Digital Tools for Design Learning
The case of a Caribbean Design Primer for Beginning Architectural Students.

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Abstract. *There is growing consensus among architectural critics and educators that there exists an increasing divide between the worlds of architectural education and practice. New social and cultural norms, new materials, and current global concerns, like sustainability, have largely influenced the need for an improved balance/integration between design theory and practice. This places schools of architecture around the world under pressure to provide their graduates with the requisite skills that support responsible design characterized by good design thinking strategies.*
The Caribbean School of Architecture, in addition to being affected by this predicament, has other pressures on its educational offerings. The region's lack of resources and particular social issues mandates that graduates of the school adopt a responsible attitude towards design in the region. A positive attitude to such issues as sustainability, energy conservation and community will only come about through an effective transmission of particular architectural knowledge that is relevant to the region. The challenge (globally and in the Caribbean), therefore, is the provision of an innovative and effective way of supporting the student master dialogue in studio, facilitating the transfer of "practical, appropriate knowledge" needed by students to create safe, purposeful and responsible architecture.
This paper exists within the research paradigm of providing digital teaching tools to beginning students of architecture. This digital research paradigm seeks to move digital technology (the computer) beyond functioning as an instrumental tool (in visualization, representation and fabrication) to becoming a "Socratic machine" that provides an appropriate environment for design learning. Research funds have been allocated to the author to research and develop the information component of the tool with special reference to the Caribbean. The paper will report on the results of prior investigations, describe the reaction and appreciation of the students and conclude with lessons learnt for the further development of the teaching tool.

Keywords. *Design Education, Digital Design, Teaching Tools*

Introduction

Today, more than any other period in history, the need to protect the well being of the planet, places architects in the responsible position of providing a more sustainable and environmentally friendly "green" architecture. This "social responsibility" requires greater sensitivity to the needs of building users, communities and the environment. The technical complexity of modern buildings, new social and cultural norms and constantly changing information regarding eco-friendly standards and codes ensures that this can only be achieved with more than a passing knowledge of the issues.

Preparing students of architecture for the twenty-first century challenges to architecture is particularly arduous considering that professional bodies, critics and architectural educators have claimed over the last few years that there exists a "disconnection…between the two separate worlds of architecture education and practice" (Boyer and Mitgang 1996). It has further been claimed that schools of architecture, are producing graduates who lack a sensibility to the real world of architectural practice and are a burden to train. This view of architectural education places schools of architecture under pressure to provide graduates of architecture with an awareness of the issues that contribute to an architecture that is appropriate to its locality and environment.

The Caribbean School of Architecture is the only school of architecture in the English speaking Caribbean. This unique position is made even more precarious when one considers that one of the missions of the school is the investigation of the role of architecture and architects within the evolving socio-economic realities of the region. The architect in Caribbean society is currently perceived as one of arrogance and aloofness without empathy for the plight of the building user. Not being adequately informed about how buildings work in the community denies the young architects the opportunity to build and win the trust of a truly sustainable community.

The challenge (globally and in the Caribbean), therefore, is the provision of an innovative and effective way of facilitating the transfer of the practical, appropriate knowledge needed by students to create safe, purposeful and environmentally responsible architecture.

In keeping with the theme of the conference, this paper proposes meeting this challenge within the research paradigm of providing digital teaching tools to beginning students of architecture. This digital field seeks to move digital technology (the computer) beyond functioning as an instrumental tool (in visualization, representation and fabrication) to becoming a "Socratic machine" that provides an appropriate environment for design learning.

Challenges

As stated previously, the Caribbean School of Architecture is under pressure from external forces to provide graduates with the requisite skills to balance/integrate the abstract and critical characteristics of design with the realities of issues particular to the Caribbean and the tropical equatorial zone. These issues include appropriate responses to the varied circumstances of climate, histories and cultures, low resources, and the desire to reconcile a regional identity within a global community. This can be summarized as two issues of particular importance to the Caribbean School of Architecture – sustainability and locality.

Sustainability

Darlene Brady (1996) defines "Green Architecture" as a "term used to identify environmentally sound buildings that incorporate ecologically sensitive products, energy efficiency, adaptive reuse, and building permanence" (Brady 1996). It involves several issues: building for posterity, maintaining, preserving, and adapting existing building stock and being environmentally responsive (sun, wind,

light, site). It involves social and cultural responsibility and awareness and understanding of how users perceive an architectural design from the point of view of inhabitation, "complete with scale, colour, and light" (Brady 1996). Sustainable architecture is therefore complex and multifaceted.

In response to society's concern for and attitude to the environment, validation and accreditation bodies demand that students of accredited architectural institutions emphasis demonstrate an "understanding of the principles of sustainability in making architecture and urban design decisions that conserve natural and built resources, including culturally important buildings and sites, and in the creation of healthful buildings and communities" (NAAB 2004). Students are also expected to understand "climatic design and the relationship between climate, built form, construction, lifestyle, energy consumption and human well-being" (Royal Institute of British Architects, Criteria for Validation, effective September 2003).

Those core competencies that students need to know in order to produce responsible sustainable design require a solid grasp of the several issues that impact on sustainable design. Responsible environmental design involves not only examining and manipulating the issues as specialist items but (most importantly) also as parts of an integrated system.

Regionalism

Today, globalisation and the homogenization of the earth require a serious "re-look" at the concept of locality. Architecture that reflects this stance is revealed in the world through the expression of some form of individuality or geographic, social and cultural peculiarity. The Caribbean School of Architecture, in addition to being extremely concerned about sustainability, is also concerned with issues of locality. Quality in the architectural education offered by the school is based on its interaction with the society that surrounds it. The region's lack of resources and particular social issues directs graduates of the school to adopt a responsible attitude towards design in the region. A positive attitude to such issues as sustainability, energy conservation, cultural attitudes and community will only come about through effective integration of architectural knowledge that is particular and relevant to the region. This direction will also result in opportunities to enhance and raise the status of the architect in the community.

The task, therefore, would be to encourage an awareness of sustainability and regional issues by allowing those issues that directly affect this important concern to be accessible to the student when learning to design.

The Student And The Master

With origins in the 19th century Ecole des Beaux Arts, the design studio is the primary means of teaching design in architectural education today. It is the only place where students inform the development of their architectural designs by integrating all the knowledge they've learned from different disciplines.

Providing support, definition and validation to this context is the interaction between student and master (an aspect of design education that most closely echoes the apprentice/master relationship of antiquity). Helena Webster (2002) describes this interaction as: "…a kind of 'ritualised transaction' in which students (as novices wishing to join the architectural community) present their architectural 'understanding' through drawings and words for legitimation by their tutors (as 'experts' and 'gatekeepers' to the community)" (Webster 2002).

One of the rewards of this enduring legacy is the notion that students receive a deeper knowledge by learning through the process of doing and mirroring the processes of a master. Widespread changes in technology and society, however, conspire against this deep learning as teachers try to provide proper balance in teaching the myriad of practical concerns with teaching critical and ab-

stract thinking. This contributes to a less than passing knowledge in sustainable and local issues.

Conversations in the I-zone

Assisting students to gain more than a passing knowledge of regional sustainable architecture requires the reconfiguration of the mental and physical "space" where the student and master engage in conversation. In this space – the zone of interaction or I-zone – the value of learning and the quality of the Socratic "give and take" that occurs during these "conversations" between student and master is a factor of the contribution the student makes to the I-zone.

Effective dialogue is achieved through the meeting of "equals". At present there exists an asymmetrical relationship between student and teacher where the student often feels obliged to accept the master's opinions, facts and information because he/she has no information to question or suggest alternatives. The master on the other hand has to spend most of the conversation attempting to "pull" the student up to a comparable enough level for fruitful discussion. For students to gain more from this interaction, they must have an opportunity to raise themselves to a level of understanding that facilitates an easier convergence of meaning (figure 1).

Even though the information needed for valuable contribution is readily available, a beginning designer sometimes has no idea of issues that exist or even where to look. More often than not, in the opinion of the student, these are the very issues that seem to "get in the way" of the solution. Unless the project is technically oriented, the student is usually expected to self learn, from reference books, the technical and social paradigms that have implications for the users of the solutions proposed. This situation requires an "enlightened" student who can take advantage of the I-zone to get more valuable feedback.

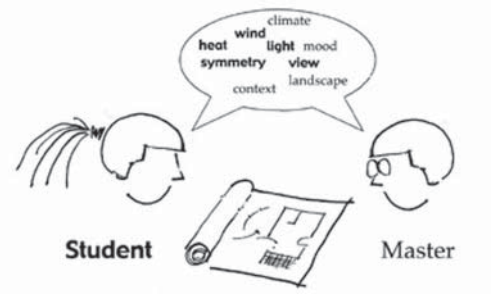

Figure 1. Convergence of meaning occurs when student and teacher speak "the same language".

Other Conversations

It is important at this juncture to mention the "other conversations" that the student designer engages in when learning about architecture. Successful design relies on the designer's ability to analyse and synthesise design issues through the essential and fundamental act of sketching. Unfamiliarity with the real world and lack of experience in interpreting and seeing ideas prevents students from taking advantage of this way of seeing. Being unable to effectively use the sketch affects the quality of the student-master conversation. Effective use of the sketch requires that the student be exposed to as much of the information embedded in the sketch as possible.

Empirical research (Bailey 2000) has sought to address this inequality by demonstrating or at least suggesting that this shortfall in contribution could be overcome by providing an "expert" that informs the student during design sketching. The information garnered by the student during design sessions would enrich the information available to the student-master dialogue permitting flexible decision-making and learning.

Digital Tools

The computer – the ubiquitous technology of the twenty first century – has in recent years significantly redefined the product and process of architectural practice and education. The classroom, design studio and curriculum of schools

of architecture are now overwhelmed with digital technology. In this context, however, the computer is extensively used for representation, communication and the generation of form. Nevertheless, despite the innovative and imaginative deployment of design computing, the teaching of architectural design has been affected little and proceeds much as it has done before computers were introduced into design schools. With technology's dominance of education it is prudent that effort is dedicated to exploring how digital technology can significantly enhance how architecture is taught and understood.

Faced with the premise that the average beginning student of architecture, lacks the knowledge base required to effectively recognise the multiple design issues embedded within a sketch, current research by the author proposes a digital teaching tool for design. This tool would be capable of processing and interpreting a freehand sketch and, having determined an intention from this interpretation, present the student with issues, connections and references related to an issue under investigation (Bailey 2003). It is suggested that the implementation of such a digital teaching aid to the I-zone could enhance the student-master conversation, helping students to reconcile the disparate elements that create habitable, environmentally friendly and community oriented places.

A Digital Design Coach

While there could be many ways of implementing such tool, the direction advocated by this research is a design coach that comprises of two main components. The first, a sketch recognition component, involves recognising sketches and inferring an intention or issue under investigation. This component of the tool has already been demonstrated by recognition systems developed by several researchers (Leclercq 2001, 2002; Do and Gross 2001) and would become the "engine" on which the tool will be based.

While it is crucial for the tool to recognise architectural intent from a personal sketch, the structure and content of the information determines the tool's value to the I-zone. This aspect would involve relating specific information to the inference and communicating such information as clues about the design situation. For such information to have a desired effect it should be based on several assumptions. First, in order to be useful to the design process and teach students about the issues involved in design, the structure must somehow relate to the structure of design problems. Secondly, the content must contain the kinds of clues that ground the student in the realities of design. Third, use of the computer, as a teaching tool, must be consistent with theories related to computer assisted teaching and learning. Finally, design learning is personal and idiosyncratic therefore a universal approach must be found to all learning types must be included in the learning advantages of the tool.

Towards a Caribbean Primer

University research funds have been allocated to the author to research, develop and test the information component of the tool with special reference to the Caribbean. Development of this "Caribbean specific" tool will be based on an existing prototype that was tested to discern the benefits of such a digital tool to architectural students.

The proposed prototype (like the previous version) of the tool will use web technology as the primary method of delivery. This allows the combination of traditional media, such as text and images, with 3D-models, computer animation, video and sound. The added advantages of this delivery would be ease of use, the capability of multiple users across a network, and the flexibility of cross platform use.

The content structure of the tool will be based on the premise that architecture is made of qualities or issues that are determined by need and external forces. These issues can be divided into several categories depending on the theme or

thrust of the studio. In the case of the Caribbean School of Architecture (CSA) the categories would be form (structure, massing), space (requirements, ergonomics, layout), and climate (sun, light, temperature). The information will also be considered in terms of 4 scales: elements, rooms, building, and site. Information to be included will range from theoretical and cultural concerns to ergonomic and bio-climatic data or rules of thumb. These will be presented as items/ideas for the student to consider and raise in subsequent conversations with the teacher.

Testing the tool

As part of the agreement with the funding body, the tool will be tested in a second-year design studio at CSA. The previous manifestation of the design coach was tested in 2001 during a design studio course at Victoria University of Wellington School of Architecture. At the end of the studio the design coach was evaluated through questionnaires, which enquired about aspects of the tool, such as the interface, choice of issues, images or selection criteria. While the results obtained cannot be assumed to represent the opinions of all the students in the studio, nor all architecture students as a whole, it provides a good basis to determine the kinds of features students will look for in a design coach and help in developing the tool for further testing at CSA.

The results of the evaluation revealed that the design coach made a good impression on the students. A large majority found the information in the design coach adequate, felt that the information was slightly to very compatible to their design process, felt they learnt something from the coach, found the design coach helpful in informing their tutorial sessions and planned to use the coach for future studio projects.

Even though the results imply that the majority of students found the design coach to be a useful contributor to their design process, the tests also demonstrated that the final tool must include

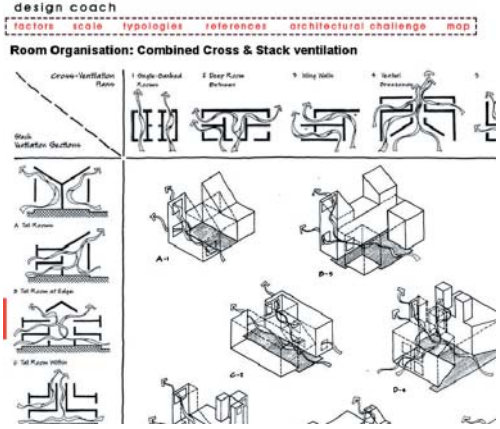

Figure 2. Students preferred the graphic rich sections of the coach.

relevant information (right information at the right time), in a mainly graphical format (figure 2). The information must be as diverse as possible, to accommodate broad preferences. The information must be internally as well as externally connected and highly relational. Finally and most importantly, the information must be firmly connected to reality, providing actual, concrete examples of the information in use.

Revising the design coach

These characteristics are the basis on which the latest coach will be developed and tested. For instance, where students needed to see actual physical examples of the issues presented, the revised prototype will provide actual built examples for the student to view. Whereas in the previous edition there were concerns about navigation, a means of tracing the path or thread of information will be implemented along with more connectedness to wider sources of information on the Internet. The student would also get the opportunity to "store" information (like a shopping cart) as they traverse the system.

The latest testing of the information component will take the opportunity to ask other important questions. For instance, will engagement with the

tool facilitate learning? This would require a look at the elements that may have influenced student engagement with the tool, such as whether or not students had a PC or laptop while designing, or used CAD software to model their project. Other aspects that need further investigation includes the quality of students' project and whether it is influenced by factors such as frequency or duration of use. Most important to the study, however, would be the influence of the tool on the zone of interaction. For instance, did the coach affect the student-teacher relationship? And what was the contribution of the tutor to the coach's success or failure?

Conclusion

The student-master conversations that occur within the design studios of architectural schools have been associated (wrongly or rightly) with the inability of architectural students to grapple with the practical realities that face 21st century society. These issues, of which sustainability and regionalism are of special interest to the Caribbean School of Architecture, require that students learn to reconcile disparate elements into a habitable, environmentally friendly and architecturally responsible whole. This should be cost effective, sustainable and, in the case of the Caribbean, appropriate to the region.

It has been suggested that these skills of integration and reconciliation can be learned effectively if students are allowed to conceptualise within a digital environment that supports the master-student relationship. This environment would provide a wide array of cultural and technical information that directs the student towards more responsible considerations in design. This suggestion, which implies the development of a digital tool for learning, highlights the existence of a research paradigm focused on providing digital design learning tools that influence the capabilities of architectural students.

Current research by the author aims to create a design coach that provides an integrated digital sketching environment that enhances the relationship of student and master. This would be achieved by permitting the student to interact with computer augmented sketches, read the questions and issues embedded into the visual sketches, and pursue these issues in the conversations with their tutors. (It should be noted that the usability investigations outlined in this paper concern only the information component of the design coach. The current prototype lacks the prompting and sketching features. The tool is still to be upgraded and tested with both components together in the future).

Having the computer in the role of a design studio aid or helper therefore doesn't seek to replace creativity but rather inform it. The student, here, has the opportunity to meet the teacher on terms rarely existing in present studio conversations. With the context of the discussion already established prior to the meeting (through the coach), the student is cognisant of the issues involved, asks the "right" questions and understands the criticism and advice on the issues. The digital learning tool therefore acts as a mediator in the relationship.

Exploring the paradigm of digital tools as ladders or scaffolds that support student learning would raise the level of dialogue in the zone of interaction. Accommodating meaningful critical dialogue between student and master, in this way, epitomises the use of appropriate and innovative technology to create affordable, sustainable and liveable architecture. In the end, digital technology promotes higher quality design learning and a greater response to the challenges of 21st century architectural education.

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