A Design Studio Pedagogy for Experiments in Collaborative Design

Kateřina Nováková¹, Henri Achten², Dana Matějovská³
¹,²,³ Czech Technical University in Prague, Czech Republic
¹,²,³ http://www.fa.cvut.cz/cs/ustavy-ateliery-dalsi-soucasti/ustavy/15116-kabinett-modeloveho-projektovani/
¹ kata.bruha@gmail.com, ² achten@fa.cvut.cz, ³ matejovska@fa.cvut.cz

Abstract. In this paper we describe an experimental CAD design studio that has the following aims: learning to collaborate, use an Internet facility for collaboration, and explore the relationship between computation and physical models. Interaction and sustainability are major themes in the design studio. We present the pedagogical approach and results of the design studio, followed by observations and conclusions.

Keywords. Collaborative design; pedagogy; Moodle.

Introduction

In order to teach students different working methods with the computer and in design teams, an experimental CAD design studio was created. The studio takes place in the Master programme of the faculty and is a voluntary course for 4 credits (ECTS). The pedagogical aims for the studio are learning to collaborate, how to use an Internet facility to communicate between design team members, and explore the relationship between computational and physical models. Up to now, three themes have been realized within the design studio: “interactive playground” (one semester), “responsive exhibition stand” (one semester), and “architecture with waste” (two semesters). The themes are sufficiently small so that they can be realized within the semester, and different enough from regular design studio assignments to stimulate curiosity. Also the theme of interactivity allowed discussion about various existing and novel technologies that are currently being explored within the field of architecture. Twenty-four students and three teachers took part in the experimental design studio.

Technical infrastructure

The experimental design studio took place within the facilities of our group. The students had at their disposal a computer lab and the workshop. In order to support the collaborative design process, we used the Moodle system which is available at the university [1]. Moodle is an open source educational system. Registered users may be either teacher, student, or guest. Teachers can create and edit courses. Students can review information and submit their work. Within predefined sub-wiki’s by the teachers they can create their own workspaces. Guests can see accessible courses but are not allowed to upload work. Moodle is predominantly used for regular course teaching. In case where it is used for design studio teaching, its typical application is as a datastore for information to students, messages from the teachers to the students, and to present the program of
the studio. In our case we changed this application by giving all students the teacher status, meaning they could change the design studio pages by themselves as they saw fit. In the beginning of the design studio, Moodle was presented and demonstrated how it worked. After that the students could take things into their own hands.

Phases in the Design Studio

The pedagogy in the design studio has the following setup: analysis, photo safari, individual design, choice of single design, creating a prototype. Each phase will be described and results presented.

Analysis

In the analysis phase, students have to study the design task of the studio. For the playground, this involved creating a provisional playground and video observation of the activities in the playground. For the exhibition stand it involved a literature review of existing exhibition techniques. For the waste project, it involved studying the work of the architect Michael Reynolds and studying properties of PET bottles and concrete. We aim to have the analysis as much ‘hands-on’ as possible, so that students are actively engaged in making models or testing materials (see Figure 1).

Students are encouraged to structure the analysis by themselves, under guidance of the teachers. They also have to document their findings in the Moodle system so that they can be communicated between each other. We find that this is very helpful, as students refer back to the analysis part quite often during the design process.

Photo safari

In the photo safari, students go out to visit concrete examples of the design studio: several playgrounds, a fair trade complex, and a waste disposal facility. The images and videos that they create during the photo safari are uploaded to the Moodle system for documentation and presentation purposes. The confrontation with real existing projects and sites proves to be very stimulating. It raises new ideas what is possible, and also shows many innovative and interesting ideas that are already realized.

Individual design

Based on the analysis, each student works on an individual design. One time during the first half of the semester, there is a two-day workshop in which the students work exclusively in the design studio. Before the workshop starts, the teachers require each student to state what their goal is during the workshop (finding this out during the workshop costs too much time). The teachers prepare the workshop by gathering much inspirational material and making this available on Moodle. The workshop typically starts with showing this material and discussion of possible implications. Further on, the students can

Figure 1
Left: Material exploration in analysis phase of the studio (architecture with waste project), and right: child observation in provisional playground (interactive playground project).
work on their individual projects. At the end of the workshop each individual design has to be worked out in such detail, that it can be presented to an outside crit. The work in progress and presentation are stored in the Moodle system. As stated in the beginning, the experimental design studio is a 4 credits (ECTS) course, which means that students can work on it half a day per week. In many cases they are taking other design studios as well, which puts quite some pressure on their time schedule. The workshop therefore, proves beneficial because they can focus exclusively on the task of the experimental design studio. Also, being in the group for two days stimulated exchange of ideas and inspiration between students.

<table>
<thead>
<tr>
<th>Final prototype objects created in the studio</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive net</td>
<td>A $4 \times 4$ m$^2$ net suspended by trolleys from the ceiling</td>
</tr>
<tr>
<td>Responsive sound installation</td>
<td>Installation that reacts to the nearness of people in a sitting area with sound.</td>
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<tr>
<td>Pavilion</td>
<td>Pavilion of which the interior decoration can be changed by the visitors.</td>
</tr>
<tr>
<td>Chair of PET bottles</td>
<td>Chair made of 120 pieces of 1,5 l PET bottles (Figure 2 left).</td>
</tr>
<tr>
<td>Chair of car tyres</td>
<td>The car tyre is cut at one side and then curved along a metal frame support (Figure 2 right).</td>
</tr>
<tr>
<td>Chair of knitted plastic bags</td>
<td>The “canvas” of the chair is created by knitting plastic bags (Figure 3 left).</td>
</tr>
<tr>
<td>Lamp of PET bottles</td>
<td>PET bottles are cut into striped, which are then combined to make a lamp cover (Figure 3 right).</td>
</tr>
<tr>
<td>Pavilion</td>
<td>Pavilion of chicken wire, concrete and towels (to be realized).</td>
</tr>
<tr>
<td>Lamp of waste paper</td>
<td>Waste paper is used in a papier-maché fashion to create a table light (to be realized).</td>
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<tr>
<td>Lamp of wire hangers</td>
<td>Wire hangers are combined in a circular array to create a lamp (to be realized).</td>
</tr>
<tr>
<td>Stackable urban furniture of waste wood</td>
<td>Box-like structure that can be opened to reveal the backrest; when closed it can be stacked in various configurations (to be realized).</td>
</tr>
<tr>
<td>Sitting object of PET bottles</td>
<td>PET bottle caps are arranged on a wooden frame. Bottles can then be screwed in various configurations and sizes on the frame, resulting in different kinds of objects (to be realized: Figure 4)</td>
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<tr>
<td>Chair of wire hangers</td>
<td>A chair that rests on the ring protection around trees; the sitting area is made with wire hangers (to be realized).</td>
</tr>
<tr>
<td>Zippable container of water bottles</td>
<td>A large water bottle is cut open along the top; it can be opened and closed with a zip, resulting either in a storage area or a chair (to be realized).</td>
</tr>
<tr>
<td>Foldable office unit of cardboard</td>
<td>A closed rectangular box which when opened contains a chair, table, and wall to work on (to be realized).</td>
</tr>
</tbody>
</table>
**Choice of single design**
At the end of the single design phase, we invite a potential investor for whom the students have to present their work. The investor then decides which design he would like to acquire, and which the students have to realize as a full-scale prototype. In the case of the playground the investor chose the interactive net design, in the case of the exhibition object no design was chosen, and in the case of the waste architecture, in both projects all objects were chosen.

Students take the presentation to the investor very seriously and invest a lot of time and energy in the presentation. In many cases therefore, the presentation also implies a big step forward in the design process. However, also because of this, students tend to take a week “off” after this presentation because the deadline for realization of the prototype seems far away. For the teachers it is important to keep the students actively engaged in the process.

**Creating a prototype**
For the realization of the chosen designs by the investor, the students have to work together to make a full-scale prototype. This resulted in fifteen objects that were created by the students (see Table 1). The objects were installed and displayed in a space provided by the investor. At the time of writing of this paper, a number of projects still are to be realized - this is indicated in the table.

**Examples of several projects**
Below we show a number of the final prototypes (as indicated in Table 1).

**Collaboration in the Design Studio**
The design process in the experimental cad studio went through individual and group phases. In the first and third edition of the design studio good teams were built, and less so in the second and fourth edition. In the second edition there were only three students, which is quite low to support a group process. In the fourth edition most of the work was individual even though we started in groups in the material exploration analysis phase.

As noted by many authors, getting collaboration started is of critical importance to the success of a project (see for example Brown and Berridge 2001). Systems that support group work or work by individuals have been created many times. To the best of our knowledge however, the switch from single design to group design that we introduce in our studio has not been attempted anywhere else. The pioneering Phase(x) project (Hirschberg 2003) offered support for multiple single designer, but always one student at a time. This is quite different from the work presented here. We feel the benefit in the switch lies in the fact that it provokes collaborative work. It is not a foolproof method however. Much depends on the students and good technical support to make collaboration possible. Therefore the teacher should stimulate the group work continuously.

**Use of the Moodle system**
Moodle is a stable platform for collaborative design. A number of observations can be made. First of all, since Moodle is intended as a teaching platform, it promotes a rather passive style of communication: putting documents online, posting notes, and writing messages. Therefore it is less suited for direct collaboration support: even though there is Wiki-support, people do not tend to use Moodle for real-time sharing of documents. Another point concerns the various ways in which material can be documented in Moodle. Documents can be placed in the main section (thematic or weekly outline for example), in the personal blog section of each participant, in dedicated sub-Wiki’s, via the news section, and so on. Left to their own devices, students tend to work much unstructured – they do not coordinate where to put the results of their work, so information gets sometimes very scattered over the system.
Figure 2
PET bottle chair by Ana Pezdiré (left), and car tyre chair by Rodrigo Díaz (right).

Figure 3
Chair made of plastic bags by Matías Saresvuo (left), PET bottle lamp by Mikael Saurén (right).
Computational and Physical Models

In the studio students are required to make both computer models and physical models. The computer models typically are used for design development and visualisation. The physical models are used to study the tectonics of a design (how it works, how it is put together). In the mid-term presentation students have to present their designs to an invited investor who can choose one or more designs to be realized. This means that the idea has to be very clearly presented, both in the computational presentation and in the scale model. Making a physical model is another way to achieve collaborating groups. In particular for larger models or for models in which a novel technology is used (like for example a 3D printer) students have to coordinate their effort to get a good design.

Making a physical model and a full-scale prototype also has a drawback however. In many cases students feel intimidated by the idea that they have to design something which has to be realized as a prototype. Very often they will hold back in the design process and “dumb down” their idea to the level that they feel comfortable or sure to achieve. For the teachers this means an extra effort to keep the level of the idea up so that the project does not end in predictable and unchallenging ideas. In this sense the pedagogical outline provided by Fox and Kemp (2009, pp. 184-185) is helpful. They state: “As a pedagogical approach, [removing the psychological barrier… against computing and engineering] this can be achieved by having designers work on a series of small, explorative, hands-on model-making exercises that are incremental in nature, and gradually incorporate engineering and computing components… In this way, the students’ initial model explorations gradually grow in complexity, integrating automatic functions at first, and later, more complex autonomous behaviors, and, finally, architectural applicability and conceptual insight.”

Taking a gradual incremental approach has the
advantage that students can focus on the concept rather than the technology, and can be allowed to get to the technology in due time rather than have to master it at the very start. An additional advantage is that in some cases the technology simply may not be available, or the knowledge or skills of the teachers is lacking to apply a particular technology - which also forms a barrier to think about interactivity.

Pedagogical Results

At the end of the project, what we achieved in the experimental design studio thanks to the effort by the students and teachers was:

- collaborating through teamwork and use of the Moodle system
- investigating the concept of interactivity in architecture
- structuring a design process with activities such as experimentation, observation, and team decision making
- presenting an idea to an outside investor
- designing and realizing an object in full-scale

Collaborative design studios have already quite a long tradition (Achten and Beetz 2009). The work in our studio falls in the category “pedagogical models.” The work in our studio is distinctive on two aspects: switch between individual and collective work, and requirement to present the work to an investor and create a full-scale prototype. To the best of our knowledge, this specific approach has not been used a lot.

It seems that the students appreciate the approach taken in the design studio. This is evident by the amount of work they invest in the design studio and the care that they take in the realization of the prototypes. Since the design studio is a predominant pedagogical model in most architecture schools, it tends to dominate the remaining curriculum at the cost of the regular courses. Therefore, although it is gratifying to see the student invest a lot of time in the studio work, one has to be careful to achieve a good balance and not over-demand the students.

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References


