Education of Professional Computing Competence in University

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Developments in the field of computer science and architecture are leading to the new relationships between these two areas, which influence architectural education, and practice. The contemporary architectural design process in its individuality and uncertainty is characterized by the integration of different media and design instruments. There is an urgent need for architecture schools to recognize the value and use of the computer as an essential tool in the teaching and practicing architects' activities.
This paper describes the results of experiment, which concerns new policy and objectives for teaching CAAD. The experiment also outlines relationship between the lecturing in CAAD and the use of CAAD in architectural projects. We discuss the problems and opportunities in teaching architecture students the CAAD and with the CAAD.

Keywords: *Computer Aided Architectural Design, architectural education, professional computing competence.*

Occurrence of the practical and academic problem

The architectural design needs a teaching model that is considered for the XXI century. The architecture schools seek to change not only the content of the curriculum but also modernize their didactic resources and pedagogical technologies. The challenge and the questions for academic institutions are:

- Will take the generation of the young architects the new jobs having appropriate understanding and working skills in using newest technologies?
- Will they be prepared to work independently and learn in the world overloaded with the information?

The problem of the professional competence is often raised and widely discussed. But today it is necessary to discuss equally widely also the problem of the professional computing competence. The competent expert in his own area – an architect, an engineer, an economist, or the boss of the enterprise – can adjust himself working in

the modern computerized organization only in that case, if:

1. He is computer literate;
2. He is able to work with the hardware and software tools of his profession, which means to use the means that do not belong to the area of general computing literacy (Kazlauskas A.P., 2003).

Thus professional computing competence could be defined as:

- Professional competence;
- Plus general computing competence;
- Plus realization of the professional computing competence, that means ability of the person to use the digital tools in the purposive way solving his professional tasks.

The intensive process of the education of professional computing competence in Lithuania started from the late eighties when the first personal computers appeared in the market. The previous decade brought up many specialists professionally fulfilling their duties using computers but the process continues. There are several reasons for that. Firstly, the computer illiteracy is not liquidated. Secondly, the young generation joining the active society has an adequate computing literacy but is not enough professionally educated and experienced what is a matter of working practice. Thirdly, the content of the concept „professional computing competence" alters when the information technology (IT) develops. In order to keep the competitive edge one has to learn constantly.

Every architecture school has to build the model of the tuition process of his own which helps to develop the professional computing competence. It could not be borrowed from the other academic institutions because technical and human resources and the other factors determine it.

The developments in the field of relationship between computer and architecture are in the phase of the high maturity. It is still a big field of experiments, testing, contemplation about architecture and how the digital media will influence the design process. How the design process can be translated into digital language? How architects should be trained to interact with these tools?

These and related problems are discussed also in some references: how the pervasive presence of computer technology in the classrooms can enhance the teaching capabilities of architecture subjects and minimize the displacement of their content matter (Vasquez de Velasco, 2002), enhancing the knowledge of spatial senses by interactive media design (Ozcan, 2001), establishing the design methodology to interact and integrate design learning in process (Asanowicz, 1999), (Achten, 1996), (Lee, 1996), separation of design thinking from the tools and media (Jakimowicz, 2002), integration of CAAD with the introduction to architectural concepts and techniques (Rochegova, 1996), formalization of design problems and CAAD program development (Cinelis, 2002).

Looking for the answers in these two above-mentioned principal questions we made an academic experiment.

Objectives of the experiment

Main goals of the experiment were:

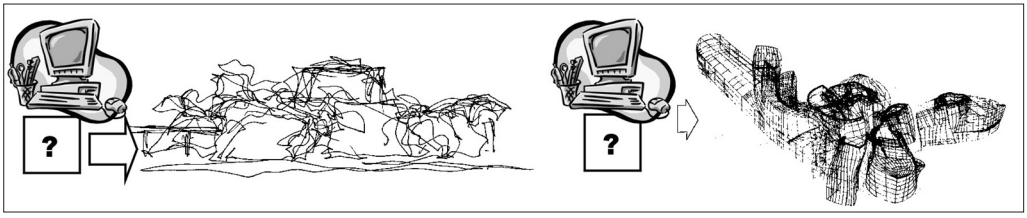

Figure 1
Determination of the IT place in the design process.

- Firstly, to explore the influence of the academic CAAD courses to the individuality and the understanding of architects about the designing process;
- Secondly, to foresee how the planned courses can fit in the curriculum;
- And thirdly, to trace the relation between the knowledge and experience of the digital methods on one hand and the content and quality of the final design solutions on the other hand.

1. Particularly the experiment was aimed to clear up the questions:How is possible to measure the influence of the IT to the design teaching?
2. What is the potential use of the IT to the process of the design teaching?
3. On which phase of the designing process should be used the methods and means of the IT (fig.1)?

Object of the study

The experimental research started in the autumn semester 2003 and initially covered all the bachelor and master degree architecture students of every year. The general and special subjects of architectural education were chosen for the experiment. Only those subjects were selected which are provided for the architectural design teaching. The theoretical architectural subjects were not included.
Participants of the experiment
During a typical academic year (2003/2004) some students from different years of study participated in the computer workshop / experiment with their architectural projects. The group of the potential participants was selected from 160 architecture students on the basis of general computer knowledge questionnaire.
The list of the questions included the topics about operating systems, concepts of the information and communication, IT terms, architecture of the computers, data storage, types of the software and its place in the society, the computer networking. Relatively high average of the ratings of answers indicates rather good preparation of the students in the field of general informatics (fig.2). General knowledge of informatics and the skills of computer use will be acquired while learning at school or at home, but at that moment there is a lack of knowledge about CAAD and appropriate software.
The final group of the 15 students was comprised taking into account their professional computing competency using the list of questions specific to CAAD. This questionnaire consisted of the questions about the possibilities and limitations of the use of computers in architectural design. Besides there were some questions about the use of IT for the studies of architecture.
The results of survey show clearly that mostly the CAAD programs are not used in the schematic design phase. The other clear thing is that the most popular software for architectural design is AutoCAD and ArchiCAD.
The software used by the students for the architectural design was divided in percentage as follows: AutoCAD is used by 38,5% of students, ArchiCAD - 33,1%, 3DStudioMAX - 7,1%, Arcon - 5,9%, Architectural Desktop - 3,6% and ArtLantis - 2,4%. 1% of respondents did not know any program that could be used for architectural design. The survey showed that recently the CAD software mostly is used for the drawing and design visualization. Speaking about the phase of schematic design the IT is used exceptionally for generating of existing sketches and not for generating of the idea. That fact will be reflected also on the answers about the

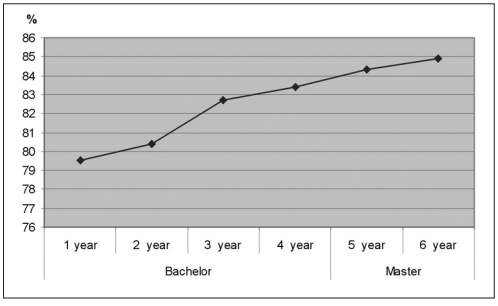

Figure 2
The results of the test of general computer literacy.

„sketching“ programs (74 % of the respondents mentioned AutoCAD and ArchiCAD, 14 % of the students do not know the software for these purposes, 12 % referred to 3D Studio Max, ArtLantis, Corel Draw).

About 84,8 % of the students have an opinion that the university education in CAAD is insufficient (fig. 3). 55,2 % of them uses the digital technologies in the subjects of the architectural design. It strikes the eye that 98 % (!) of the students that work in the consulting and designing companies permanently work on the IT basis. But this number significantly differs from the academic experience.

On the base of survey were selected the computer literate students that have also the basics of the professional computing competence. There was a goal also during the experiment to encourage the people to think first of all about the object they design not about the digital tool and the sequence of actions.

Methods of the implementation of experiment

During the experiment the students learned how the conventional software could represent the architecture in a variety of ways. All these students took an introductory computer course coupled with a design process already from the first year of architectural education. The computer was considered as a design media leading to the results that would be impossible or difficult to achieve with analogue media. This was an important issue of the experiment.

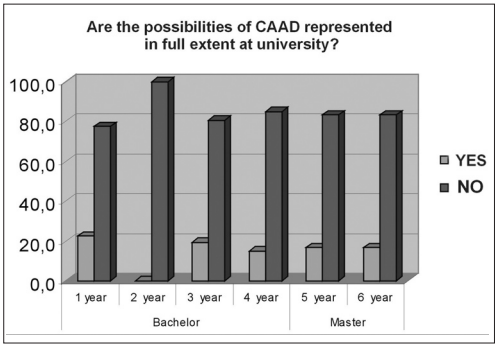

Figure 3
The results of the use of CAAD potential at university.

During the design process it was suggested for the participants of experiment one or several directions of the IT use:

1. The computer is used for the preparation of specific projects, for example when the deconstruction style or organic style forms are modelled that are difficult to describe mathematically;
2. The computer is used in order to extend the design basics as theory of colours and conceptual design;
3. The computer is used in order to extend the non-graphical design as energy analysis and economical evaluation;
4. The computer is used as the tool for drawing and / or modeling.

Selection of the experimental tools

One of the experiment tasks is to design emphasizing the dynamic processes in architecture using the digital tools. The students work with all kind of the media like traditional sketches, CAD drawings, video and sound, texts and photographs, which they combine during the design process into digital environment. In our research we try to highlight the importance of interaction between the human brain, its creativity and the computer.

The hardware and software were selected separately for every participant of the experiment taking into account the character of the design object. One could change the working tool and the environment during the designing process. The scanner, digital camera, digital pen and the other devices were used in various designs on the sketching phase. The factors that influence the architectural result (lighting, acoustics, energy etc.) were evaluated using different software.

Results of the experiment

The main problem of the computer aided design is to start manage its graphical environment what from

the beginning requires precise geometry description, knowledge of the software structure, interface and adaptation to the new unusual way of interaction. Insufficient managing knowledge of CAD programs turns the designing process to boring sequence of tracing of the objects from the paper to digital environment. There is no relation between the creativity and the expression in electronic drawing in the designing of that kind.

During the experiment the computer was not only the tool of the drawing or / and modeling but also the intelligent working tool. When the design tasks became more complicated the computers and software altered the designing process essentially. The digital technology became not only just a new tool for the work activity but they were considered like a new space for planning, design and modelling. The use of computer encouraged the occurrence of the new forms while the search and the modelling took place directly in the computer (fig.4).

The experiment pointed out that in some cases the students are misled by the computer implication for design. Often they are unaware of the more imaginative possibilities of the digital technology. Some students demonstrated a critical attitude toward computing not accepting it blindly despite their ability to exploit it as a design tool.

The results of the experiment after their quantitative and expert evaluation indicated the problems related to design education, timetabling, assessment, staff and machine resources, training and program documentations. At the time being the professional computing competence is educated mainly in the general informatics courses and during the learning process there are no possibilities to test the IT based solutions starting from the generating of idea till its putting into shape and rendering in the digital environment. Additional teaching and research responsibilities will include curriculum development of advanced obligatory and elective computer subjects.

The evaluation of the results of experiment:

- The designing with the help of computer made easier to solve some geometry problems during the investigation and expression of complicated architectural forms which are not possible to describe in the manual methods.
- The students were able to explore more design alternatives in the same time and in that way better result was achieved.
- The digital tools helped the students to evaluate the visual impact of the project to the environment
- Some technical aspects were integrated already in the early phase of the design what is usually provided in the other courses (for example, acoustics, sun lighting, economical evaluation).
- The designing in the digital environment enabled the students to find the new ideas reducing the risk that brave but doubtful solution could lead to failure.

After the experimental study of the design process

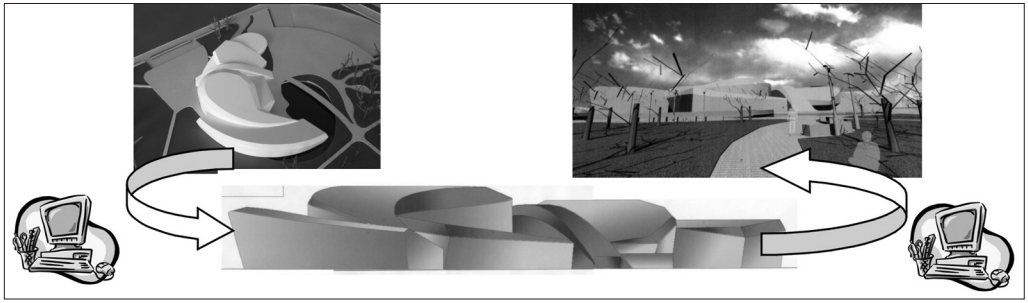

Figure 4
Modern forms become convenient with a new tool.

and its results we noticed that the role of the computer increases and there is a need to analyze and summarize the essential problems of the tuition of CAAD. It is important to foresee the possible impact of the CAD to the architectural result and CAAD tuition.

Directions of possible changes in curriculum

The education of the architectural professional computing competence in the tuition has to cover a broad range of the subjects. So we need to define main directions of the computer use in the design tuition:

1. The methods of the CAD have to be integrated into majority of the architectural subjects;
2. The IT based methods can help to represent the peculiarities of the architectural subjects;
3. The specialized subjects should be coupled with the IT methods.

Still there are the architectural subjects where the use of the IT methods is not clear enough or not extended as the applications for the design practice (for example, quantitative evaluation of the aesthetics of the architectural object and it's visual impact to the landscape, mathematical evaluation of the quality of design solutions). The changes in the curriculum of the university in that direction should fill also these white spots and stimulate the use of these new methods in the practice.

There are also the subjects of the architectural education where the use of the digital methods could be considered as the negative (so called classical subjects: sketching, painting, physical modelling, sculpture).

Students have to learn working on the same design with different tools, both analogue and digital. When working in CAD environment students should think more about the object they design and not about the tool they use. The teachers could help them to think on two levels in the same time.

In summary we can generalize that the volumes of CAAD in the academic design should be increased from the very beginning of the architecture study. A big part of the work in general computer education probably should be done at the secondary schools. And essential work of the education of professional computing competence then will be at universities (fig.5).

The computers actually influence the design teaching significantly. However the pedagogical experience and the results of the experiment should be successfully applied in the academic process. In that viewpoint we see some technical, administrative and pedagogical barriers, which should be overcome in the future.

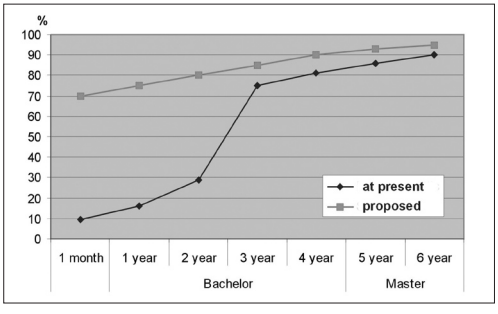

Figure 5
The volumes of the use of IT in the academic design.

Conclusions

One of the main problems when creating the teaching methods of computer aided architectural design is that the process of the IT development is very dynamic and fast. This is the reason of the difficulty to implement research of sociology, cultural processes and possible results and sequences. Anyway the results of the experiment which was aimed to find out the influences of the IT for architectural quality allow us to summarize that as a rule it works the law of the sad experience: in one place you win, in the other place you loose.

There is a need to find a relation between the imagination of the human being and the means of its expression – CAD software. The curriculums of the architecture schools should be addressed to encourage the software users for creativity in the

virtual environment. We can recognize the gap very clearly when one jumps from the early design phase to the phase of the construction drawings.

The academic modules for education of professional computing competence should not be provided as the isolated teaching activity for architecture students. It has to be included into main architectural subjects.

When the IT came we knew that this meant the beginning of the incredible process. We have not to forget that this is only the media but not the solution. Still this media provides the opportunities we never had before. This research cleared up new possibilities we have to apply in the education of professional computing competence.

References

Achten, H.: 1996, Teaching advanced architectural issues through principles of CAAD, Education for Practice, 14th eCAADe Conference Proceedings, Lund (Sweden) 12-14 September 1996, pp. 7-16.

Asanowicz, A.: 1999, Computer in creation of architectural form, AVOCAAD Second International Conference Proceedings, Brussels (Belgium) 8-10 April 1999, pp. 131-142.

Cinelis G., Januskevicius E., Kazakeviciute G.: 2002, CAAD program development : expectations and results. eCAADe 20: [designe-education] Connecting the Real and the Virtual, 20th eCAADe Conference Proceedings,, Warsaw (Poland) 17-21 August 2002, pp. 118-121.

Jakimowicz, A.: 2002, The physical and the digital in designing architecture – do they really meet? [designe-education] Connecting the Real and the Virtual, 20th eCAADe Conference Proceedings, Warsaw (Poland) 17-21 August 2002, pp. 144-147.

Kazlauskas A. P., Kleniauskas L.: 2003, Generating of the intelligence with modern information technology, http://www.infobalt.lt/common/pranesimai/J_Kazlauskas.doc: Jan 2003.

Lee, S. W.: 1996, A cognitive approach to architectural style several characteristics of design thinking in architecture, CAADRIA '96 Proceedings of the first conference on Computer Aided Architectural Design Research in Asia, Hong Kong (Hong Kong) 25-27 April 1996, pp. 223-226.

Ozcan, O.: 2001, Integration of architectural education in teaching interactive media design – A course for space composition, Architectural Information management, 19th eCAADe Conference Proceedings, Helsinki (Finland) 29-31 August 2001, pp. 245-249.

Rochegova N.A., Barchugova E.V.: Use of computer technique at the initial stages of architectural education, Computer in Architectural Design, 4th Conference Proceedings, Bialystok (Poland) 25-27 April 1996, pp. 201-205.

Vazquez de Velasco, G.: 2002, The computer to Blame. The Disruptive potential of a CAD Curriculum in an Architecture Curriculum. eCAADe 20: [designe-education] Connecting the Real and the Virtual, 20th eCAADe Conference Proceedings,, Warsaw (Poland) 17-21 August 2002, pp. 50-54.