It is undeniable that the computer has affected every aspect of our lives. Many people work with computers on a daily basis, from writing e-mail or simply browsing the internet to hours of serious modeling and drafting for those in the architecture field.

As we spend more time working with computers, research into improving computer teaching and working environments becomes more important. For those working in an architecture office, it almost certain that a major part of the day will be spent in front of a computer drafting. This research provides a preliminary set of guidelines that can be applied in the design of computer working/teaching environments.

The on-going research is focussed in creating facilities geared toward user comfort and productivity and improving teaching environments.

It covers issues regarding the position and orientation of the room, lighting aspect (including natural and artificial light), acoustics, user visual comfort, psychrometric conditions, furnishings, and the adaptability of the space for future changes. The project includes analysis of existing examples of computer-lecture rooms, noting the problems and suggesting improvements.

# The Design of Computer Teaching Environments

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Es innegable que las computadoras han afectado cada aspecto de nuestras vidas. Mucha gente trabaja con computadoras diariamente, desde escribiendo correspondencia electrónica o simplemente curioseando en el Internet hasta horas seriamente modelando y bosquejeando para aquellos en el campo de arquitectura.

Cuanto más tiempo pasamos trabajando con computadoras, investigaciones sobre como mejorar el ambiente de enseñanza y de trabajo con computadoras son mas importante. Para aquellos que trabajan en una oficina de arquitectura, es casi seguro que la mayor parte del día se la van a pasar bosquejeando frente una computadora.

Esta investigación proporciona un set preliminar de guías que pueden ser aplicadas al diseño del ambiente de trabajo/ enseñaza con computadoras.

Las contínuas investigaciones se enfocan en crear facilidades adaptadas hacia la comodidad y productividad del usuario y a mejorar el ambiente de enseñanza. Cubre puntos con respecto a la posición y orientación del salón, aspecto del alumbrado (incluyendo luces naturales y artificiales), acústicos, comodidad visual del usuario, condiciones psicométricas, muebles, y la adaptación del espacio para cambios futuro. El proyecto incluye análisis de ejemplos exisistentes de salones de lecturas para computación, notando los problemas y sugiriendo mejoramientos.

## Introduction

The size, and particularly the quantity, of computing teaching facilities in universities and other educational institutions has grown substantially with the introduction of the desktop computer. Often these facilities are inserted into existing spaces and treated much like an ordinary classroom. Because of differing patterns of use and methods of teaching, treatingcomputer teaching facilities as normal classrooms leads to a number of negative consequences and overlooked opportunities. While it is not always possible to develop new buildings or spaces for computer teaching facilities, recognizing the characteristics of these type of facilities may improve the selection of existing spaces, and the renovation of these spaces, to help create better learning environments.

*Fig.1 A typical computer teaching room on a university campus.*

While much has been written about the appropriate characteristics of classrooms, lecture halls, and studio spaces, there is not as yet a substantial body of research into appropriate architectural responses to computer teaching labs. Initial surveys of educations institutions have shown that new teaching labs are often placed in existing classroom spaces. Characteristically they are placed in windowless basements or in the center of large floor plate buildings to avoid the issue of reflected natural light on monitor screens. Little attention seems to be paid to important architectural issues including the configuration of the space, the selection of materials, and even the location of doors and windows.

The goal of this research is to develop a checklist to be used by designers and teaching lab managers to help with the design of new and renovated spaces for computer teaching facilities.

## Method

The strategy for the development of the checklist includes developing a set of issues through observation and survey, structuring the issues and creating a draft checklist, interviewing each of the user groups, establishing a set of experiments for individual issues to objectify value judgments, and finally testing the checklist through comparitive evaluations of an existing computer teaching facility both before and after modifying the facility to fall within the recommended guidelines.

For the observation and survey, we selected a set of computer teaching facilities on the campus of the University of Southern California. The labs varied by location, purpose, and architectural characteristics, but were reasonably consistent in the use of furnishings and equipment. By both observing tha use of the facilities, and interviewing the users of the facility, we collected a large number of issues that were deemed important to the design of the space. Because our subjects were not knowledgeable about the field of architecture specifically, the range of issues described often extended well beyond the normal professional boundaries usually ascribed to the profession. During this interview process, we deliberately sought out a wide variety of user group types, including students, faculty, staff, and administration.

*Fig.2 A large computer user lab.*

The issues collected were then sorted into rough categories by the type of expertise that would be likely to know about possible resolutions. The structuring proved to be the most challenging task of the research thus far, and it still falls short of satisfactory.

We are currently in the process of establishing individual guidelines for each of the issues, and we hope to carry out our first comparitive analysis in the fall of 1998.

**The checklist**

A few examples of the topic categories are listed below, along with sample individual issues. The focus of our explorations is on architectural resolutions, the kinds of items that an architect can help with. Most, if not all, of the issues raised can have multiple alternative strategies for resolution. For example, the negative effects of fan noise from CPU units may be diminished using architectural resolutions, such as acoustical treatments, but they may also be resolved by choosing quieter equipment in the first place, or by choosing apropriate furnishings, etc.

**Shape**

Room height:
appropriate to be able to see the entire projected image (possibly looking over a monitor)

Distance from projected image:
a proportion based on visual accuity and the size of the image)

**Natural lighting**

Dark adaptation:
Provide transition spaces for at least brief daylight adaptation

Contrast and glare:
1:3 maximum contrast between screen and background

Insolation:
Direct daylight does not hit computing equipment, causing local overheating and UV breakdoan of plastic housings.

Annual and diurnal illumination analysis:
Check lighting levels throughout the space, consider light shelves for directing light deeper

The psychology of daylight and natural rhythms:
Provide access to circadian rhythm reinforcement

Light wash from entrance doors:
Locate entrance doors to side and back (theater style)- avoid wash of light during presentations

**Artificial lighting**

Task lighting:
Individual control
Contrast ratios between monitor and background

Lamp color temperature:
Consider warm lamps when choosing fluorescent

**Acoustics**

Equipment noise:
CPUS not on desk top - to avoid fan noise
projector fan noise
select equipment wisely - fan noise
Mask or block outside noise
Lecturer acoustic reinforcement

**Furnishings and equipment**

Work area (while this checklist is not directly concerned with furnishings, their size influences the shape and layout of the room):
desk area size - prof hedge 28x36 and 27 high
place for personal belongings to keep aisles clear
dark aisles and instructors moving through the crowd

**Aisles and circulation:**

disabled access

**Analysis of existing conditions in an example teaching lab**

Sample Evaluation of Leavey Library, Learning Room B

*Flg. 3: Leavey Library, Learning Room B*

The room uses a combination of localized incandescent spot light fixtures directed towards the whiteboards, and fluorescent uplightings for general ligthing of the room. The provision of several set of lights enables the room to be dimmed to allow students to see the whiteboards, while preventing glare and contrasts when the uplights are on. The entrance into the room is on the side of the room in the back.

The room has too much fan noise. For better speech transmission, it uses a amplified speaker system. The door is exceptionally loud.

The desk space is less than 28" deep and 36" wide. The desk space seems to be a little tight. It has enough space behind the desk for a person to pass by comfortably with a person sitting down. The aisle arrangements comply with the Americans with Disability Act (ADA) . The chairs are comfortable for extended seating, and they also adjustable in different heights. The desk spaces are cluttered with the placements of CPUs on the desks.

The instructor does not have the satisfactory control of the room. The light switches for the room are located in the back of the room away from the instructor. The control for the projector is also hidden. The room has a teaching lecturn that holds the major teaching equipment. Complaints from the instructors include that the counter does not have a task light for dimmed lighting condition, there is a lack of desk space, and no storage space. Visual contacts with the students are poor due to the monitors. The room has a digital projector that allows the students to be able to visually follow instructions. It also has a VCR that enables the instructor to convey recorded instructions. The room has a row of whiteboards that are plenty for notes and instructions to be left on the boards. The aisles are wide enough for the instructor to pass by to help students.

The chairs are adjustable in heights and comfortable. There are no task lights. The CPUs are obstructive in the view towards the projector screen and the instructor. The view angle towards the screen is within 45°, which is comfortable for viewing. The room is rectangular and has level floor.

The room has suspended ceiling for the HVAC and lighting system. The computer and electrical cabling are integrated with the floor. The HVAC outlets have diffusers that prevent direct output onto a person. The complaints from the setup and maintenance technician are the lack of computer cabling outlets that restrict the flexibility of the room. The room has more than two computer stations connected to each circuit outlet. When one or more of the circuits break down, it affects several computer stations. The teaching lecturn was not properly designed to allow access to maintenance, upgrade, connection of extra peripherals, and to accept different platforms and configurations of computers with enough audio and video outlets. The layout of the room allows easy maintenance.

There are no built-in shelves for storing the students belongings. Bags are usually scattered on the floor. The room also lacks a place to temporarily store wet umbrellas. The room has a restroom facility nearby and there is a drinking fountain outside. The placement of peripherals and the storage of materials are easily accessible in the room. There is a nearby storage facility for janitorial supply. It has some seating arrangements that allows students to wait for class transitions.

## Conclusion

We are continuing to develop the checklist. The next phase of the project will involve evaluating an existing space, amking changes in reponse to the checklist, and reevaluating. We will also be asking each of the primary user groups to provide before and after evaluations of several of the conditions.

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