The importance of physically built working models in design teaching of undergraduate architectural students

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ABSTRACT

The increasing ease with which computer technology can be utilised nowadays results in students avoiding the use of physical models. Instead they tend to favour the development of three-dimensional computer models. Before-computer (BC) lecturers do not encourage this practice and believe that physical models still allow the best exploration within the design process.

The pedagogical studio-teaching approach at the Cape Peninsula University of Technology (CPUT) is based on the facilitation of learning by emphasising the value of the design process, the value of an informed architectural idea and the value of active reflection on that process and idea. Within this approach a “container” that could act “as the central location for both recording and reflecting on” (Webster, 2001:9) was investigated.

In undergraduate design projects, students were encouraged to actively build a series of working models. The building of the working models was the major part of the studio activity, but did not exclude sketching, drawing or computer modelling. Rather, a balance of media was used where the models played the major role in the development of projects.

Two case studies are presented to illustrate the importance of the use of physical models. The process often started with a simple site model, from which a first architectural idea was developed. The models varied in scale and detail, but all contributed significantly to the development of an appropriate and integrated response to the design problem. They helped the students to recognise and develop their main architectural idea from concept to detail. They served as physical evidence of a student’s thought process and development. Unexpected and unintentional ideas often developed from these models.

This paper documents the value observed in working models as a tool to help students in the design process with the development of, and active reflection on, an architectural idea.

I. BACKGROUND

The studio investigated is the design studio of the undergraduate architectural technology students of the Cape Peninsula University of Technology (CPUT). Many universities have no formal methodological approach to architectural studio teaching. As Mark D Gross (Gross & Do, 1997:4) writes, “the lack of formal methods in architectural design puzzles each generation of students entering studio; they learn the ‘how to’ skills through imitation of their teachers and more senior classmates. Indeed a strong belief in studio culture asserts that every student must independently develop her own process of method of design. It is the rare teacher indeed who shows students how to follow a systematic method.” Most design educators are intimately familiar with studio situations, but not necessarily with the theory that underpins design-studio teaching and learning. The value of the design process and the development of a strong architectural idea are often not taught.

At the CPUT the design teaching pedagogy aims to avoid the “no formal methodological” method and is in agreement with Ellmers (2007:1), who says that “… concern with these approaches is the emphasis on project outcomes, marginalising the design process and the important learning opportunities it presents”.

However, recent research and literature on teaching indicate that many educators are investigating a more formal pedagogical method of design teaching and learning in the studio and are seeking to understand the theory behind the learning that takes place. Jiun-De Chen and Ann Heylighen describe the “pedagogical idea and didactical method” of the design studio as project orientated. They then go on to further describe the paradoxical nature of the studio, which at the same time prescribes to problem-solving theory as well as design thinking and cognition theory (Jiun-De Chen & Heylighen, 2006:579). Sarah Kuhn (2001:349) describes the project-based work that is carried out in a design studio as work on “complex and open-ended problems, very rapid iteration of design solutions, frequent formal and informal critique, consideration of a heterogeneous range of issues, the use of precedent and thinking about the whole, the creative use of constraints, and the central importance of design media”. This suggests that the lecturer in the studio “has to introduce many different types of didactics to build up students’ design capacity” (Jiun-De Chen & Heylighen, 2006:581).
The design process introduced at the CPUT is a fairly pragmatic approach to studio teaching, with the emphasis on a rational design methodology. The studio environment is further formalised and monitored by introducing a "reflective strategy" instrument called a passport (Morkel & Voulgarelis, 2009). This passport combines program, assessment and reflection and provides continuity in a fragmented system with teams of lecturers and many students.

Active reflection within the process is encouraged. As Barbara de la Harpe (De la Harpe, Peterson, Frankham, Zehner, Neale, Musgrave, & McDermott, 2009:39) observes: "student learning was deepened and shifted from a focus on the final design artefact or product to the process of learning, through a cycle of continuous reflection". The focus is thus on the process rather than on the product.

As part of the process, students must define an idea. This architectural or holding idea must be informed by careful investigation of the brief and the problems and opportunities that it presents.

Philippou (2001) seems to argue against the emphasising of ideas, but then goes on to say that this is because these ideas are often not well informed. He writes: "students are frequently encouraged to have what is termed a 'theoretical position', yet, the methods to develop such a position on the bases of rational premises do not appear high on the studio’s priority of concerns. It also seems to me that the concept of a theoretical position is counterproductive as far as the development of the students’ skills of critical enquiry is concerned" (Philippou, 2001:4). At the CPUT the aim is to introduce students to such rational premises.

Kaufman and Glaser (2004) write about the value of an idea that: “in its simplest form the idea is the basic building block of solution, creativity and innovation” (Kaufman & Glaser, 2004:68). They further argue for ideas to be concretely represented for them to be of the greatest value: “The experience of the writers has led to the belief that ideas in the mind are nothing, an idea that is spoken is transient, an idea that is written is fixed, and an idea that is visualized is salient” (Kaufman & Glaser, 2004:71), and through their investigation conclude that “... students responded well to learning a design process that focuses on idea generation” (Kaufman & Glaser, 2004:71), and “…data shows that students build trust and confidence in their own intuition allowing them the ability to generate many ideas” (Kaufman & Glaser, 2004:71).

II. WHY THE EMPHASIS ON MODELS?

Although the CPUT design studio has been structured as described, there are still possibilities for enhancing the learning process for the students. Ellmers and Foley specifically refer to “(f)urther developing of learning activities specifically engaging with reflective practice” (Ellmers & Foley, 2007:4) within an already structured environment. Physical models as a vehicle for process, idea and reflection seemed the appropriate choice in the undergraduate CPUT studio.

The working model as a specific graphic communication medium can be used as a summary of the idea, define a specific place in the process and provide a physical form for reflection. Webster (2001) used the Design Diary as such a specific vehicle in the studio. It is described as a “container” and as a “central location for both recording and reflecting on...the process of design” (Webster, 2001:9) and it was found that it also helped to “enhance the effectiveness of the reflective stage in the learning cycle” (Webster, 2001:9). Webster (2001:10) also referred to a specific practical application: “unlike the normal working method, where students continuously use drawings to help the ideation phase, and as a result amass piles of doodles and sketches which mean little to them after the event and usually mean nothing to an external observer, the Design Diary ‘working method’ encourages students to reflect on their personal doodles and to transpose them into a form which explicitly communicates their ideas and explorations”.

The physical act of making something is also described as very valuable by Philippou (2001:12), who writes that “the craft of making functioned as a vehicle for thinking ideas in concrete matter”.

The cognitive focus of the physical model is that it enhances dialogue. Not only does the model talk back, but it is an easy graphic form to access visually and verbally for both student and lecturer. This is in contrast to the accessibility of three-dimensional computer drawings. These are often only accessible within a “live” computer where students can show the whole model with ease. However, students tend to print out views that hide problematic issues – this is not possible to achieve with a physical model.

It is further important to remember that the models described here are working and not presentation models. Further practicalities in the CPUT studio that had to be considered were:

- Students are often from financially disadvantaged backgrounds, therefore low-tech presentation methods are emphasised, and not mind-boggling, high-cost coloured-ink pages.
- Students do not all have laptops. Computers are available, but in computers laboratories, where crit situations are impractical.
- Printing is often difficult and costly.
- Working models can be made cheaply from left-over materials.

Ultimately the working model was introduced as a design tool.

The Model Project

The study described here is based on observation and recording of projects that spanned 2009. Discussions were held with students on the value of the process, and reflective, self-critical thinking, analysis of the teaching process and feedback received from external examiners were taken into account.

Working models were the one graphic presentation that students had to bring to every crit. Students did not receive crits without these models and all previous models had to be shown. Sketches and drawings were optional. The process was observed within the crit situation. The passport served as
a method of data collection, where process was recorded and reflection was done.

The two case studies presented here have two different contextual and functional briefs. Both were, however, the last project for third-year students in 2009. Students were by this stage familiar with the process of intense model building. There was a two-week research period and four-week conceptual design stage before they moved to the working-drawing stage. The conceptual-design stage is presented here. The two projects were chosen from a number of projects that had been observed. These were not the projects with the best final product, but projects where students participated well in the process. A brief description of each project programme will be given to place the development of the main idea in context.

The comments that follow in addendum 1 and addendum 2 reflect the discussions held with students, reflective, self-critical thinking, analysis of the teaching process and feedback received from external examiners. The comments are organised to show the value and contribution of each model to the idea development, to the process and to reflection. The specific progression made with each model is indicated and should give a good indication of how valuable each of these models is individually, but also in combination.

Case study 1

Project summary: The context is a rural wine farm in the Durbanville area close to Cape Town in South Africa. There are several historically significant buildings on the farm, all in the very simple Cape white-walled vernacular. The green landscape is magnificent and the existing cellar, which had to be considered, is situated next to the source of the Elsies River. A wine-tasting and restaurant facility had to be provided.

The student recognised the significance of the traditional layout of the buildings, but also found the surrounding natural context important. The geometry of an existing “werf” wall that opposed the normal geometrical organisation of the existing buildings, the position of the former slave bell in relation to the chosen site, the direction of the flow of the river, views of surrounding hills and some important existing circulation routes were all deemed to have an influence on the idea development. In its simplest form, the idea was to connect to each of these diverse influences with a contemporary white-walled architecture.

Please see addendum 1 for a full explanation with photographs of the series of models.

Case study 2

Project summary: The site is situated next to the ocean in the Mouille Point area of Cape Town, South Africa. This is on a pedestrian route to the well-known Victoria and Alfred Waterfront. There is a direct and unobstructed view of the historic Robben Island. There is also a direct view of and pedestrian access to the new World Cup 2010 soccer stadium. The program required a general information centre with a display area for local crafts.

As a simple first idea, the student wanted to axially emphasise the three most important aspects of the site that he had identified. This was the pedestrian route to the Waterfront, the visual link to Robben Island and the visual and pedestrian link to the World Cup stadium and the mountain behind.

Please see addendum 2 for a full explanation with photographs of the series of models.

III. REFLECTION

Making a model forces students to physically put something together, even more so than just making drawings and sketches. Drawings are not as concrete as models, are more easily lost and tend to become rather unorganised.

Why models help with the process and reflection

In the design process described, working models were the one graphic representation that students had to bring to every crit session. Students did not receive crits without these models.

As with Webster’s Design Diary, the models became the “container” in which students stored their thoughts and ideas and reflected on their process. It was relatively easy for both lecturer and student to refer to earlier models for continuity and also to see the thinking process. External examiners reported that they were able to access projects quickly and in depth by looking only at the models.

Because of the relatively short time between crit sessions (two to four days), students were forced to build these models very quickly. This made the models less precious and altered students’ perception that once something is relatively concrete, it cannot improve or change. Sarah Kuhn (2001:350) emphasises the value of early commitment to an idea and also the “rapid proliferation of potential design solutions”. She also writes that “…a three dimensional model of the building, or a visit to the site, may offer a fresh way of seeing the problem and of approaching solution” (Kuhn, 2001:351). The models indeed provided opportunities for experimenting and taking apart ideas.

The models help to control the process, make it clearer and more transparent for the students who are taking part. They also help to force active participation by students.

Why models help with the idea development

The models help to physically retain the design idea in conceptual development. Compared to other graphic forms, the model is the best 3D communication about the initial idea. It is easily accessible and easy to refer back to.

It is possible to look at various possibilities within the main idea.

IV. CONCLUSION

After reading the available literature and reflecting on the model-building design process at the CPUT, it seems clear that, in a structured studio, there are many advantages in making working models – the one container that will help students to develop an idea and to actively reflect on that idea in the design process. Further investigation can be done that
compares the effectiveness of the model method more directly with the use of other graphic forms.

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REFERENCES


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Addendum 1: Case study 1

Contribution to process, reflection and idea development

Figures

The first model can be referred back to throughout the process to be able to see existing context. It indicates the existing building (top left) and how reference was made to the architectural geometry, organisation and important aspects in the landscape.

This first idea is abstract and not to scale. It is not a building yet, only an idea. The white jaggered forms (right) link up to the influences from the context and could still become almost anything.

Fig. 1. First model

The second model shows the discovery that the jaggered forms can make spaces and also become an organising mechanism and even functional holders. To simplify the many contrasting forms, the student set out to prioritise and find the most important references only. It also became clear that the whiteness of these forms was an important reference to the white-walled architecture. How these forms would be enclosed became the next challenge.

Fig. 2. Second model

Contextual and functional requirements are considered simultaneously in the first ‘to scale’ model.

The white jaggered forms became white organising walls (unfortunately not white in the model) that in some instances grew to hold services. The more open spaces became the served spaces and those held by the walls the servant spaces.

The formal resolution of the roof, which now tried to imitate the jaggered forms below and the connection of the resultant footprint of the new intervention to the historic geometry, is questioned and has to be investigated further.

Fig. 3. Third model

The functional idea of served and servant is refined further. The further idea of the light frame holding the roof over the solid structure makes the functional space below takes shape.

The roof now aligns with the geometry of the historic buildings, but in a contemporary manner. (It is rectangular except for the cut-back section visible on the right.) The white walls underneath continue the initial idea that references the various aspects of the physical context, but unlike the walls that are load bearing in the historic example, does not carry the roof.

Fig. 4. Fourth model

The integration of the frame with the solid walls is investigated. Functions are further refined.

Fig. 5. Fifth model
The functional aspects of the building have been finalised as far as possible. This is a more detailed model that investigates the making of the frame and the detail integration with the walls and walled spaces below. It indicates a stage in the process where design of technology starts to become the central concern.

Fig. 6. Sixth model

The design idea is now finalised. The design process will continue into working drawings, but the student has a very firm base from which to make further detailed decisions. (It is a pity the student did not show this model in context.)

Fig. 7. Seventh model
**Addendum 2: Case study 2**

**Contribution to process, reflection and idea development**

**Figures**

This model kick-started the initial idea and can be referred back to throughout the whole design process. It gives visual confirmation of the built environment and the sea-edge context.

It establishes the threefold conceptual axial approach. There is no clear idea yet of what these three axes will become.

**Fig. 8. First model**

A decision is made that the three axes will align with, as well as indicate, circulation routes in and around the building. The model investigates further how the three axes could be similar or different, each with its own strong identity. A decision on covered and uncovered spaces is made and a hierarchy of functions determined. Public-public and public-private spaces are defined, with the circulation routes now being the guide that further determines the functional layout.

**Fig. 9. Second model**

Each axis and enclosed space is investigated and starts to be refined with an own identity.

**Fig. 10. Third model**

The contextual and functional idea is made concrete with investigation into the technological resolution. The technological development of structure and how that can strengthen the idea of floating roof over walls below is investigated in more detail.

**Fig. 11. Fourth model**

Form linked to specific technology and the expression of the outside space is investigated in this model.

**Fig. 12. Fifth model**
Final model for conceptual-design stage hand-in presentation. The model is fairly detailed inside, which makes it easy to understand the functional layout.

Fig. 13. Sixth model