CAAD influences in Web-based teaching

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Abstract. A recent restructuring of the CAAD department at the Faculty of Architecture, Delft University of Technology, was based on the principle of coupling technological and methodical development to application areas. This resulted into decentralization of CAAD and the positioning of computerization groups in other departments. The task of these groups is to stimulate broad integration of ICT and initiate the development of computational applications relating to specific tasks and areas. The paper is a description of a channel for such integration and applications: a Web site intended as a support to the research and educational activities of a whole department. In addition to its conventional role in presenting the department, the site accommodates the majority of learning aids for the students (lecture notes and presentations, readers, syllabi, audiovisual material) and a comprehensive database of completed and ongoing research output (online publications for internal use). The design of the site was based on earlier experiences with Web-based teaching and collaborative design environments, which were projected on the processes and products of the new context.

Keywords. web-based education, computer-mediated communication, interaction, collaboration

Restructuring: causes and effects

Shortly before the end of the twentieth century the Faculty of Architecture, Delft University of Technology, decided to restructure its CAAD department. A few years ago this department had been formed by bringing together the main chairs that had been active in the area of CAAD. The intention behind a central CAAD department had been consolidation of activities, pooling of human resources and concentration of computerization developments. The assumption was that this would permit more powerful and focused stimulation for research and CAAD teaching at both introductory and advanced levels. With the rapid democratization of the computer in the same period, priorities and necessities changed at an equally high pace (Castells, 1996; Castells, 2001). It soon became evident that simple ICT applications no longer required a CAAD specialist, especially in teaching. Knowledgeable users with a modest training or experience of computing were able to use the computer efficiently and frequently effectively and reliably.

Unfortunately democratization also increased the danger of superficial and arbitrary computerization. The wide availability of affordable ICT (including applications for architectural and building tasks) meant that quite a few domain specialists assumed that CAAD had become redundant as a distinct specialization. The consequences of this assumption were generally negative for the computerization of their domains. Due to lack of understanding of the methodical background of CAAD, domain specialists may fail to correlate their priorities and processes with the possibilities

of computerization through sound, grounded approaches. Also lack of experience with the practical and technical side of computerization may result into substandard choices and limited utilization of available facilities. A typical example of things that can go wrong is the representations used for input and output: despite significant developments in the standardization of building representations (e.g. www.iai-international.org: May 2003), inputting information in an architectural program is frequently redundant, complicated and inefficient, while the output is generally limited to basic visualizations and conventional analogue documents (Koutamanis and Mitossi, 2001).

In this (largely externally defined) climate, a counterargument for the centralization of CAAD emerged: if the CAAD specialists were directly attached to the primary application domains they could cooperate closely with domain specialists on the computerization of specific areas and tasks. This would enrich the domain with knowledge and technology from CAAD and vice versa, to the benefit of both parties. Decentralization of CAAD by positioning computerization groups in other departments was expected to stimulate broad integration of ICT in teaching and the initiation of research into the in-depth computerization of promising areas and tasks. This was further supported by a positive perception of the state of the art in commercially available CAAD and the computerization of architectural practice.

As a result, the Chair for Computational Design (Bouwinformatica) became a part of the Department of Real Estate & Housing (RE&H), which also comprised the specializations project management, real estate management and housing studies. RE&H focuses on the management and guidance of architectural, building and town-planning processes throughout the life cycle of the built enviroment. Its central themes include the relationships between process and product; performance, quality, cost and time; client, user and decision maker. In this framework CAAD has two primary functions. The first is to help improve the methods and techniques of RE&H by means of computerization, e.g. through information management, computer-mediated communication and decision support. The second function is to develop products and activities that serve as an interface between the rationalism and innovations of RE&H and the requirements and needs of other architectural and building specializations.

Web-based teaching

One of the first activities of the CAAD specialists in the framework of RE&H was the development of facilities and structures for Web-based teaching. This was due to two reasons. The first was the extensive experience of the CAAD specialists with Web-based architectural teaching (Koutamanis, Barendse et al., 1999) – not only with the technical and organizational sides (Geraedts and Pollalis, 2001) but also with the pedagogical backgrounds (Koutamanis, 1999). The second reason was the transition of Delft University of Technology to the Bachelor-Master structure. The inevitable extensive reorganization of the teaching curriculum also implied opportunities for improvements in the course structure and content, as well as in the didactic effectiveness and efficiency. One important consideration was the closer relationship between research and teaching, especially during the last stages of the Master programme. To accommodate the processes and products of these changes, the Web site of the Department evolved from a conventional online presentation of people and activities to a support instrument for communication, interaction and cooperation.

The new character of the Web site retains the formal overview of research and teaching activities but is not hampered by the periodicity such overviews entail (Koutamanis, 1998). Drawing

from prior experiences with Web-based teaching but also from design applications of online collaborative environments (Gross, Yi-Luen Do et al., 1998; Chiu and Yamaguchi, 2001; Hanser, Halin et al., 2001; Morozumi, Homma et al., 2001; Rosenman and Wang, 2001), the role of these overviews became primarily a front-end to the dynamic processes and evolving products of research and teaching. In doing so, an important consideration was the correlation of processes and products in a way that reduces the black boxes conventionally generated around processes when adopting the viewpoint of products and vice versa. This was explored through the application of innovative concepts, e.g. by widening the definition of products so as to include discrete actions and decisions (Avouris, Dimitracopoulou et al., 2003). The resulting structure of the Web site consisted of three overlapping areas that correspond to both abstraction levels and spheres of influence and activity:

• General space: modules containing abstract information on research, teaching and organization. These are compiled, edited and managed centrally by the Department and are characterized by a long periodicity (mostly annual) that is determined primarily by University deadlines. The general modules provide the most frequent entries to the Web site. Users can find specific information in a top-down fashion that supports overview and explains relationships between e.g. differences in theme or approach in various research projects.

• Group space: modules that accommodate specific group activities in research or teaching. Each of these modules is used and managed by a small group, e.g. the teachers of a particular course or the team members of a research project. Changes in the content of the group modules are frequent but their structure evolves rather slowly, once again bounded by the periodicity of University procedures and research planning. Group modules are customary entry points for seasoned users of the Web site, as they provide an actual local picture of specific activities together with relationships to other modules.

• Personal space: modules which focus on personal activities and are managed by individual faculty members. Personal modules generally derive from research and attempt to communicate the state of a project not only to other researchers but also to students of the Faculty. Students have their own Web space that is used for the presentation and communication of their work. This also includes the responsibility of portfolio management. Personal modules are a means of informal communication aimed primarily at the Department itself and its direct contacts. They also form the essential information for updating and enriching group and global modules. For example, personal registration and online publi-

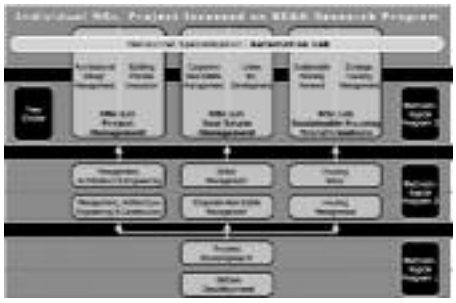

Figure 1. General space example: overview of the RE&H MSc programme. The courses indicated in the diagram generally correspond with a discrete group module.

Figure 2. Personal space example: excerpt from work-in-progress research presentation.

cation of lecture notes, bibliographies, digital presentations and demonstrations provide much of the material used for the production of internal readers and the compilation of syllabi.

The end product of all these modules is a Web site that accommodates the majority of learning aids for students. Connections between these aids and background information (including audiovisual material) reduce the conventional limitations of the character of these aids (Koutamanis, 1995). For example, a syllabus, reader or bibliography serves primarily as a familiar entry point to a comprehensive, up-to-date multimedia system that integrates all available information. This system is not limited to a particular course but applies to all courses of (initially) the Master programme of RE&H. As such it accompanies the students throughout their studies and hopefully beyond that, as an informal source of lifelong learning.

The emphasis on education is due to the high priority of the new Bachelor-Master structure. Research inevitably lags behind, especially in the global and group space. A few notable exceptions concern research output with a direct relevance to teaching. For example, papers, articles and reports that were deemed accessible to the students were attached to a database of online publications for internal use. This database is a subset of the total bibliographic database of the site, which is compiled by the agglomeration of all locally available bibliographies (as used by different RE&H members in various research projects). The same bibliographic database provides the references and suggested reading for each course (by means of selections predefined by the teachers and focused student queries).

Computerization and management

The choice for Web-based teaching is generally due to practical reasons of efficiency and flexibility but also as a less oppressive medium of rationalization and integration than top-down prescriptive or proscriptive structures. In the case described in the present paper care was taken to ensure that the organization of the site and related activities reflected the structure and character of existing individual or group processes. The correspondence of the two supports continuity and stimulates personal responsibility for the quality and actuality of the content of the learning aids. At the same time, the constraints of the site structure facilitate processing of information made available in this way, including (in order of application) cross-referencing, conflict resolution and abstraction.

The main innovation of the site in relation to the earlier Web-based learning environments is that it introduced distributed information management and common authorship on a department-wide basis. Most members of the Department are individually responsible for maintaining and augmenting the content of group modules, not as an additional task but as an extension of their normal research or teaching activities. Despite the frequent complaints of information overload and untimely intrusion, the directness and immediacy of Web-based communication and interaction with colleagues and students increases the feeling of responsibility for the content and provides stimuli for its further development. It also returns significant feedback concerning the structure and functionality of the site, together with an indication of the urgency of possible modifications or additions.

At the didactic and pedagogical level the site has serves as an unobtrusive introduction of constructivist teaching, where students have the opportunity to learn from more than one teacher at the same time (Kafai and Rensick, 1996; Wilson, 1996). The transition from instructivism to constructivism is generally a sensitive issue for the teacher who may feel threatened by the pres-

ence of other teachers in an area he is used to considering as his own. Prior experience with multidisciplinary research or design projects is frequently instrumental for the acceptance of constructivist learning. This is less straightforward for the student, who is asked to play a very active role in planning and acquiring knowledge and information, e.g. by resolving conflicts arising from differences of opinion in his sources. To solve such problems one needs a comprehensive, responsive information environment and a smooth transition to new ways of teaching and learning. The progressive, incremental introduction of digital learning environments and techniques can have an extensive positive influence on both aspects. On the one hand, the learning environments can be adapted to emerging requirements and necessities, while on the other the adoption of a new didactic approach becomes part of the transition from conventional teaching to Web-based learning (Hedberg, Brown et al., 1997; Relan and Gillani, 1997; Romiszowski, 1997).

Integration and performance

More important than the evaluation of the utility of the described Web site in teaching and research is the analysis of the opportunities offered by such projects for the integration of CAAD in specific application areas, as well as of lessons to be learned by CAAD specialists. In this case, the analysis essentially refers to the relationships between the Chair for Computational Design and the Department of Real Estate & Housing. At the conceptual level the methodical background of the two parties are very similar. Both aspire to rationalization of architecture, accept and stimulate the emergence of new specializations, and advocate strong connections with all aspects of practice both as a source of application opportunities and for relevance feedback.

However, these similarities are less apparent in the use of ICT. The critical choices of the CAAD specialists and their attention to completeness and detail do not always match the pragmatism of the rest of RE&H, who tend to follow the ICT choices currently common in practice and the rather opportunistic patterns of ICT use in practice. It appears that the democratization of the computer frequently results into low-level, practical expectations from computerization, such as efficiency improvement in repetitive tasks or compactness of storage in design information management (Koutamanis, 2002). Advanced technologies such as simulation are often viewed with awe but also with suspicion. The applicability of new methods and techniques is judged in terms of direct benefits without any necessary structural changes in the application context.

The most important reason for these differences is arguably the definition of problems and requirements for automation in most architectural and building application areas. This can be too restrictive or simplistic for computational approaches, thereby creating a fundamental conflict between domain and CAAD priorities. Anecdotal evidence supports the hypothesis that, in order to define computerization in an area, one must have a secure, intensive and personal understanding the potential of computerization. This obviously involves a time-consuming acquaintance based on lengthy experimentation and reflection at a variety of levels. On the other hand, CAAD is aware of the possibilities and limitations of computational methods and techniques but not necessarily fully cognizant of the intricacies and complexities of an application area. This may result into superficial suggestions and unconvincing demonstrations.

Dissimilarities due to different exposure to the possibilities of ICT and their underlying methodical principles relate to differences in the priorities

of different areas. For example, design presentation and communication by means of the Web may be approached differently by the CAAD specialists (who focus on issues of collaborative design, representation, analysis and feedback) than by the rest of the Department (who pay more attention to the registration of design decisions). Similarly, RE&H in general may experience considerably more difficulty than the CAAD group with the effects and pedagogical backgrounds of Web-based learning, such as the distributed authorship of learning aids implied by constructivist teaching.

Despite the operational difficulties that arise from such differences between the CAAD specialists and the specialists of an application area, the results of the cooperation between the two must be judged beneficial for both parties. The Department gained from the augmentation of its technological and methodical instruments, while the CAAD group had the opportunity to consider not only new applications but also a new, wider perspective (that of the complete application area – as opposed to the narrower methodical and technological interests of CAAD against a frequently vague, sketchy background of architecture and building). This widening of scope and capabilities also carries a price: a longer time of development for the site and initially cumbersome decision and management processes, as each step had to be considered from a variety of viewpoints. The result was usually a number of alternatives that had all to be explored before a decision could be taken.

The internal development of CAAD in the context of RE&H is also considered positive. The prior central position and uniqueness of CAAD allowed for overview of methods and techniques and for broad interests and activities. This had proved beneficial for the integration of problems and solutions in a comprehensive and consistent theoretical and technological framework. Such a framework is a prerequisite for the effective and reliable handling of realistic problems, as well as for anticipating new possibilities and applications. With the decentralization of CAAD the completeness of CAAD activities became problematic. Even the wide scope of RE&H presented insufficient opportunities for the continuous exploration of all technologies and directions that had been pursued previously.

Compensation came in the form of more precise and accurate requirements for specific aspects and tasks. This led to the refinement of existing methods and techniques, as well as to new questions and working hypotheses that stimulated further fundamental research. The partiality of the new requirements was often frustrating but also challenging: working with incomplete or even inconsistent problem definitions sets higher standards for the effectiveness, reliability and universality of CAAD solutions. The simultaneous relaxation of the necessity to cover the entire spectrum of CAAD applications meant that less time and effort were spent on introductory matters and already widely adopted technologies that contribute increasingly less to the development of CAAD. This favoured the in-depth treatment of the new challenges towards more demanding and concrete applications than simply for the benefit of CAAD, such as the Web site described in the present paper.

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