Evolution of CAAD Teaching Methods

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In this paper evolution of CAAD teaching at architectural faculties will be presented. The CAAD will be considered as one of the components of skills and knowledge needed to support Design Studio. The paper is focused on the question “How architectural design may be combined with CAD teaching?” Formulation of this question results from opinion that position of CAAD in teaching of architectural design curriculum is different than other disciplines being taught at architectural schools. Introduction of CAAD to teaching schedules unquestionably and explicitly uncovered the need for changes within the whole schedule of study. Although great number of computer equipment is used, the students are still being taught as in the XIX century. In terms of achieved results it proves ineffective. Analyses have shown that evolution of teaching methods may be divided into four stages: software teaching, “personal involvement”, “replacement” and integration.

Keywords: CAAD education; design curriculum.

History

Let’s look back at the beginnings of CAD-support (the time of large-scale mainframe computers). According to me – I worked with CAD-system for the first time in 1980 during my diploma work. I used the computer for creation of a school plan and next for drafting its 3D model. It required an incredible number of punched cards with hundreds of space-coordinates and lots of edge-information. Without help of computer teachers it was impossible to work with CAD-software.

Early Years – software teaching

The year 1982 marks both the start of widespread acceptance of the personal computer and the formation of Autodesk and Autocad – the most popular drafting programs for PC. In 1987 CAD was first introduced into our faculties. It was decided that the school would use AutoCAD software. As at the faculties we hadn’t any CAD specialist the subject was taught by our colleagues from Faculty of Informatics. Their method of teaching may be described as a “software-specific”, aiming at the handling of specific CAD-software. The caad-course started with lecture on hardware and operating system (DOS), and an overview of architectural computer applications. Each workshop session had a particular program, related to the teaching of specific commands. In a
result CAD was taught as a skill which was independent from architectural problems. Students learned separate software commands only. They knew a narrow set of techniques passively and they were not able to reapply those techniques into Design Studio. Students can draw line with Autocad, but, in most cases, they didn’t understand how to draw a “wall”. As G. Smeltzer (1987) said - “In short: not everything of general program is needed and not everything that is needed will be presented.”

It was the time of serious discussions of important questions concerning CAAD teaching:

What are the goals of teaching? How should we teach? Who should teach? Should we develop a CAD-system which follows the traditional design method of architects or should we develop a tool regardless of architectural traditions, or maybe a compromise would be the best solution? Many thought that if we want to take architectural education seriously and we want to teach CAAD, we need professional computing experts. In result in many schools architectural teachers was replaced by computers expert. But analysis of our first experience showed that we couldn’t concentrate on the CAAD software because if it is the main area of teaching, a great gap appears between technical factors and creativity.

**Early years – personal involvement**

“One cannot learn how to keep balance on the bike by trying to act by the rule, which says that to restore balance the bike has to be thrown into a curved trajectory, opposite to the direction of imbalance and with a radius proportional to the velocity squared and the angle of deviation. This kind of knowledge is entirely unproductive unless transformed into a practical, sensual skill, unless it becomes secondary and auxiliary, unless you do it instinctively” (Polanyi and Porsch, 1975).

In the past caad has often been taught in isolation. But even in year 1987 R. Schijf (1987) saw that the design studio took up the central place in architectural teaching and it should be determined to get caad into the design studio. It demands that the caad-teachers are design teachers at the same time, or at least that the design teachers are well aware of the potential and limitations of the available computer facilities.

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**Figure 1**

*Holiday house for two*
But in early 90’s practical implementation of CAD skills was still very problematic. We observed that in many schools students redrew projects of known architects. We decided to change the method of teaching to an active approach to architectural computing education. Elaborated by us and presented at ECAADE Conference in Munich (1991) methods aroused intense interest, and were introduced in many schools. (Bridges, 1994, Roberts and Forster, 1998) This method was built on the principle of “personal students’ involvement”. We tried to switch students’ attention from software into design problem. Another reason for this way of teaching was our deep conviction that drawing and visualization without a specific task do not add much to design thinking and degrade the level of education. In our method students made architectural project (“Holiday house for two”) and simultaneously receive CAAD tuition aimed at providing skills that support this project. An important issue during these courses was to ascertain that they would not degrade to mere training of cad-system commands. Students applied the cad-system in their studio design work and in result saw the sense in what they had been doing. They discovered their own ways of “misusing” and “abusing” the digital media.

Results of the personal involvement method were very promising. Students have learned Autocad much more quickly. However, it was the only success we achieved. We were teaching drafters, who used computers, but they were still only drafters. Process of designing, especially its early stages, took place without computers. We felt that on the one hand we didn’t use potential of new technologies and on the other we stopped using the traditional ones. It was the reason for analysis of caad in creative architectural design.

Nowadays

Replacement
As a result of application of informative technology in many areas of architect’s activity the question arises: How will the architectural curriculum be affected by implementation of IT? We started analysing this problem in Lund. One of the aspects of this problem is computers’ using in designing. Development of hardware (computer, 2D and 3D scanner) as well as a software (understood not only as a computer programs but as a new methodology) gives us possibilities to create architectural forms in a different way. Computer is treated as a medium, which lets students explore different spaces of architectural design. It is an extension of our creative possibilities. While traditional tools enable architects to work only on objects, the computer gives them access to the processes and sources of creative activity. They can use it at early design stages for searching of idea (Asanowicz, 1998).

At the basis of this idea we elaborated the method of architectural composition teaching using the modelling software. In this method the traditional mock-up were replaced by digital mock-up.

First time we introduced the digital media to Architectural Composition course in 1997, after many years of experience with teaching traditional architectural composition. Usually, at the conceptual design stage architects use sketches, drawings and physical models. Our experiment showed that is possible to do the same thing using the computer-based 3D modelling, experiencing no physical limitations of the ‘real’ substance. At the same time, at the early design stages, when formal value is sought, computer modelling can be done almost intuitively. In 2002 the whole course was elaborated. This course included five groups of exercises: façade, solid composition with specific formal values, transformation - from cube to parallelepiped, walk through (desert, valley, and tunnel), walk through the internal space. For each exercise we have elaborated the short description including general remarks on exercise, goal, description of the exercise, and information about required skills and software. In this course we permitted using all possible geometrical elements and surfaces with different colour and light. Practically in all exercises the animation is the obvious
element. The process of designing in both Traditional and Digital Course proceeded in the same way. The starting point was searching for the inspiration. Each student presented photos of existing architectural objects and a text, which explained the reasons of the choice. Next obvious stage was preparing the sketches of the idea. Sketches were discussed and on their basis the model of the composition was realised (Asanowicz, 2003).

Integration

“… the architect experiences, synthesizes, and creates, he experiences proportion, balance, line, recession and so on, he coordinates and organizes his experience, and he gives it definite form in a building” (Wilensky, 1927).

The traditional way of teaching students architecture is mainly based on an organized and simplified simulation of the design practice. It consists of the production of architectural projects in a strong context called the Studio.

The idea of integrating the teaching of design computing into the design studio is not new. For many years there have been several proposals concerning this issue (Dvorak, 1995; Fuchs and Martino, 1995; Kalisperis, 1996; Kenzari, 1996; Marx, 1998). Therefore, the predominant approach, at the level of program as a whole, remains system oriented. Courses like “Computer Graphics”, “Image Processing”, “3D Modelling” or “Multimedia” are run along side with design specific courses without mixing with each other.

This situation was a reason for elaborating new way of teaching based on the idea of mixing computer techniques with manual ones. When we discussed this integration we considered different traditional tools (sketch, drawings, mock-up and full-scale model) and digital techniques, which are used in architectural design. Medium for this would be the Cyber-Real Space, which is a fully realistic space, defining the area in which our creative activities would take place (Asanowicz, 1998). As a result we created exercise in which mixed media and tools are used at different design stages. The subject of this exercise was “The Gate”. The main teaching principle is full integration of different design tools and even project realisation in full scale.

The Gate

Goal

The main goal of it exercise is to show students how to combine thinking about relationship of the design process with the process of construction, which is understood as a dynamic activity in which “mistakes” may result in interesting solutions. In this exercise student may feel materiality of the space and forms. Unlike most studio projects, which is usually terminate in a set of drawings and models, full-scale construction is exactly what it is. Students may “taste real world”.

Process

Phase 1 – Idea searching and sketching
Phase 2 – Specification. In this phase the students made a 2D drawing and tectonic models (mock-up) as material transcription and translations of the idea coming from the first phase.
Phase 3 – Computer modelling. In this phase students returned to the computer and its virtual world of images. This phase is process of iteration in which two elements (3D visualization and re-thinking) are repeated until receiving acceptable solution. At the end students built 3D models and prepared short animation.

Phase 4 – Realisation. Students prepared technical drawings - plans, sections and elevations. The important part is material specification – decision about material will use in realization. When project is finished during one day working in groups of 14 students, the teams built real “Gate”.

Figure 3
The Gate
Results
We decided to broaden our design on to part of physical realisation because practically every design and planning activity aims at its ultimate realization in the built environment. The true spatial dimensions and proportions can be conceived on a 1:1 scale “without any mental detour”. Moreover, the interaction of light, colour and material is best represented in the 1:1 model (Linzer, Martens, Voigt, 1994).

To conclude, we can say that “Gate project” become a pedagogical tool that highlights the need to think about new work at its various scales and media. Exercise forces students to think about materiality, detail and about how things interact with each other, to push them beyond thinking of architecture design as preparation of 2D drawings. A main characteristic of full-scale construction is the fact that it does not represent anything other than what it is. The key to the success of all gate projects was in process of mixing different tools and media. A balanced combination of physical and virtual models in full-scale is very important for quality of the design. Physical models are used in order to elucidate the lack of clarity found in the two-dimensional representations of design, and digital models have provided a more effective way of differentiating curvature and space with greater accuracy (Lin, Cheng-Yuan, 1999).

Conclusion
The “Integration” is based on the idea of Hybrid Design Environment presented by author at ECAADe Conference in Warsaw. When creating a Hybrid Design Environment, we start from the synthesis of different means of conveying the image, making use of real objects, traditional media. As a result of such actions, which assume the free use of all sorts of different elements, we obtain an environment of not just an inter-medial character but also of a multimedia character – a uni-medial synthesis (Asanowicz, 2002).

The need to work in a mixed designing space is based on the thesis of a dual spatiality of man (the virtual and the real). These two different areas of human activity and, at the same time, images of its world, overlap. As Hall (1997) has said “the way we perceive a given space is determined by what we can do in it”.

Our intention was to demonstrate students that using the new media is not enough to create architecture. There are many traditional tools of design. Each one of them is different, and their good point is that they can be used at any stage of design. Efficiency of those tools is different, and varies from the individual skills of the designer. The main traditional tools are the sketch and the scale models. Sketches best correspond to the specifics of the future object search form, due to quick materialization of the idea invented. With its help the visual pictures formed within the architect’s mind change and become more precise. Simultaneously as a feedback, drawings reflect our memory, complementing spatial pictures already conceived in it. At the same time, many designers prefer to present their ideas through scale models, even full-scale models. Such method of design influences the character of form to a larger extent than when using a drawing (Asanowicz, 1997).

In our approach we want to show students that old tools and methods are important in the same case as new ones. Finally, we hope that the course demonstrates the potential of mixed media for creative exploration through searching, transformation, interpretation, visualization and realisation.

References
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