Selective Jamming: Digital Architectural Design in Foundation Courses

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Abstract
This article considers how the concepts and practice of digital architectural design can influence early architectural education. The article approaches this topic through one example, the Virtual Environments course – a constituent of the Bachelor of Environments program at the University of Melbourne. The institutional remit of this course is to introduce first-year students to the roles of design representation. However, recently, the course developed to encompass these pragmatic educational aims and began to question canonical attitudes towards architectural education and practice. At the core of this course are the notions, methods and skills of digital architectural design, understood not as a stylistic option or as a novel paradigm, but as a catalyst for creativity, experimentation, critical thinking and the sustained growth of creative communities.
I. INTRODUCTION: REINVENTING THE WHEEL

The origins of this article are in the earlier paper presented during the Computer Aided Design in Asia (CAADRIA) conference in 2011 [1]. That paper discussed a particular digital fabrication project, integrated into the structure of a first-year course at the Faculty of Architecture, Building and Planning at the University of Melbourne. Instead of simply extending the argument presented in that paper with further evidence, this article considers the cultural and social circumstances that frame integration of digital architectural design into architectural curriculum. This topic is far greater than the confines of one article but I hope that it can furnish its readers with tangible and useful grounds for further reflection.

1.1. The dream of good teaching

In a rare and extensive study, Zehner et al. [2, p. 4, 5] outline successful studio teaching in terms of interconnected dimensions that include: 1) quality projects; 2) quality staff; 3) positive studio community; 4) student engagement and commitment; 4) high level of interaction; 5) effective collaboration amongst students; 6) reasonable class and group sizes; 7) connection with industry and the profession; 8) a variety of studio outcomes; and 9) provision of appropriate studio spaces and facilities. This functional template is useful as a general guide and I shall refer to its aspects in this paper. However, it can also be seen (perhaps unfairly to the effort behind it, but nonetheless) as an illustration of an apolitical understanding of teaching, an understanding that underwrites the transmission mode of education without questioning what is taught, why and for whose benefit.

Without the consideration of such issues, it is not possible to value the effectiveness of teaching techniques, such as those of the studio model in general or of the architectural foundation courses in particular. Even where it is possible to demonstrate that a particular pedagogical approach is effective, it is not clear whether its effectiveness is achieving desirable aims. Therefore, before discussing whether computing belongs to foundational education in architecture, or whether particular techniques of teaching it are indeed effective, it is necessary to consider the ambitions and modes of practice accessible within design education.

To illustrate, Angélil and Hebel’s [3, p. 13] recent book argues against advocating specific formal vocabularies or styles, preferring to focus on what they call “performative” rather than formal evaluations. It criticizes the authors’ previous approach that propagated an “architecture with capital A”, an institutionalized, inward-oriented practice, disconnected from everyday life. They confess that this past approach promoted “an understanding of architecture as an institutional body and a formal discipline, unwillingly reinforcing the status quo.” I share their suspicion towards hermetic institutional practices but, instead of subscribing to their conclusions, offer the discussion in this article as an invitation for further reflection. For
example, why does the practice that reinforces the status quo constitute a problem? Is such a practice avoidable, even in principle? And what might be a pragmatic alternative?

1.2. Valuable disruption

11 Years ago, Vidler [4, p. 3] argued that “any serious “rethinking” of architecture at the start of this century cannot be undertaken without upsetting the structure and emphases of the traditional profession, of traditional typologies, and of traditional modes of envisaging the architectural subject […]” and, I can add, of architectural education. In my judgement, this radical proposition is as actual today. Indeed, I see it not as a call for a momentary change but – rather – as an attitude that accepts open power struggles as an expected characteristic of any vibrant, relevant and inclusive cultural field.

Angélil and Hebel [3, p. 14] seek to resist retrograde tendencies by encouraging instructors and students to expose their “convictions and be prepared to defend them. Part of the instructors’ responsibility is to give such courage to students, cultivating their own beliefs, standing up for them when necessary and encouraging them to take risks, even if it means being vulnerable.” I agree with the notion of taking risks and learning to defend one’s stance. However, encouraging first-year students to cultivate their own positions is not easy. Pedagogies emphasizing students’ backgrounds are often advocated as the foundations for diversity. But in our experience, when asked to design, first-year architecture students typically refer to mundane commercial environments or popularized historical precedents. Instead of encouraging freedom of thought by celebrating difference, this approach can result in an uncritical acceptance of the dominant mass-cultural trends.

What if, instead of calling upon students’ existing background, we seek to cultivate diversity by providing students with an opportunity to experience strongly expressed positions already defined by recent radical experimentation and thinking? Many relevant conceptual approaches could provide a useful vehicle for such an experience; for example, ecology and subaltern practices immediately come to mind. This article proposes that diversity, critical attitudes and creative practices can be also cultivated through explorations in digital architectural design.

1.3. Radical digital?

Recent, there appeared multiple calls for architectural education to respond to the rapidly changing architectural practice that increasingly generates outcomes impossible without the use of computers [e.g., cf. 5, p. 11] and utilise the new opportunities for design and education [e.g., cf. 6]. For example, discussing the challenges for architectural education in her work on design pedagogy, Oxman [7] argues that contemporary design teaching needs
to be founded on new digital design thinking rather than on the outdated and outmoded templates typical for paper-based workflows. Her argument is that computational capabilities introduce associative and performance-based processes that were not available in the pre-digital era. The argument continues that these new methods change the conventional relationships between such fundamental categories as ideation and making or form and material. Reflecting the new capabilities afforded by computing, a growing brand of recent architectural theory also moved away from the once dominant notions of formal knowledge, typology and representation to new concepts that prioritize dynamic generation in response to performance criteria and the linking of designing to the affordances of material systems [8-12]. Furthermore, digital fabrication is increasingly discussed as a fundamental shift in design development and construction [13-16]. Characteristically, Kolarevic insists that being able to fulfil “informed manufacturing potentialities [becomes] a principal strategy in realising innovative contemporary architectural design intentions” [17, p. 7].

In the original paper [1], we joined this enthusiasts’ line of argument and suggested that the new emphasis on processes and materiality requires a new vocabulary, new domain knowledge, new practical skills and – consequently – new approaches to teaching. That paper also suggested that this need for change can be even greater in foundation courses that typically focus on explorations of shape, colour, rhythm, light and idiosyncratic experimentation with materials [18] rather than on issues of performance, generation and emergence.

These approving interpretations of the influences exerted by digital technologies in architecture are not without internal contradictions. For example, such processes as performance, generation or emergence typically express as shapes, colours, rhythms, light, etc. and, therefore, do not constitute contrasting characteristics. Furthermore, history suggests that it is reasonable to expect for the current understandings of digital architectural design to be superseded or subsumed by new practices or theorisations when new technical and cultural opportunities become available.

In these conditions, how can digital architectural design contribute to the early architectural education without becoming a distraction? Given the capped amount of total time students can spend within a program, is it wise to prioritise geometry and method over questions of human perception and appropriateness? How can the use of digital technology support educational outcomes able to outlast the tools the students learn with? Can it provide tools for critical engagement on par with or beyond those inherited from Bauhaus’s Vorkurs?

As a preliminary reaction to the challenges posed by these questions, I suggest that it might be more productive to think about digital architectural design as an optional conceptual frame with specific (and potentially
advantageous) social and cultural capabilities rather than as a new and better paradigm. Surprisingly, this modesty leads to greater freedom. Without the burden to be universally useful, one’s approach can be more radical in its explorations of consequences because its idiosyncrasies can be compensated for or exposed by other co-existing thematic orientations.

1.4. Early indoctrination

As was already mentioned above, one can begin understanding potential contributions of digital architectural design to architectural education by considering the existing pedagogical context. The design studio is commonly discussed as an essential device of architectural education [19, 20]. Within this education, the role of the first-year studio is particularly important. It helps students to form initial ideas about design and architecture, establish the foundations of their personal creative practice or – as legitimately – to convince them not to specialise in the field. It is also commonly thought that most new architecture students need to abandon their preconceptions about designing [for a parallel discussion, see 21] because their understandings of creativity are often naïve and their knowledge of useful architectural precedents – minimal. Moreover, design studio work typically requires a significant shift in learning behaviour, away from habits formed during pre-architectural education. Required changes amount to a significant personal transformation and this transformation can be challenging and uncomfortable (or even harmful rather than productive).

In our original paper [1], we suggested that, if successful, this transformation should also be long-lasting. Presuming that, we also argued that it was particularly important for this shift in thinking to introduce creative processes that can provide a solid and enduring foundation. Taking into account the feedback to this earlier publication and on further reflection, the idea of providing student with “durable knowledge” [22] in an early studio is potentially problematic, especially if this knowledge takes the form of practice recipes.

Should the early studios be about durable knowledge at the risk of establishing canonical notions and stifling innovation? Or should they be about attitudes? Ways of learning? Ability to construct coherence from piecemeal sources? Readiness to be surprised? Readiness to be critical? Ability to be self-directed? Ability to defend one’s decisions in public? How can they achieve what Boucharenc [18, pp. 1, 2] calls “creative spirit” (an ambition of “basic education” inherited from VHUTEMAS, the Bauhaus, the ‘Chicago Bauhaus’, and the Ulm School)?

It seems a mistake to strive for “durable” or “deep” knowledge without a consideration of the ideological implications within and beyond the discipline. After all, “[t]o propose a pedagogy is to propose a political vision” [23, p. 371]. For example, the studio culture with its transformative ambitions has been convincingly criticised as problematic and unsustainable.
in its current form [e.g., cf. 24]. For example, Stanton [25, pp. 29, 30] forcefully argues that the notions underpinning early design education remain “surprisingly hermetic” instead of relating to the designer’s roles in broader culture. He agrees that early studios instill an ongoing attitude but also observes that this is the moment where “ideology is most readily transferred. […] This fraught period is particularly vulnerable to emphatic doctrine and is complicated by the biases of extremely noninnocent individuals who determine curricula and exercises.” Similarly, Crysler [26, p. 210] discusses how “[o]ne of the common goals of first-year training (with its emphasis on making kites, shelters, and experiments with primary form) is to return the student to a state of intellectual infancy”, or to produce an “innocent eye” [27]. He argues that this desire is predicated on the transmission model of architectural education that wants to treat all students as essentially the same and as empty vessels that have to be filled with some approved, canonical substance [28, 29].

Indeed, the once atypical Vorkurs and other similar knowledge systems are now recognisable as such canonical discourses. As such, they reinforce the dominant knowledge and dominant power structures, ignoring difference, perpetuating existing hierarchies, resting change and stifling innovation. Thus, the remit to transmit existing knowledge and the associated resistance to change come in conflict with the ambition to develop all-challenging creative cultures ascribed to the in-studio education and the demands for innovation imposed by the rapidly advancing field. These fundamental contradictions cannot be comprehensively resolved. Instead, critical pedagogy advises that the educational environments – such as architecture schools – need to accept and cultivate situations of “contradiction and conflict. Volatile and disruptive, they should encourage work that constantly challenges not only its own construction, but the incorporative processes of professional education as a whole. Instead of “top-down” reforms, we need to consider ways to achieve a selective jamming of the machinery of architectural education. We should aim to produce moments of crisis and open-ended possibility in which contested histories and a competing range of situated political issues become integral to the critical transformation of the field.” [26, p. 215]

These descriptions of architectural education put early design teachers into a difficult situation. Should they attempt to represent the general goodness (as they subjectively understand it or as prescribed by institutional traditions)? Should they rely on the students’ varying backgrounds and interests in the search for relevance (as is advocated by those associated with critical pedagogies)? Or – our current, exploratory stance – should they build on their own existing strengths, capabilities and interests (but doing this consciously and with full disclosure)?
2. TEACHING AS A SOCIAL PRACTICE

2.1. Institutional wilderness

Interpreting students as empty vessels is a critique that can be applied to our course, if it is considered as an entity solely responsible for the students’ early education. This, however, is not the case. Availability of variously defined courses at early stages of architectural education is now common in many institutions, in contrast to the totality and coherence that are broadly understood as the ambitions and legacy of the Vorkurs (the actual history of the Vorkurs at the Bauhaus is a story of opportunistic adaptations in a difficult context, but the implications of that fascinating discussion are beyond the scope of this article). At the University of Melbourne, this modularity is also an institutional choice, expressed as the Melbourne Model of higher education. Under this model, the university’s 96 undergraduate degrees were replaced with six. Within this system, the path to a professional architectural qualification begins with a Bachelor of Environments degree that also covers a range of other disciplines. This system appears to sacrifice – consciously, and with some convincing arguments – coherence and focus for breadth and flexibility. Within the Bachelor of Environments degree, the first year students are required to take two core subjects, Natural Environments and Reshaping Environments. They can also choose four other subjects that include Governing Environments, Designing Environments and – the course under discussion – Virtual Environments. The situation that led to the emergence of this course, the Bachelor of Environments degree and the whole of the Melbourne Model is highly complex. There exist multiple interpretations, many of which are highly contradictory (and fought over in high-profile public domains). Deep research into these issues is beyond the scope of my topic and my existing research capabilities (or my research interests, really). Irrespective, these issues constitute the direct context for my pedagogical efforts. When I arrived to the University of Melbourne (almost three years ago now), I found it hard to decipher the institutional stance: separate facts from propaganda, financial motivations from best teaching practices, bureaucratic momentum from the persistence of valuable knowledge. Still, I was assigned the courses to teach and had to cope the best I could.

2.2. Dilettante teacher

I believe this situation is typical, especially in architecture where much teaching is done by practitioners (and academics) lacking pedagogical training or an experience of dealing with large bureaucracies (aka management skills). This situation is exacerbated by other common conditions. For example, academics and universities commonly perceive teaching as a chore – research is what one wants to do instead and research is what the institutions tend to reward (it can be hard to find the time and support to take the perceived best route in one’s teaching – the
design and operation of a course are always a compromise). Universities impose the curriculum structures, finances and student numbers, often creating difficult teaching conditions (in our case, this leads to the challenge of maintaining a studio culture without its typical face-to-face contact with the students, for example). Universities control admissions (in our case, mixing dramatically different students into one course – some struggle with language or are locked into rote-learning habits; while others are studying for a second degree and have several years of professional experience). This list can be easily continued.

Into this restrictive situation, a new academic arrives with limited credibility, limited skills and a limited number of allies. Adapting to the conditions and finding a working balance is a slow and difficult process. Clearly, issues such as the introduction of new content – for example that emanating from digital architectural design approaches – or any type of experimentation that deviates from the canon have to be discussed in relationship to this context. As Spivak [30, p. 62] observes, within such contexts, questions like “What is worth studying, teaching and talking about” become recast as “What can best be parcelled out into a fourteen- or ten-week format of the semester?” or “What are the best available textbooks?” or – in our case – “What is available with no permanent studio spaces?”, or “What is possible with free software?” In these conditions, considerations of how one can gradually grow a particular educational initiative and what is necessary for such growth take primacy over abstract questions of what knowledge is most necessary or what pedagogical technique is most effective.

2.3. The course as a journey

I mentioned some of the pragmatics of the “real-world” teaching to present the context for experimentation with digital architectural design and explain the practical steps taken (and not taken) when teaching the Virtual Environments course. This course pre-existed my involvement and was put together in consultation with a committee seeking to satisfy the perceived requirements of several disciplines/departments. Even at that stage the development was difficult. When I inherited the course (after four iterations since commencement), I was introduced to its loosely defined ambition to be a primer in the use of representation in architecture, landscape architecture, urban design and other allied disciplines. New to the country, the university and to the teaching of large-size early university courses, I was faced with the task of developing a stable and rewarding pedagogical ecosystem.

As per the discussion above, my approach was not to attempt to cater for all of the competing interests but – instead – to introduce the content and the structure that reflected my convictions, knowledge, interests and abilities. This meant that the course shifted towards the concerns of digital architectural design while retaining its generalist remit. Our earlier paper provides additional information on the course structure and the
organisation of content [1]. This article, instead, attempts to describe the course as a dynamic and growing enterprise. The available space does not permit a complete description but I hope that the included examples illustrate the issues at stake.

Briefly, as of now (late 2011), the course is structured around a practical project that necessitates learning about design precedents, encourages an understanding of theoretical concepts underpinning digital architectural design and convinces students to develop essential skills through practice. The project asks students to design and build geometrically complex sculptures that can be made from paper and worn on their bodies. The theoretical focus is on three types of representation: 1) to develop ideas; 2) to convince others; and 3) to provide instructions for action.

Figure 1: A headpiece design by Laura Ng; HEADSPACE 1 project, semester 1, 2010.

Figure 2: A headpiece design by Choi Woo; HEADSPACE 1 project, semester 1, 2010.
The course consists of four modules: A) in Module I (Engender), students use drawings and physical scale models to develop three-dimensional forms from the analyses of dynamic processes; B) in Module II (Digitize & Elaborate), students use orthographic projections, contouring techniques and/or point clouds to describe their models and convert them into three-dimensional computational representations. These representations are then modified and extended with digital modelling techniques; C) in Module III (Fabricate), students use computer software to unfold their models into two-dimensional components that can be cut out of paper.
components are then used to manufacture self-supporting paper structures, manually or with automated cutting machines; D) in Module IV (Reflect & Report), students produce documents describing their projects. These documents include justifications of design logic, evidence of analyses and precedent studies, precise geometric descriptions (in 2D, 3D and 4D), how-to manuals and depictions of the resulting objects in context.

The course is run in challenging conditions. An iteration of the course can attract up to 400 students specialising in a variety of disciples within and outside of design. For many, this is the first course of their introductory year at a university. The course lasts 12 weeks with one 50-minute lecture and one 2-hour workshop per week. Students attend lectures together and are subdivided into groups of 16 for the workshops. Each group has a tutor who meets the students during these workshops.

Attoe and Mugerauer [31] report that award-wining teachers constantly redesign their courses to avoid burn-out. Another important characteristic of excellent studio teachers in their survey was vitality (or the ability of teachers to retain interest because they do not know the answers to the questions they pose and are intellectually engaged in the subject themselves). This characteristic also requires on-going modification of content. Similarly, the Virtual Environments course tackles material that its teaching team finds intellectually challenging – the issues at the forefront of the contemporary discourse – instead of trying to satisfy general notions of what can be universally important in architectural education. As Attoe and Mugerauer also confirm, “enthusiasm spreads” – and we can demonstrate our practical involvement with the issues we teach well beyond the confines of the course.

The course I inherited just after semester 1, 2009 provided the core template for further development. It had a modular structure, frequent submissions and multiple, quasi-architectural projects. No doubt the course had its successes but it also had characteristics that I adjudged to be incompatible with the idea of provoking “creative spirit”. The course’s projects were largely driven by the acquisition of technical skills and the assessment focused on quantity (e.g., of versions). The course produced low quality design work (in my subjective opinion). Lectures were poorly attended and students complained that they did not see their relevance. The students used limiting free software. They complained that short-duration projects did not allow them to achieve quality outcomes. The course lacked a strong identity or a public profile.

Semester 2, 2009 was the first time I coordinated this course. That semester, we introduced various tactical changes in response to the student feedback but the overall structure of the course was retained. The primary challenge of that run was to become familiar with the surrounding social, financial, epistemological and bureaucratic structures.
Given my background and the available context, greater emphasis on digital architectural design seemed useful as a motivating device that could simultaneously address multiple concerns. Consequently, for the semester 1, 2010, we developed a new project that engaged with the core issues of the architectural curriculum through digital fabrication. This project asked students to produce full-size paper structures that could be worn on their heads (Figures 1–4 show some of the headpieces produced that year). This theme motivated the integration of the topic-specific theoretical content that exposed students to the discussions on process-based designing, new materiality, emergence and so on.

To enable higher-quality and more sophisticated outcomes, the course now used only one project. Assessment procedures were adjusted to become more qualitative and encourage experimentation. To disclose the assessment criteria, we instituted public presentations of outcomes. To reward the best work and to strengthen the sense of communal effort, we introduced a public exhibition and a public parade (Figures 5–7) as the core events of the course. In short, the course moved to encourage design culture where free speculation was expected and risk-taking was not penalized.

In Semester 2, 2010, we made an effort to attract the best possible tutors and to help them prepare, practically and theoretically. This was easier to achieve because the course now had plenty of intellectually challenging content, which many tutors wanted to master, and an attractive public profile they could associate with their track records. An important conceptual change was to insist for the design ideas to be generated from the analysis of existing natural processes rather than arbitrarily or through copying of historical precedents (as was the tendency before that). That semester, the students produced a greater selection of interesting work. Yet, they still saw the lectures as disconnected and the teaching team felt that the free software used up to that point was limiting their (and ours) creative explorations.

The next iteration, semester 1, 2011, the course reached a degree of maturity. This time we introduced a modified version of the project in an attempt to achieve more varied results and provide students with a greater choice when establishing and analyzing the context for their designs. The students now designed lanterns that could be worn anywhere on the body. To emphasize the connection of the material with the current practice and to illustrate the agency of the underlying concepts, we invited guests to give lectures on a broad range of topics in digital architectural design. These guests included distinguished academics and experienced practitioners with a variety of backgrounds. They were asked to link the course content to the overarching issues in the industry and discuss the relevance of the course material. We switched the core software to Rhinoceros 3D and the core geometry engine to Paneling Tools (useful as an easy-to-master proto-parametric system). This change was motivated by the desire to introduce
students to the principles and practices of parametric modeling as a logical extension of an already existing focus on process-based designing. These changes were only possible because of the credibility gained through our previous work. The faculty had to be convinced to invest into additional software and pay for extra contact hours. The teaching team had to learn the new tools and develop additional learning materials. ... And so on. We could support our greater ambitions with convincing evidence of an international track record, the award-winning design outcomes and enthusiastic reactions by the colleagues, students and the general public – in other words, through the display of our cultural and social capital.

The central point of this abbreviated history is to show that a real-world course, especially a first-year course of large size, is not an abstract exercise in application of technical expertise but – instead – a slowly developing ecosystem that involves multiple human and non-human stakeholders. These stakeholders have personal motivations for participation (or obstruction) and their actions are never in full accord. Changes in such environments cost time, money and psychic energy. And yet, even in difficult conditions the changes are possible and can be highly rewarding. In our experience, a shift towards a freer, braver and louder creative culture (that we experience as fun and not a chore) was catalyzed by the introduction of digital architectural design. Significantly for the present discussion, its main role was not as a new technical approach or a novel conceptual paradigm but instead as a social motivator able to win allies and support idiosyncratic practices that could resist traditionalist institutional pressures.

3. GESTURES OF RESISTANCE

This section briefly highlights some of the elements of the course. Many are similar to the approaches adopted in the best design studios and yet their idiosyncratic quality and their association with recent digital architectural design techniques contrast them with the existing institutional background and cast them as – however modest – gestures of resistance to the centralised, top-down sense-making.

3.1. Encouraging risk

Attoe [31] reports that several surveyed award-winning teachers talked about their assignments as “experiments”, designed to avoid expected solutions. In a parallel argument, Zehner et al. [2, p. 5] also conclude that the “magic” of the studio teaching emanates from “the creation of an open-ended space of exploration in which students and staff work collaboratively. The importance of the ‘project’ in a quality studio points us to what is really significant in all studios: challenge, inspiration, multidisciplinarity, relevance, the taking of risks, and the unpredictability of the speculative.” How can this broad statement be incorporated into pragmatic steps in relationship to digital architectural design concerns?
In the original paper, we argued that the focus on digital fabrication allowed a move away from the emphasis [cf. 7, p. 106] on typologies, formal representations, visual precedents and arbitrary ideas. Instead, the structure of the course – we continued – prioritised gradual, iterative development that searched for outcomes by exposing initial concepts to different media, techniques, contingencies and materials. To illustrate, in the Virtual Environments course, students were asked to base their designs on an existing dynamic event, for example that of ink dissolving in water, plant extending towards light, a match bursting into flame, a sand dune pushed by the wind or a stalagmite rising from a floor. In this article, and with greater experience in hand, I can confirm that the exposure to the experimental forms and digital architectural design methods encourages students to question their preconceptions of architectural designing and of its products. The choice of an unusual (some would say absurd) project proved to be challenging to the students. And yet, because of their strangeness, wearable headpieces and lanterns served to motivate logical discussion of formal patterns derived from and resembling many rich, natural and man-made, form-making and form-finding processes.

The unusual project precludes easy judgment by comparison, freeing (or – sometimes – forcing) the students to engage with the formal, functional and logistical consequences of their design. They are encouraged to radicalize their proposals because the conceptual framework of the course and the structure of assessment emphasize the process of learning and their transformation as participants over the designed objects. The course does strongly encourage students to produce excellently engineered and crafted artifacts but does not punish “failures” resulting from aspiring experiments staged by beginners. In fact, I do not think we had any real failures – only pragmatic adjustments. At least not with the ambitious students, trying for more. This safe learning environment helps to demand (but not always achieve) excellence. Attoe [31] notes that having high standards is a typical characteristic of the courses described by award-winning teachers. “Demand a level of excellence beyond what they ask of themselves,” one teacher recommends, “and tell them every day that that’s what you are doing.” I agree and in our experience, the digital architectural design theme could sustain such demands while not over-taxing our resources dramatically to provide the necessary degree of support and safety.

3.2. Integration

It is generally accepted that architectural challenges become increasingly interdisciplinary and design tasks require integration of multiple concerns. An inability to create an environment that fosters such integration is a recurring criticism of studio culture. Gutman [32, pp. 44, 45] warns that discontent in practice often stems from misplaced expectations for all architects to become “successful design artists”. He suggests that architects poorly understand the
nature of their work and fail to appreciate the multiple organisational and technical tasks necessary for the construction of buildings (and – today – of more complex tasks associated with dynamic and distributed digital/physical environments). Others commented that architectural education focuses “more on the aesthetic and theoretical dimensions of design than on the integrative nature of the process itself”. [20, p. 73] Utilisation of computer-aided design and more recent interest in parametrics are also criticised for a narrow and unrealistic interpretation of design challenges [e.g., cf. 33]. In response to such criticisms, digital architectural design attempts to develop new foci, for example on functionally understood performance [e.g., cf. 34] and on fabrication [e.g., cf. 14]. Much broader integration, well beyond existing disciplinary boundaries is necessary, given the transition from the production of objects to the production of discourses [cf. 35], but even these partial but useful offerings struggle to reach the majority of the students (or the faculty).

Attempting to contribute to the development of conceptual understanding along with the acquisition of skills, the Virtual Environments course insists that students read recent literature on the issues of concern and analyse relevant precedents. This work does produce excellent results for a small number of students but tends to be perceived as disconnected from practical tasks and secondary by the majority.

Seeking to remedy this situation, we also found that tying the digital work to fabrication usefully slows down the process and makes students seriously consider the implications of easily produced procedural forms in the computer [cf. 36, p. 102], thus compensating for the ease with which new forms can be created in software. Introduction of fabrication allows students to develop ideas in response to the contingencies of making, closer to the way design happens in practice and in extension to the more typical approaches to architectural education that support students through ideation but rarely provides opportunities to engage with production. [37]

The course also asks its students to work at full scale. We realise that this decision cannot simulate construction of large buildings. And yet, the contingences of making, and especially the complex logistical concerns triggered by digital fabrication processes, work to acculturate students into the mode of thinking that considers such issues as materiality, structural performance or cost of manufacturing right from the start. Manufacturing at full scale also allows us to associate designed objects with a readily available, familiar and cherished site – the students’ own bodies. The course project takes students from ideation, through development, through making and to the conclusion, staged as a functional test and a cultural performance. Within this journey, digital fabrication is employed not as a technique to master but as an enabler that helps to emphasize and – when successfully employed – reward integrated approaches to designing.
Figure 5: HEADSPACE 2 exhibition, semester 2, 2010. This exhibition was staged in Wunderlich gallery and included video projections, dynamic multimedia displays, soundscape and headpieces themselves.

Figure 6: BODYSPACE 1 exhibition, semester 1, 2011. This exhibition was staged at one of the most prominent exhibition spaces in the city – at Federation Square and was included into the program of a major cultural event – The Light in Winter festival.

Figure 7: BODYSPACE 2 parade, semester 1, 2011. Staged in a darkened theatre space this lantern parade was a picturesque and atmospheric event.
3.3. Enduring exposure

To encourage emotional investment and to make students feel greater responsibility for their projects we organised for all of the designs to be demonstrated in prominent public events during specially staged “fashion parades” (lantern parades were an early – and subsequently banished by the advance of functionalism – tradition at the Bauhaus, as I subsequently realised – so, certainly an example of reinventing the wheel), e.g., see Figure 7. For young people, whose creative personality is still in formation, and who – many as teenagers – are particularly conscious of their public image, such exposure can be highly embarrassing or highly rewarding. A public event at the end of the course caps a prolonged development process with a distinct and picturesque resolution reframing a potentially dry project as a socially meaningful and emotive encounter. In my impression, the event of this kind can be as (or more) influential than the effects of the formal assessment. These public engagements also help to expose the course’s theoretical stance and its designed objects to the scrutiny of peers. If those peers (students, faculty, practitioners, relatives or general public all can act as significant stakeholders) approve of what they see or – sometimes as usefully – are provoked to disagree, the course and its participants acquire an opportunity to make their case and acquire significant allies.

4. TEACHING OUTCOMES AS SOCIAL CAPITAL

Teaching outcomes can be and are appreciated in multiple ways. For the purposes of this article, I suggest valuing teaching outcomes as social/cultural capital rather than more or less efficiently transmittable canonical knowledge. Capital can take objectified or materialised forms and has the tendency to persist, to reproduce and expand [cf. 38]. Its accumulation takes time and education can be seen as a structure that strongly affects this process. Acknowledging that accumulation of social capital is significant [e.g., cf. 39] matters because the field of architecture can benefit from greater and broader critical analyses of this process and from the construction of approaches able to question the traditional power structures that control it. The notes here can only sketch a direction that certainly requires further reflection and practical experimentation.

4.1. Rites of passage

Fisher [40, p. 13] discusses education as an “abstract system” – functioning as formalised rites of passage – and suggests that design educators are implicated in the construction of their students’ self-identities, for example as “creative people”. He cautions against the romantic interpretations of creativity seen to be enabled by exceptional talent and resulting in elitism. A rigid self-identity, he argues, is poor preparation for future collaborative work or the identity shifts necessitated by the circumstances of professional
careers. In a parallel argument, Crysler [26, p. 208] suggests that “architectural education constructs a model of cultural assimilation that assigns everything that differs from the corpus of knowledge and practices embodied in the figure of the architect to a marginalized, private realm. Students are encouraged to sever the connections between personal and professional worlds. They learn to subordinate their other identities to the task of becoming a professional.” This task of becoming a professional takes the form of the rites of passage: long working hours, the crit system, collective exhibitions and even the tendency to wear black. In these conditions, a contribution of architectural education, especially in an early design course, can be towards the ability of individual students to construct their identities as on-going stories [cf. 41], flexible, able to change and yet strongly evidenced.

4.2. Learning outcomes as propaganda

This evidence can take the form of material traces. These can be particularly potent in design disciplines because they can participate in knowledge systems manifesting as embodied social/cultural/intellectual capital [cf. 42, p. 110]. The Virtual Environments course generates such material traces by producing completed objects rather than design proposals or prototypes and by staging performances demonstrating these objects in use and offering opportunities for visual documentation and interpretation. These documents can be used as propagandistic content that helps to build the track record – a valuable currency in many situations and in many hands (mine, students’, faculty’s marketing, etc.). To date the course generated such capital in the form of local exhibitions, coverage in press and in design blogs, participation in film festivals on art and design as well as design awards.

4.3. Evaluation as a permission to continue

Propaganda combines with student feedback into the evidence necessary for the course to be accepted as legitimate and retain its character. Student response in a large and complex course such as ours is difficult to evaluate. Our original paper [1] gave examples of specific students’ responses, highlighting their appreciation of various aspects of the course. This feedback endorsed such characteristic features of the course as working from idea to completion, the making of full-scale objects and exhibiting in public. Here, I include a snapshot of the formal and standardised evaluation of teaching conducted by the university. The table below shows the summary for semester 1, 2011 (the last semester for which such data is available). To put this table into context, that semester the Virtual Environments course matched orbettered all other design-based Bachelor of Environments courses as well as both undergraduate and graduate averages for all questions (in semester 2, 2011, these results – unofficial at the moment of writing – improved still further).
This type of data also constitutes a form of cultural capital, particularly valuable in negotiations with the institutional hierarchies. As Glassner observes, for faculty members, "Individual ideologies are tolerated as long as the fundamental educational approach is not changed". [43, p. 251] The universities find it easier to tolerate difference (in fact, they do not even interrogate in our experience) when the people responsible can demonstrate "good enough" outcomes.

4.4. New allies and others

As already mentioned above, the ability to make and reward allies is an important outcome of a pedagogical strategy (and another form of social/cultural capital) because the ability to teach the course discussed in this article depends on the continuing cooperation of multiple stakeholders. The trade in allies has become a familiar part of academic landscapes.

Tellingly, Cohen [44, p. 42] observes that "the claim to knowledge [can be] more important than its actual possession. New faculty are hired as ‘players’ whose texts enable the administrative sector to thicken its image/exchange identity, the increase of value imputed directly to the academic institution itself.”

<table>
<thead>
<tr>
<th>Intellecually stimulating</th>
<th>Well-co-ordinated</th>
<th>Supported by useful learning resources</th>
<th>Well taught</th>
<th>Have been required to work at a high standard</th>
<th>Found the assessment tasks useful in guiding my study</th>
<th>Received valuable feedback on my progress</th>
<th>Learnt new ideas, approaches and/or skills</th>
<th>Learnt to apply knowledge to practice</th>
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▲ Table 1: Student Experience Survey, 2011, semester 1. Virtual Environments subject: response summary (strongly disagree = 1, strongly agree = 5).
Zehner et al. [2] also emphasize the importance of quality staff for successful studio-based education. “Excellent teaching occurs when there is a strong collegial context, a bond between teachers” [31] and this is why in the course like Virtual Environments, where I, as the coordinator, do not get to meet the students too often and where most of the face-to-face design teaching is delegated to the tutors, it is important to have those tutors as allies. Especially, in the field where the teaching of digital techniques is yet to become mainstream and computationally proficient tutors (or academics, or practice directors), who also possess other characteristics of good teachers, are hard to come by. Especially at a faculty that – as an institution – is yet to establish a pedigree in the area of architectural computing (and this is still true about the majority of architecture faculties out there).

However, the idea of allies as capital extends beyond having knowledgeable and committed colleagues. Continuing the argument established by Feire [29], Giroux [45] and Bourdieu [46], Crysler [26, p. 211] emphasizes that the transmission model of education itself can be seen as the “banking model” characterized by consumerist, objectifying logic. This model converts knowledge from a social product sustained through relations of power to the apparently benign form of information and skills that – like money – can be aestheticized and exchanged.

In the architecture school, decisions about which faculty member to identify with become crucial because in doing so, the student is deciding on the type of cultural capital he or she will accumulate. Faculty are regarded as resources from which students receive “interest payments” in return for the time invested in their projects. This relation also operates in reverse: Talented students are interpellated into the tutor’s system of cultural capital. Whereas a novice architect can add luster to his or her credentials through association with a famous teacher, that teacher’s reputation is legitimated through the production of students that the profession deems masterful.

The in-depth discussion of these issues is beyond the scope of this article but this line of thought is included here in an attempt to suggest the further avenues of exploration that can consider contemporary architectural experimentation, and – specifically – experimentation in architectural computing, in terms of ideologised, political and quasi-financial transactions. Understanding these types of relationships can provide powerful means of analysis in the consideration of problems well beyond the field of formal pedagogies enacted in educational institutions and applicable in an open world where “any practice which intentionally tries to influence the production of meaning is a pedagogical practice” [47, p. 230].
5. CONCLUSION: DIGITAL ARCHITECTURAL DESIGN AS A SOCIAL CATALYST

It would be an exaggeration to argue that I have achieved the “selective jamming of educational machinery” as discussed by Crysler [26, p. 215]. Indeed, I only developed a conscious realisation that such jamming could be a legitimate and useful goal after several iterations of this course. However, I found the socio-cultural perspective offered by the cited literature and discussed through the example of the Virtual Environment course recognisable, liberating and inspiring. Consequently, with this article I am attempting to share this perspective with others in the subfield of architectural computing (where the awareness of these issues appears lacking). It is clear that much further work is necessary before my (and the field’s) understanding of implications matures. In spite of this, I hope that this article can prove instrumental in thinking about and developing innovative practical pedagogies embedded into the complexity of the real world and – at the same time – able to resist its unifying/canonizing pressures. Greater awareness of benefits given by diversity and productive conflict can be dramatically empowering. They highlight areas for future work, supply arguments with which to convince other stakeholders and provide tools with which to think about pedagogical efforts in concert with research and creative/professional practice.

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References


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