CAADidactics
An Instrument for Tuning CAAD Systems to Student Styles

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Abstract

This paper discusses the features of an instrument for tuning CAAD systems to student styles implemented in the authoring shell Authorware Professional (1989). This application enables students and teachers to evaluate the design progress. It also makes it possible to assess their preferences with respect to their working styles (Subject style) and style preferences in terms of the product style (Object style) in different stages of the design curriculum. The availability of this information enables teachers to adapt their didactical approach to their students. The progress they make during design education can be evaluated by looking at the process documentation as well as by looking at the product documentation generated by the application. This makes the students conscious of their own preferences and affinities. It is up to the student and the teacher whether they want to enhance or compensate those preoccupations. The documented information of previous design sessions can also be used as a guide system for further development and adaptations in styles of design and designing. In the design studio this style knowledge can also be used to establish adequate and workable design teams. Some of the features discussed in this paper are already implemented in a small prototype application. The prototype application will be presented and discussed. Other features will be implemented in the near future.

Introduction

Working Styles

A number of experiments and protocol studies on styles of designing has shown that designers have preferences for particular working styles (van Bakel, 1991, 1992). Generally speaking there are 6 main styles of designing (figure 1). This working style is determined by practical experience as well as personality characteristics (See Daru, 1992). To assess a designer's working style a questionnaire has been developed in which the construction is based on the knowledge acquired in the time consuming experiments and protocol analyses. This questionnaire is now adjusted to be implemented in the authoring shell, Authorware Professional (van Bakel, 1993c, Authorware Professional, 1989).

Product Styles

During design education it appeared that students not only sometimes have explicit preferences with respect to a working style (Process style), also referred to as the subject style (Daru, 1992). Many students also show preferences with respect to the style of the outcome (Product style) also referred to as the object style (Daru, 1992). Preferences for the object style might be related to preferences for the subject style. At

this moment special courseware has been developed to assess this object style preference of students (Daru, 1993)

We believe that in order to be successful in design education we need to make students aware of their own personal preferences. That is we need to find out whether they have preferences with respect to how they design but also whether they have preferences with respect to what they design. This knowledge about the "student preferences" needs to be documented in a way that not only it allows the teacher to use it in determining grades. This knowledge is very important for lots of other reasons.

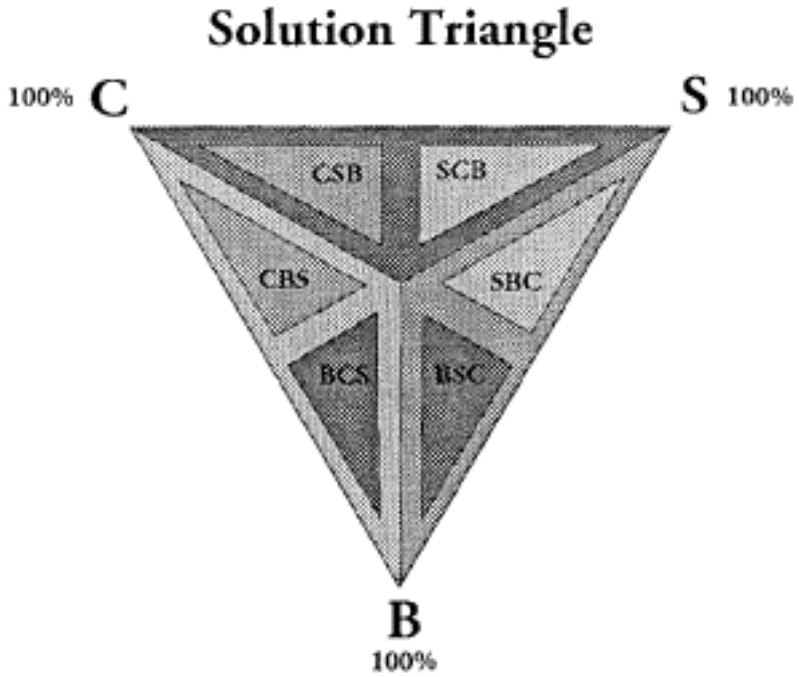

figure 1. The Solution Triangle represents the solution space of designing styles of architects. P C and S represent the features "design brief" the "design concept" and the "site" respectively. Each of these features are given different priority hierarchies by each individual designer (van Bakel, 1992).

Knowledge about the subject style can be useful from a didactic point of view. If for instance we know that a student has a preference to approach most of his design projects from a conceptual point of view (van Bakel, 1992, 1993) and is rather successful in this approach, we might stimulate him to explore what the benefits would be of a different approach let's say a more programmatic approach of the project. On the other hand conscious awareness about a preferred design approach can also be beneficial to the student himself in cases that during the process, problems occur that he has never encountered before. for instance a design task that is much more complex then the housing projects that he has been tuned at in the design curriculum so far.

Knowledge about the object style can help us understand the relation between the process and the product or between the object style and the subject style (Daru, 1992). If they are related (and we assume that to a certain level they are), it would be

very likely that students might obtain different grades for different types of design studios. The question is how we deal with this kind of information from a didactic point of view. Should students only take courses that comply with their preferred object and subject style or should they be encouraged to do just the opposite? We suggest that once this knowledge is available it should be discussed with the individual student so as to make a plan that allows the student to develop an amount of skills that are tuned to the student's preference.

Subject style assessment

The assessment of the subject style is discussed here very briefly. A detailed explanation is given 1n the discussion of the Assessment of Strategy Questionnaire In Designing (ASQ ID) (van Bakel, 1993). In protocol studies and other assessment techniques it was found that 5 features play an important role in describing style differences in designing approaches. Three of them are important from a more architectural designing point of view in a way that they might be related to the object style. These are called S for Site, P for Design Brief and C for Design Concept. These features are used in the construction of a number of questions that a student are asked before he starts to design in the studio. The questions are implemented in the CAAD Courseware application in such a way that the student decides how and in what order he answers the questions (figure 2 and 3). All his answers are immediately documented in a personal log file (figure 4). An algorithm analyses the log file after the student has finished this session to determine the presumed designing strategy. This result is discussed with the student before he continues the next session, determining the object style preference.

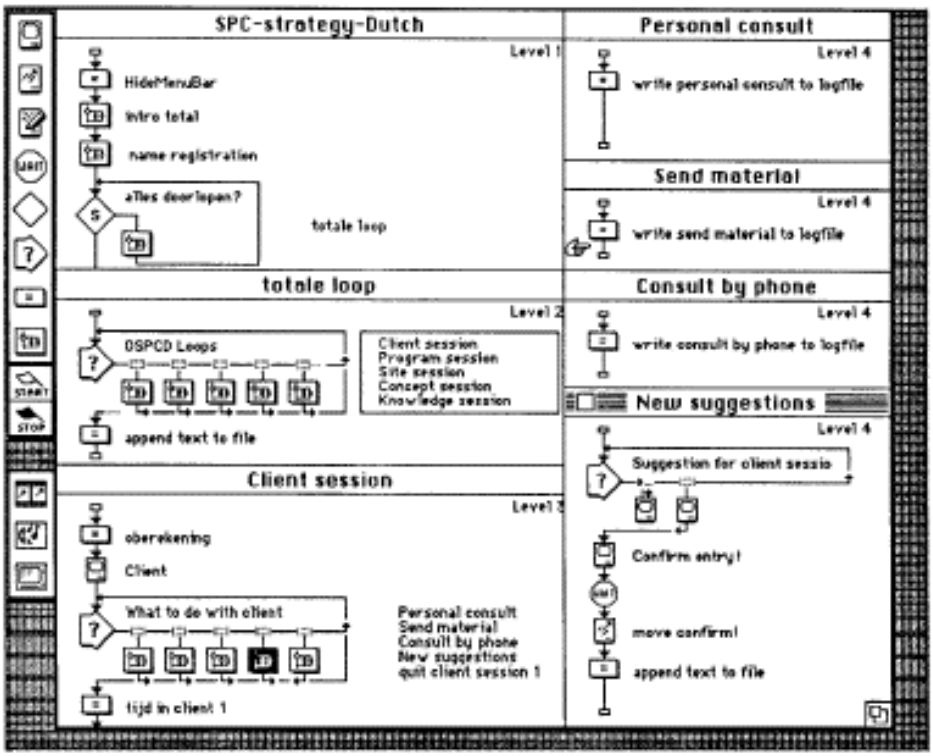

figure 2. Authorware Professional Implementation Environment. All procedures are object oriented and can be maintained in a very easily way. The levels show the hierarchical structure of the different procedures and functions.

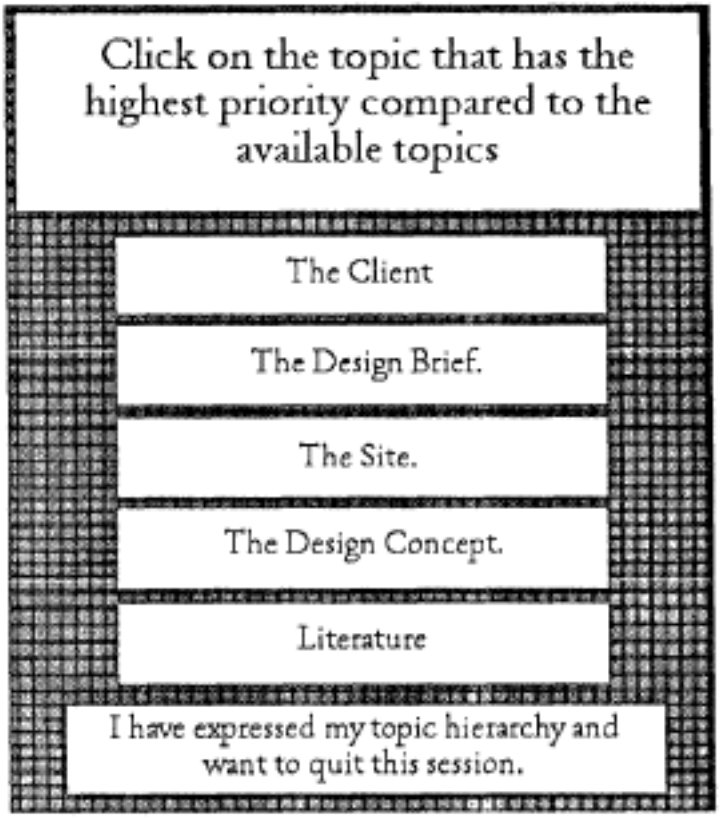

figure 3. Menu page of the prototype version of CAAD Courseware. The application can be passed through by the individual student using his or her preferred strategy.

Object style assessment

The object style is assessed by the use of pictorial material which is associated with semantic meaning known by the experimenters and not available to the students. A number of pictures will be displayed in pairs on a computer screen (figure 5 and 6). One picture is on the left, the other is on the right part of the screen. The student is asked for his preference by clicking the corresponding button. The pictures are chosen in such a way that they correlate with different archetypal object styles (Dondis, 1973). A pilot study has been executed with 12 students in architecture. All the subject's responses were recorded by the system and we are now working on an algorithm that automatically determines the preferred object style of the student. To increase the reliability, before discussing the results with the students, we asked the student about the object style preference as distinguished by Dondis (1973). There was no significant difference between the style as chosen by the student, and the style preference as calculated by the application.

At this moment we used MAT, an application also developed by our design morphology group. See figure 7 for a graphical representation of the results by MAT. The matrix shows us 4 groups of students. Group 1 consists of 5 students with a preference for the first 3 styles. Afterwards these students suggested they had a clear preference for an object style, because they got more years of design education than their fellow students. A second group of 2 students shows a weak preference for all styles except the classical style. In the evaluation session it appeared that they were second year students and did not yet have a clear idea about their preferences. The third group consists of 2 students preferring clearly the functional and classical styles. They explained they both had a degree in traffic planning. The fourth and last group of

students shows a preference for mixture of contrasting styles. This raises the question whether they are also still not sure about their style preferences or, perhaps more interestingly, are trying to define a new kind of object style. For the didactic implication of these results see the paragraph on "Didactic implications, etc." The advantages of using an automated system in both sessions are that the results are available immediately once the student has finished the session and it takes only a few minutes to complete the tasks.

Design task & Morphological Exercises

Once the student has finished the subject and object style assessment session (it will take approximately 1/2 hour) he is given the design project and suggestions for CAAD support that matches his subject and object style preferences. This implies that we have evaluated suitable CAAD applications with respect to features that correspond with the object and subject style. Of course these suggestions are motivated by the application and will be discussed with the teacher before the student starts designing. All the materials produced by the student will be stored in a data bank attached to the application. Students are asked to describe drawings using about 10 words. The words will be matched with the lexicon that describes the different object styles. Students are also asked to keep a journal of their design activities. The contents of this journal will be matched with a lexicon that describes the different subject styles. The structure of the data bank that stores all this information has to be conform the knowledge retrieval strategies and tactics of the user (van Bakel, 1993). Fellow students will try to identify these results using the same protocol as the system. All the results can then be discussed collectively, and specific exercises can be carried out based on the results.

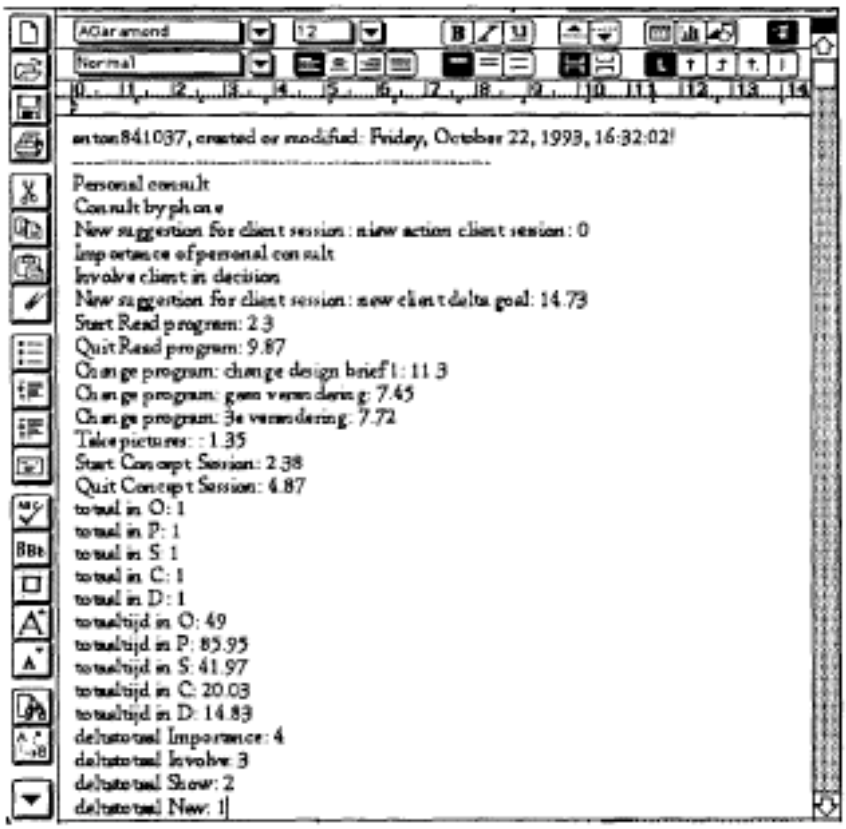

figure 4. Example of a personal log file created by CAAD Courseware. All interactions are recorded together with the time spent in each interaction. Also all input given by the students is copied to the log file for analysis.

Didactic implications of knowledge about preferred and observed subject and object styles

The use of this application enables the teacher to keep track of the progress of each individual student. But it also gives information about possible attention that might have to be given to weak points of an individual student. It tells the teacher about group preferences and weaknesses. He can then decide to have the students work on special exercises.

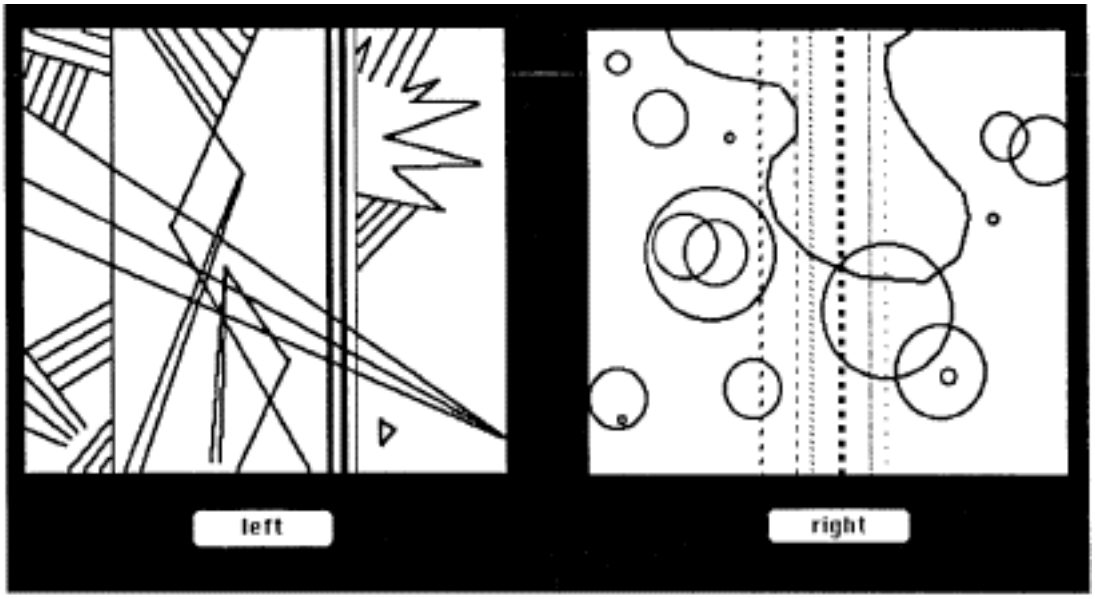

figure 5. Stimulus example screen 1 of the object style assessment tool. The application shows 9 pairs of stimuli randomised for each session. Students are asked to click the button under the figure that matches their preferences best.

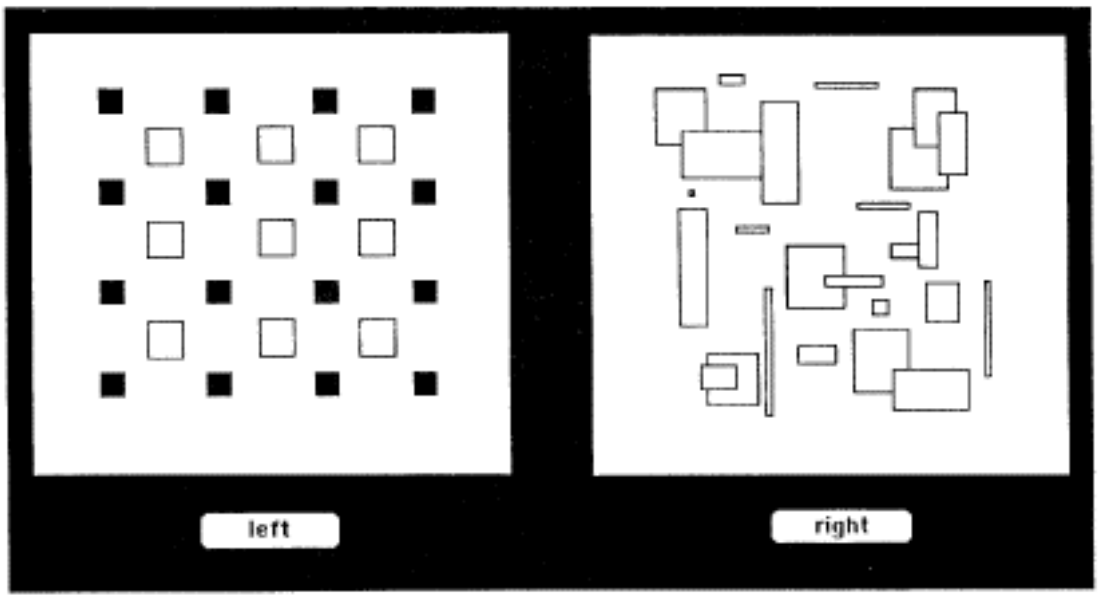

Figure 6. Another example of a stimulus pair. After each student has judged all objects his results are documented in a log file. This log file can automatically be transferred to a MAT file which allows the user to get a graphical feed back of his object preferences.

The application is not only helpful for teachers but also for the individual student. The students can keep track of their progress. They can see how a preferred object or subject style might change during education. They cannot only learn from the mistakes they made but also from the mistakes of fellow students. They can use variations on solution types they successfully used before. They can decide to pay special attention on activities that need some improvement. Furthermore knowledge about style preferences can be used to select appropriate members for a project team.

Computer Backlash & Computer Phobia

The lack of adaptation to computer environments can lead to computer phobia, even in students open to computer use (Daru, 1991). We have experienced that the same computer program could be used in a casual manner by one student, and be conducive to serious technostress in another. We shall seriously take such affective problems of implementation into account. The attitudes acquired by the student during his/her education will be of importance in future professional life. It is therefore necessary to avoid computer repulsion in order to make the future use of technology easier. This implies more research on the technical level, as this is the level where stress is felt most. See ECAADE '92 Daru & Daru on Strategy and Tactics, and Van Bakel, 1993 on Creativity & Cognition in Architectural Designing. Technostress is not only a problem of students but also of the faculty. Are they open to using such an instrument? What are the changes necessary to incline them to implement it?

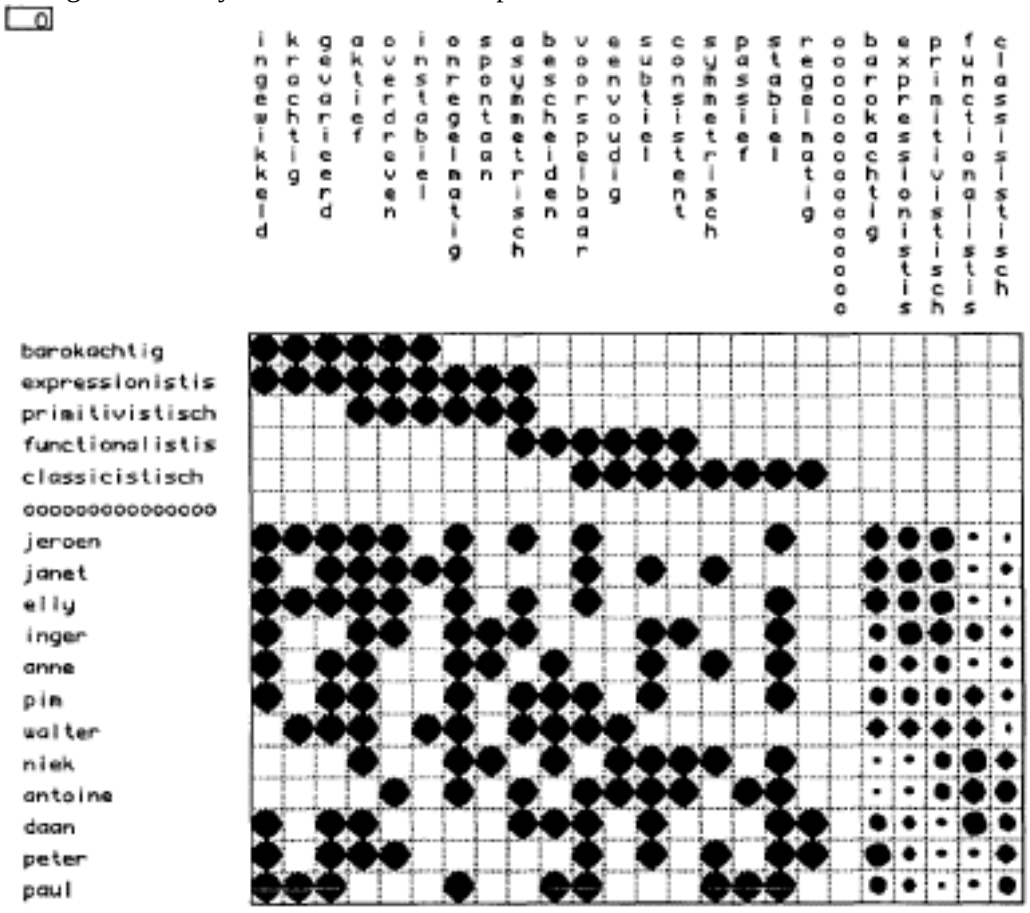

Figure 7. A graphical representation of the results by MAT. In the first 5 rows each object style as distinguished by Dondis (1973) is represented in terms of there (dichotomous) values on the features in the column headings. In the last 5 columns the scores of the students on each object style is graphical represented on a 16 point scale.

Specialisation or Generalisation?

As discussed before, knowledge about object and subject styles can be used in adjusting the design curriculum for each individual student. The question however is, how is this knowledge used? Should the student be encouraged to elaborate on his strong points? Or should he be encouraged to elaborate and pay special attention on his weak points? We think that this should be decided in close consultation with the teacher. For adjusting the curriculum to the individual or sub-group preferences of the students might develop an interesting specialisation, but could also result in a neglecting of other important aspects of the design process. A complete generalisation of the curriculum however might ignore the individual preferences too much. It is therefore suggested that specialisation of a preferred style is allowed as long as it doesn't interfere with the successful execution of the overall design project.

The Implementation Environment

As implementation environment we used Authorware Professional (1989). This enabled us to implement a design evaluation and documentation environment that can easily be adjusted in the future. Because of its transparent object oriented implementation approach it is easy to understand and maintain. The application allows students to retrieve knowledge about their object and subject style. It permits students to run another computer application and store all activities in the data bank. It can give immediate feedback of the process and product using the log file and the analysis protocol.

Conditions for Success

We can distinguish at least three types of conditions for success: empirical, technical and cultural conditions. As an empirical foundation of the subject and object styles we used the research results of a PhD. study by van Bakel (due 1994) and a study by Dondis (1973) respectively. It is not the focus of this paper to discuss them here in detail. One of the main technical conditions for success is a large storage capacity, if all the material produced during the design process is imported in the application by means of scanned hard copy drawings, photographs and the usual computer files for text and drawings. We are convinced though, that in the near future machines will be available for a reasonable amount of money that use a graphical user interface with high compression techniques without delaying the processing of the information too severely. From a cultural point of view a user friendly interface is also a major requirement for the application. Because conventional media can be imported by scanning, no restrictions are introduced for the use of tools preferred by the student. With such a demand oriented approach, the honest conclusion can sometimes be that there is no adequate CAAD environment for a certain student. In the short term this means using traditional means. In the long term this means other specifications for CAAD. But perhaps the most important cultural condition for success is that it be implemented by the teaching staff themselves.

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