibility, and above all, its user generated content. Regardless of the feedback and survey data underscoring the *Arch-App*'s success as a design and data tool (Table 1), the most significant aspect of the entire platform is its level of engagement it generated within the entire school community. The sense of accomplishment that students garner in having their work immortalized as a contribution to an authoritative resource on architecture in Canada's largest city goes far beyond the exercises driving this pedagogical platform (Fig 12).

Figure 12: A newspaper article of the students with the *Arch-App* creator

Please rate the following questions with regards to the use of the Arch-App:

	(1) Poor	(2) Fair	(3) Good	(4) Very Good	(5) Excellent
How would you rate the Arch-App in learning about the material in this course?	0%	1%	5%	53%	41%
How would you rate the Arch-App in helping improve your performance in studio?	1%	1%	17%	45%	35%
How would you rate your use of the Arch-App outside of academic work?	3%	5%	42%	40%	10%
How do you feel about your work posted via the Arch-App?	4%	5%	25%	56%	10%
What is the likelihood that you would use the Arch-App in another city if applicable?	1%	10%	51%	38%	1%
How would you rate the Arch-App's ease of use?	2%	4%	33%	45%	15%
Would the infrastructure of the Arch-App be suitable for other courses?	1%	2%	12%	44%	41%
How would you rate the value of the Arch-App in first year architectural design courses?	0%	2%	9%	16%	73%
How would you assess the potential adoption of the Arch-App by the general public?	12%	16%	28%	23%	22%
How would you feel about the potential adoption of the Arch-App by other institutions?	0%	2%	4%	61%	32%
How would you feel about the potential adoption of the Arch-App by industry?	2%	2%	5%	68%	23%

Table 1: A sample of the survey administered to students using the Arch-App in various courses (n=92)

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