COMPARISONS IN REPRESENTATIONAL MEDIA USE IN DESIGN STUDIOS BETWEEN HONG KONG AND AUSTRALIA

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Abstract. Representational media – analogue, physical, digital, or virtual – are employed by students in the conception, development and presentation. In 2013 a survey at two architectural schools was conducted to study the current representational media use in design studios. The survey examined the role digital and physical media play in students’ design work and how students use the various media to generate and communicate their designs. This study presents its importance through the shift in architectural education whereby digital tools are not taught per se any longer, however expected to be mastered throughout the course. Yet students’ learning experiences are strongly dependant on the successful acquisition of skills and its transfer to deep learning. Especially architectural design studios build upon the premises that re-representation leads to a better acquisition of knowledge. Architectural educators may use the study to revisit their studio and reposition the role of media as well as align learning outcomes, deliverables and communication tools with the actual working- and learning-styles of students.

Keywords. Representational media; design studio; pedagogy.

1. Representational Media in the Design Studio

The means through which architecture students work through design studio problems and communicate their outcomes is through design descriptions or ‘representations’. These act as surrogates for real architecture and enable students to test solutions to design problems without necessitating actual physical construction. Representations of design concepts are recorded through media using tools within certain procedures (Dave 2000). Represen-
tational media, constituting analogue or physical systems (tracing paper, graphite and ink) or digital or virtual systems (involving scanning, 3D CAD modelling, animations and rendering) (Bermudez and King 2000) are employed by students in the conception, development and presentation of designs.

Five principal representational media are widely used in the undergraduate architectural design studio either alone or in hybrid combinations: (i) 2D CAD-based drawings, (ii) manual, hand produced drawings, (iii) handmade physical modelling, (iv) laser-cutting and (v) 3D CAD modelling. As the use of parametric modelling and integrated BIM software is minimal or non-existent in both of the Universities in this study: Deakin University (Deakin) in Australia and Chinese University of Hong Kong (CUHK) in Hong Kong, we have excluded these from the study.

Bermudez and King (2000) provide an extensive summation of media use hypotheses, derived from a summation of research in the area. We argue that, although there has been significant research in the area of representational media, with a particular focus on digital media, the fundamental issues of media interaction as outlined by Bermudez and King retain their relevance some fourteen years on. Thus that the basics of media use, processes and interactions remain a fundamental issue to students in the design studio, and are of relevance to researchers and have been overlooked somewhat.

Bermudez and King (2000) define the fundamentals of media interaction, finding that:

"Media and design process methods associated with media have a direct and essential impact in the way architecture is conceived, developed and communicated’. A hybrid physical/digital media process is proposed, wherein ‘multiple iterations of analogue/digital media interactions… are of great importance as they enhance the design process in cognitive, qualitative, and productive terms."

Whereas ‘digital media are stronger for design development as they demand higher levels of geometrical definition and abstraction’, analogue representations are far more fluid and appropriate than digital media for initial and fast development of ideas, the stimulation of the imagination (and) free enquiry.’ By engaging in a hybrid media process, designers create a condition that lowers the ‘overhead and labour-intensive use of computer generated visualizations’.

This concept of ‘embodied effort’ (Ham, 2013) is an important factor in media and tool selection, particularly when the project duration requires quick and effective development and representation of design ideas during the formative stages of design. Representational media and tools with a high
‘embodied effort’ are an often cause of frustration for students with low media skill sets, especially in the early years of their architectural education.

Skill levels still have a critical impact on students’ decisions relating to the use of representational media in the design process. Despite the advancement of media, tools and software over the last decade, the issue of basic engagement remains a primary one for students. Students, as emerging designers, are developing the knowledge, skills and abilities they, and their educators, perceive will be of value for them in practice. Because of this, they utilise representational media differently than mature designers (practitioners). They may adopt different (less mature) design and media strategies and may be more dynamic in their learning.

Bermudez and King (2000) found that designers develop (and conservatively keep updating) a media/representation repertoire that they manage during the design process. They suggest that there is a breaking point in the media iteration process where the designer settles on either analogue or digital representations to complete the design. Media iterations are highest at the beginning of the design process and tend to slow down and eventually come to a stop at the end-phases of design development. There is a comfort zone where the designer tends to flee when faced with high performance expectations under stressful conditions. The designer leans towards media where they feel most comfortable so that they can concentrate on addressing the content of the challenge without having to add the practical and theoretical problems of the media.

The length and assessment weighting of design projects are significant influences on how students use different representational media. Longer projects worth more marks appear to result in a wider band of use of media within the cohort. Design studio at both Universities in Australia and Hong Kong generally involve during one semester short (2-3 week) and long (4-7 week) design projects. There is some evidence that reduced project time forces students to select, and settle on representational media quickly and efficiently. The degree to which students settle quickly on an effective media use strategy also appears to impact the outcome of their project work.

Availability of tools and media, the cost of operation and maintenance and resourcing issues, impact student use of representational media within the design studio. In addition to pens, pencils, drafting board, rulers and cutting knives, almost all students possess their own laptops, tablets and smartphones for use both privately and at University. We have also witnessed the transition from students relying on University-based computers to working in a mobile, laptop-based work environment connecting to each other through a series of social networks (Schnabel and Ham 2013). Even though there have been advances in the impact of cost, accessibility and ease of use
of digital media, this has not necessarily resulted in better quality work in terms of the quality of design or design representations (Ham 2013).

3. Drawing comparisons in media use between Australia & Hong Kong

An online survey was undertaken of Architecture students from Deakin and CUHK in October 2013 at a time when students were actively engaged in their design studio work. The questions asked included:

- What approximate proportion of time (in %) did you spend using each medium for the current design project? (Note: Time spent both on working through design problems and final presentations)
- Estimate the relative importance of each medium for you achieving your desired outcome for the current architectural design studio project.
- How would you assess your skill level in each medium prior to undertaking this project?
- Do you think that your skill level in this medium influenced your decision to use it for this project:
  - This medium made it easy for me to understand important aspects of my design and to demonstrate this understanding to others
- What CAD programmes do you consider yourself as being proficient enough to enable you to successfully use in the current design studio project?
- Please comment on what factors led you to using your representational media in the current design project. These may include skill levels, communications classes at University, work experience, your personal attitudes towards certain media, cost, availability, time and effort etc.
- Please comment on how you used one or more media within this architectural design process in hybrid combinations for a certain purpose. Did you use one medium during the sketch design phase, then another for final submission? Did you integrate sketching and 3D CAD (or other media) during your design process? Can you describe how you used certain media for certain purposes, and how effective these were, or if there were any limitations?

A range of qualitative and quantitative data was gathered from Undergraduate third year students with a sample size of 47 students at Deakin and 29 at CUHK. The relatively small sample size (38% of students enrolled in 3rd year design at Deakin and 52% of students enrolled in the second year design unit at CUHK) does not provide data to extrapolate findings to the general population, but as an instrumental case study where the primary purpose is to provide insight into a particular set of issues (Stake 1995). Thus, the
survey provides an insight into the perceptions of an individual student and adds to the development of understandings of important issues relative to the similarities and differences in media use between Deakin and CUHK.

Students at Deakin were surveyed whilst completing a nine-week design project based on the design of a fifteen storey mixed use commercial building in Hong Kong. ‘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 within a commercial context.

Students at CUHK were enrolled in their first semester design studio called ‘U3 – Use & Programme’. The studio places emphasis on a ‘project of sufficient programmatic complexity such that the consideration of user needs and spatial development dominate the generation and resolution of the architecture’ (course guide). The studio is directly connected to a digital media course that ideally allows students to apply their newly gained skills in architectural computing in their design and studio contexts. Student are encouraged to explore how different CAD, and modelling applications can help them in expressing their design ideas and develop a programmatic adequate design proposals. Their final presentation included diagrams, 2D plans and (physical and digital) 3D models.

3.1. HOW STUDENTS USE MEDIA IN THE DESIGN STUDIO

As one Deakin student stated, ‘Time management played a great role in this the decision as well as actually achieving an outcome’. The time spent using representational media is a key factor in student engagement in the project, especially in the Deakin context, wherein many students report to be working for 20 to 30 hours a week outside of University.

Students at both universities were asked to approximate what percentage of time they spent on 2D CAD drawings, hand drawings, hand-made physical modelling, laser-cut or 3D printed models and 3D CAD modelling. Student responses from both Deakin and CUHK reported a spread of media used in their current design project. CUHK students reported spending more time using 2D CAD (mostly AutoCAD) and physical modelling for their project work, whereas Deakin students appear mostly to rely on 3D CAD (mostly Sketchup) and 2D CAD (mostly AutoCAD).

Comparisons between Deakin and CUHK can be drawn out in student comments on how they used representational media. Survey quantitative and qualitative data, participant-observation in the studio and analysis of assessment reflect widespread engagement in what Bermudez and King’s (2000) described as ‘hybrid media procedures’. This involves moving in and out of
digital media and physical media within the design process in order to develop ‘representations for’ as well as ‘representations of’ the final design product (Ham 2013. ‘Hybrid media procedures permits flexible and intuitive transformation of electronic technology into plastic media more suitable to the highly mutating nature of design inquiry’. Both cohorts of students utilised a common repertoire of media and tools, including hand drawings, physical models, 2D CAD and 3D CAD, as well as software such as Illustrator, PhotoShop and InDesign to refine imagery in production.

As one Deakin student described a rich media repertoire:

'I used mixed media for just about every aspect of my project. Auto-cad overlayed on a revit model with photoshop overlays for the sectional perspective. Both hand and laser cut modelling for the model. A combination of revit and photoshop for 3d representations, etc.

The percentage of project time spent on representational media in project work correlates to that media’s relative importance in achieving their desired outcome for their current project. Deakin students placed the most importance on 3D CAD, slightly above that of 2D CAD and hand drawings. HK students placed equal highest importance on physical modelling and 2D CAD, with hand drawings and 3D CAD perceived to be of slightly lower importance.

The authors observed, and Deakin students reported in the survey during the trimester presenting very few physical models for formative feedback. No Deakin comments emphasised physical modelling at the core of their hybrid media process:

"I used autocad, google sketchup, 3dmax, photoshop & laser cutter"

Whereas HK students described processes utilising physical models:

Basically I do hand-made models to explore the possibilities in the fastest way. And then I use Sketchup to model it (or Rhino if I would master it better).

Thus CUHK appears to have developed a representational media culture that is grounded more in physical modelling that Deakin. Deakin students appear to rely on the capacities of Sketchup and AutoCAD throughout the design process and present few physical models for formative review. For both Deakin and CUHK, laser cut and 3D printed models were perceived to be of least importance. This could be attributed to the observation that laser cut models (used predominantly over 3D printed models) are brought into the design process at the end solely as a means of generating a physical model from the CAD file to represent the final design. In Deakin’s case, these "models of" (Kvan and Thilakaratne, 2003) were generally poorly exe-
cuted and provided mainly just to meet the brief requirements. 42 of 150 students at Deakin failed to meet minimum standards for the model component of the project. Given the low quality of laser cut models, it could be that ‘computers are the problem’ Kvan (2004) and that laser cut models may simply represent a convenient means of deriving a quick 3D model from CAD data, with little of what McCullough called ‘digital craft’ (McCullough 1996) or what we call ‘hybrid media craft’.

3.2. WHY STUDENTS USE MEDIA IN THE DESIGN STUDIO

Students utilise representational media within their design processes for many reasons, including previous and acquired skill levels, practice experience, cost, availability and resources required, perceptions of brief requirements, artistic proclivities and strategic decisions relating to project length and assessment. Core to decision making is the fact that students are learning representation skills within the design process, and that the representational media ‘media and design process methods associated with media have a direct and essential impact in the way architecture is conceived, developed and communicated (Bermudez and King 2000). The issue of ‘embodied effort’ (Ham, 2013) or the effort required for a designer to complete a representation for a desired purpose, is prescient for students designers that forms a major determinant of what media are used, and how they are used.

Skill levels in representational media are a major determinant of media use in the design studio, for students in both Deakin and CUHK. The mean response (3.04/5) for CUHK students in self-assessing their skill levels across all representational media surveyed was ‘basic’ skill levels for all media, with slightly higher perceived skills in 2D CAD and physical models, and the least skill in laser cut modelling and 3D CAD. In the Deakin cohort, there was greater variation in reported skill levels with an overall higher mean skill level of 3.32/5. Deakin students reported "good" skills in 2D CAD, above "basic" levels in hand drawings and 3D CAD and basic skills in physical modelling and the least skills (2.43/5) in laser cut modelling. Even though they were different cohorts in different countries, the results accord with a common sense view that 2nd year students would have lower perceived skills across the range of media than 3rd year students.

Thus, skill levels prior to undertaking the design project impacts the media used to complete the tasks required in the design project. As one CUHK student reported:

‘Skill level in hand drawing lead me to do all drawings by hand. Not proficient at 3d modelling & would have wasted too much time learning. Haven’t been properly taught how to use the computer programs’.
As a Deakin student stated succinctly, the factors that led to their use of representational media were ‘Skill levels, work experience and time availability’. Another Deakin student stated:

‘I’m not proficient enough in one particular program & the time it takes to learn a new one would have an impact on the desired finish’.

We observe that, despite generalised perceptions of millennial students as digital natives with some intuitive third sense of instantly learning computer programmes, students tend to use the representational media that they have learnt. Constraints of outside-of-University work, tight timelines at Deakin further constrained by 12 week trimesters (to be 11 weeks in 2014) lead to students being very strategic in their media use. Students use what they are taught, but some students further this of their own initiative. Several AU comments highlight this point, and illustrate their frustration with representational media education at AU:

‘Just use microstation because it is what we are taught. Have no idea who was stupid enough to teach us that instead of revit which is actually used in the industry’

Industry experience was perceived to have influenced several students’ media choice AT both Deakin and CUHK, especially in relation to industry-relevant CAD packages:

I have previously worked as a draftsperson using ArchiCAD for both Town Planning presentation drawings … and construction drawings (Deakin student);

Work experience gives me confidence in using CAD (CUHK student).

Overall, there were higher levels of agreement at Deakin that skill levels influenced students’ decisions to use various representational media in their design projects. Skill levels in 3D CAD were perceived to have the greatest influence at both Deakin and CUHK (55% and 73% agreement respectively) and responses were similar for laser cut and 3D printed models (50% AU and 48% HK). The survey reported a divergence between Deakin and CUHK in the areas of 2D CAD (58% vs 44%), hand drawings (62% vs 39%) and physical models (51% vs 40%). This may draw out an insecurity about skill levels brought about by perceptions of inadequate training in AU students, which is illuminated by the comment:

‘Not proficient at 3d modelling and would have wasted too much time learning this. Have not been properly taught how to use the computer programs’ (Deakin student).
Students were asked which software package they were most proficient at to successfully use in the current design project. Deakin students reported a wider range of software use, including AutoCAD 2D, Revit, Sketchup as the most popular, but with a large number of students reporting the use of multiple programmes. CUHK students reported more concentrated use of Sketchup, AutoCAD 2D and Rhinoceros, but lesser use of Revit. The survey reported very low use of ArchiCAD (8 respondents at Deakin, 2 respondents at CUHK) and low or non-existent use of FormZ, DesignCAD, CATIA, DataCAD, SolidWorks, TurboCAD and 3D Studio Max.

3.3. IMPACT OF MEDIA USE IN THE DESIGN STUDIO

Representational media have a profound impact on design processes as the primary means through which architecture students engage in design activity. Representational media are integral to the design process, from the earliest stages of ideation, through to the iterative development of these ideas into planning, form making, spatial layout and tectonic concepts. Towards the end of the design process, representational media are then used to communicate developed design proposals to studio staff and reviewers for purposes of assessment.

For both Deakin and CUHK, there was broad general agreement to the proposition that media made it easy for students to understand important aspects of their design and demonstrate this understanding to others. Significant differences were found between Deakin and CUHK in the medium of physical modelling (49% Deakin vs 86% CUHK) and laser cut modelling (34% Deakin vs 53% CUHK), however general agreement to the proposition in relation to other media ranged between 63% and 81%. This correlates with the data that suggests that CUHK students spend more time using physical models and that these are important to their completion of the project.

Despite reported high usage of 3D CAD at Deakin, hand drawings were perceived as being easiest for students to understand their designs. As one student commented:

‘My skill lies in models for visualisation and hand drawings. I think there is something really nice about hand drawings ... something that is faster. I feel like so many people got stuck trying to resolve every little thing (in their 3D Computer models) that they lost sight of what they really set out to do. And, ended up running out of time. Where for me, the hand drawing simplified things, so I could slowly develop my ideas into resolution’.

We offer support and provide a context for Bermudez and King’s (2000) hypothesis that ‘Digital media are stronger for design development as they
demand higher levels of geometrical definition and abstraction, and the elaboration and coordination of complexity and details (and delivering in kind).

4. Conclusions

Many years after the introduction of computers into the architectural curriculum, the issue of engagement in 2D and 3D CAD remains a primary one in the design studio. Issues of training, skill levels, cost and resourcing, assessment and project length, and the ‘embodied effort’ (Ham 2013) inherent in the representation of design ideas have all not been address sufficiently in education of architectural students. The findings of our study challenge architectural educators to revisit their curricula of design studios and digital media courses and to reposition the role of media as well as align learning outcomes, deliverables and communication tools with the actual working-, learning-, and engagement-styles of their students. Kvan postulated in 2004 reasons why we shall stop teaching CAAD, yet we may have to explore reasons why and how students shall learn CAAD.

References

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