DRAFT

The University of West Florida

eClassroom Standards

Revised March 2004
INTRODUCTION

This document has been developed to establish standards and design guidelines for high-tech (eClassroom) facilities at the University of West Florida. The considerations included in this document are provided as guidelines; they are neither static nor all-inclusive. These guidelines will need to be adjusted and adapted to specific applications and modified to fit specific projects early in the planning process. These guidelines will also be considered when retrofitting or upgrading existing classroom spaces.

This document is subject to review and modification when appropriate. Changes should be made regularly to address significant changes in available classroom technology and trends within the educational environment. At a minimum, this document will be reviewed once every 6 months to ensure it reflects current and up-to-date standards for eClassrooms.

INFORMATION TECHNOLOGY SERVICES (ITS) SUPPORT RESPONSIBILITIES

ITS supports the following University generally scheduled eClassroom types (see attachment for specified equipment):
- A/V Classrooms
- Small eClassrooms
- Large eClassrooms
- Interactive Distance Learning Studios (IDLS)

ITS will support Collegiate eClassrooms (classrooms scheduled by a College and not the Registrar) under the terms of a special service level agreement established between the College and ITS, except for the provision of network or cable television services to the facility.

ITS has no support personnel located at the Fort Walton Beach campus; A/V classrooms and eClassrooms are supported by local technology staff. Support of the Interactive Distance Learning Studios is accomplished by collaboration between the Academic Technology Center and the ITS Academic Infrastructure Services team.

Services provided for eClassrooms:

Planning and Consulting Services
Planning and consulting services involve participating in projects to build new eClassroom facilities; renovate and equip existing non-technology classroom facilities with classroom technology; or enact major upgrades to existing eClassrooms. The role of ITS in these services is to serve as the specialists on information technology and IT infrastructure issues. It is imperative that ITS be involved in all phases of these projects. Proper planning for technology at the onset of a project will avoid costly mistakes and oversights later on.

Installation and Upgrade Services
When a classroom technology project moves from the planning to the execution stage, ITS handles the provisioning of IT infrastructure services and the ordering and installation
of classroom technology equipment going into the classroom facility, working within the
parameters of the budget defined for the project and adhering to established standards
for eClassrooms.

Maintenance and Repair Services
For existing eClassroom facilities within the scope of services, ITS maintains the
equipment and infrastructure in the eClassroom and performs repairs and replacements
as necessary. Preventative maintenance is also performed on equipment in all
eClassrooms to minimize equipment failures and malfunctions.

Instructor Support Services
ITS provides a variety of services to instructors using eClassrooms, including training in
the use of equipment in the eClassroom and problem-response services, provided via the
ITS Help Desk.

Interactive Distance Learning Studios
ITS manages and schedules facilitators for the Interactive Distance Learning Studios.
IDLS support is accomplished by collaboration between the Academic Technology
Center and the ITS Academic Infrastructure Services team. ITS Academic Infrastructure
Services provides training to facilitators and instructors on the use of classroom
equipment only. Pedagogical and instructional support are provided by the Academic
Technology Center.
General Concepts

These key points should be kept in mind when designing and implementing high-tech classrooms:

- Technology in eClassrooms is intended to serve a broad range of academic users with general purpose systems.
- Installed technology should not interfere with non-technology uses of the room.
- Classroom technology systems should be fully operable by any faculty member (who has completed training in their use) without the assistance of an AV technician or engineer.
- Technology design should be closely coordinated with design of lighting and mechanical systems.
- Installations should provide easy access to equipment for maintenance and flexibility to change equipment over time.
- Controls for operation of the technology equipment should be centrally located as much as possible to allow for intuitive and straightforward operation by the faculty member.
- eClassrooms should be standardized to the greatest extent possible, with considerations being made for existing viable equipment, with the goal of having the equipment in each eClassroom operate in the same manner.
- Manufacturers of equipment should be standardized to the greatest extent possible. This document does not address the specific vendors and models to be used, but rather the requirements for each component. A separate attachment, containing the standards for specific makes and models of equipment, is provided and updated regularly, as new models and features are introduced.
- A regular schedule for refreshing and updating the technology in eClassrooms will be established to maximize the use and viability of all eClassrooms for the future.

Classroom Shape and Orientation

- Industry publications and literature suggest there are preferred shapes for classrooms:
  - Faculty tend to prefer a rectangular shaped room;
  - An ideal room dimension ratio is 1.0 (height) to 1.5 (width) to 2.5 (length);
  - The length of the room should not exceed its width by more than 50%; for example, if a room had a width of 40 feet, the length (depth) of the room should be 20 feet or less;
- Classrooms should be designed with a landscape, rather than a portrait, orientation. Faculty tend to request a “wide and shallow” rather than a “long and skinny” orientation in order to keep the instructor closer to the students and provide a larger presentation area.
Presentation Space

- The main presentation wall should be at the front of the room, on the opposite side of the entrance area, to minimize interruptions and traffic for the instructor.
- Classrooms and lecture halls will also continue to be used for traditional instruction. The front center of the room (presentation wall) needs to accommodate whiteboards, an overhead projector, projection screen(s), and walking space for the instructor.

Doors

- Vision panels should be installed in or near doors to allow observation to see whether the classroom is in use. Panels should be narrow to reduce spillage of light from outside the classroom.
- Guidelines for doorways:
  - Doors should be located in the back of the classroom in order to minimize disruption from late arrivals;
  - Doors shall be 2” thick, sound-rated, solid-core to prevent noise from entering the room.

Ceilings

- A minimum 9-foot ceiling height shall be utilized for rooms with less than 25 people. For rooms with a capacity of 26-50 persons, a minimum ceiling height of 10 feet shall be used.
- Soffits should be avoided; they can cause unwanted acoustical reflections.
- Solid ceilings must have access hatches installed to facilitate access to the ceiling cavity.

Acoustics

- All classroom facilities must have appropriate acoustical treatment and materials so as to absorb all echoes and reverberation that would impact on audio intelligibility. An individual with the qualifications of a certified Acoustical Engineer who has with experience designing similar facilities should be included as part of the design team.
- Acoustical treatment should address the twin concerns of hearing the presenter more easily and containing the room sound so it does not bother nearby classrooms and offices. Appropriate "voice friendly" acoustical treatment permits faculty to teach without sound reinforcement, except in the largest classrooms (100-plus students). To hear the presenter more clearly, attempt to lower sound reverberation in the room to .7 seconds. Carpeting, acoustical ceiling treatment, sound absorption panels on the back wall and sound absorbing fabric below chair rails help minimize unwanted noise in the classroom.
Lighting

- Lighting control is critical. Adequate light is needed for student note-taking. Sufficient light is needed at the multimedia console and on the whiteboards. All light fixtures must be located and controlled to minimize washing out the image on the projection screen.

- Because all classrooms, meeting rooms, and auditoria will utilize some type of projection or display device, all facilities require appropriate lighting and lighting control systems so as not to interfere with projected images. All lighting must be controlled:
  - To eliminate or minimize light spillage on the projection screen;
  - During projection, switched lighting systems should be designed so that the rear 2/3 of the room has sufficient light for note-taking while the front 1/3 is without light that might spill onto the screen.

- To achieve these requirements, switched lighting systems should be zoned in rows positioned parallel to the screen (i.e. side-to-side across the width of the room) rather than perpendicular to the screen (i.e. from the front-to-back of the room). Multiple controls shall allow, at minimum, that lights are switched-off near the screen, with other lights remaining on away from the screen.

- All lighting switches and controls must be located adjacent to the multimedia console as well as each doorway. The switching of the lighting system shall be designed to include low-voltage interfacing with an external audiovisual control system, such as AMX.

- Light from outside the room needs to be controlled. Vision panels in doors should be narrow to reduce spillage of light from the hallway.

- All classrooms must have a minimum of two lighting zones: one zone for the instructor at the multimedia console, and another zone for the student area. Ideally, the student zone should have the capability of multiple light levels. Each zone shall be independently controllable via its own separate switch.

- Large classrooms, such as lecture halls, must have a minimum of three zones: the two zones above plus a zone for the presentation/whiteboard area. This zone should be dimmable, with incandescent lighting preferred.

- In addition to general room lighting, other systems may be required, including a ceiling-mounted track light System above and in front of each teaching station. Such systems will primarily be used to provide appropriate lighting for a document camera. This lighting can also provide general lighting for the area.

- In studio classrooms and computer labs, lighting must be designed to minimize glare on computer screens. Indirect lighting fixtures are ideal for computer environments. If indirect lighting is not used, fluorescent light fixtures should include 3", 1.5", or .5" cells parabolic diffusers to minimize glare on computer screens.

- In auditoria, master control units (e.g. a LUTRON's Grafik Eye system) shall be provided. These master control units must include multiple zones and presets plus be provided with an RS-232 AV Interface for connection to a control system. The AV Interface must provide appropriate bi-directional RS-232 feedback status back to the control system.

- In auditoria, a pipe grid with individually controlled theatrical lighting units is recommended to provide:
Overall stage wash;
- General lighting of the multimedia console area; and
- Specific lighting for special events.

Lighting Interface and Control

- Although the traditional method of light control has been to provide 3-way wall switches in the appropriate locations, it was also the tradition, due to the limitation of projection technology, to significantly darken the room during projection. A darkened room limits interaction and student attention. Modern classrooms can take advantage of several advances in lighting technology, combined with higher lumen output from projectors, to adapt lighting to multiple purposes (i.e. discussion, exams, multimedia projection, ITV Distance Learning):
  - Low-voltage control switches can provide wired, wireless, or RS-232 control of zoned lighting systems, both incandescent and fluorescent fixtures.
  - Fluorescent dimming – electronic fluorescent dimming ballasts provide flexible, reliable, and cost-effective control of standard drop-in ceiling fixtures.
- Lighting control systems allow faculty to create personal light settings or recall preset scenes. Such systems can easily be interfaced with manufacturer or third-party control systems. Such systems can also be integrated into a campus-wide energy management system.

Window Coverings

- Reducing and controlling daylight coming into classrooms is always identified as major concern for classroom design.
- Sunlight shining into the room can wash out projection images; window coverings are imperative. Blinds, room darkening shades and/or drapes need to cover all windows to control light and assure that glare from windows does not interfere with computer screens, TV screen or projection screen(s).
- All window treatments shall be capable of controlling and eliminating all outside light.
- Ideally, each window should have two window coverings, one totally opaque and another that is transparent, to provide a range of light control.
- Motorized window shading systems must be capable of control by multimedia systems (e.g. AMX) and/or easily controlled from switches located near the multimedia console.

Safety Lighting

- As a safety feature, it is desirable to have a fixture or two at the rear of the room, unswitched, which remains on at all times, so that the room is never totally dark. Such unswitched fixtures must be positioned as required by code, but without spilling light onto the screen or interfering with projected images.
HVAC

- Placement of HVAC vents must be planned so as not to co-exist in the same location as ceiling-mounted projection equipment and document cameras. Vents must be located away from projection screens, so as not to create air circulation currents that might move the screen.

Electrical

- Audiovisual and multimedia systems require clean, high quality electrical power to operate correctly and reliably. Dedicated electric circuits are required for the video projector and computer electrical outlets.
- A true isolation transformer is recommended, specifically designed for technical system power.
- All circuits for the system shall be taken from the same phase.
- All audio, video and control electrical circuits should be fed from "clean" legs of the transformer free of high inductive loads. There shall be no elevator motors, compressor motors, blower motors, etc. on the side of the power transformer that feeds the media equipment.
- Audiovisual and multimedia equipment require standard 110VAC electrical outlets in specific locations:
  - All classrooms must have at least a single floor-mounted electrical outlet located approximately 8 feet off the center of the screen wall to allow for plug-in of an overhead transparency projector;
  - All eClassrooms must have a floor-mounted duplex outlet in an appropriate location under the instructor podium;
  - All eClassrooms must have a ceiling-mounted outlet a distance of approximately 2.2 times the screen width off the center of the screen wall to allow for plug-in of a ceiling-mounted data/video projector;
  - A duplex electrical outlet should be located on the instructor podium to provide power for the laptop computers.

Network Connectivity

- All eClassrooms require connectivity to outside resources. Network connections enable accessibility to and real-time interaction with resources such as distant computers, databases, banks of stored information, via local networks and the Internet.
- Network connections in all eClassrooms will be run using Category 6 twisted pair cabling, also the UWF standard for all networking.
- Classroom facilities are to be designed with appropriate wired network connections available:
  - 2 data (Ethernet) ports must be provided in the ceiling, to accommodate network-capable projection devices.
Conduit, Cabling, and Floor Boxes

- All eClassrooms will be designed to accommodate a teaching console (instructor podium) to function as base station for faculty or presenters lecturing and/or using instructional technology. This podium will house equipment and therefore must be provided with connectivity and electrical power. The podium will be located to the side of the screen, without obstructing the view of the screen.

- Multi-purpose conduit and connections must be provided under each podium. Each in-floor location must include at minimum:
  - A duplex 110-VAC electrical outlet;
  - Category 6 communication wiring for network connectivity (4 ports);
  - Empty continuous conduit running from the podium to the wall, then up inside the wall to an over-the-ceiling stub-out;
  - A connection to the campus CATV system.

- Such conduit and connections can be provided cost-effectively as stub-ups, or be recessed at the floor level within commercially manufactured floor boxes.

- Separate continuous non-metallic conduit must be provided during construction including:
  - One 1.5-inch or two 1-inch empty conduits from the podium location to a stub-out above the ceiling. This conduit is to be installed during construction with a pull-tape accessible from both ends. This empty conduit will accommodate various audio, video, signal, and control cables to be installed after construction by the designated audiovisual contractor;
  - One 1-inch conduit complete with all required Cat6 cabling which is connected to the Telecom equipment room;
  - One ¾-inch conduit complete for electrical.

- All conduit direction changes must be completed with gradual “sweeps”, not 90-degree bends.

- To meet code, an approved fire-stop material may be required at floor and wall penetrations.
Instructor Teaching Station (Podium)

- The teaching workstation is an essential component in each room. This workstation or "teaching station" is a specially designed presentation console (podium) that serves as the central control point for all of the system's operational functions. It houses the system control interface, has room to accommodate a computer system or thin client, and offers multiple connecting points for the output of both computer and composite video devices.

- The following equipment is to be housed (and installed in such a way to deter theft) in/on the instructor podium:
  - Audio amplifier;
  - VCR/DVD Combo Unit;
  - Digital Document Camera;
  - Multimedia Control Unit;
  - Touch Panel Control Interface.

- Additionally, the following optional equipment may be included in the podium:
  - Computer or thin client;
  - Wireless microphone system.

- The instructor podium should have a work space on the top to accommodate the instructor laptop as well as notes, books, or other necessary instructional materials needed by the instructor.

- The podium is to be placed on the right or left front edge of the room, facing the students. Location must not interfere with doorways or traffic, or, most importantly, viewing the screen or whiteboards. Faculty will find it is desirable to face students when using a computer in a classroom. They don't want a massive desk/console barrier between them and their students. An instructor podium should be is 39" high.

- The podium will require floor boxes with appropriate electrical, CATV, and telecommunication connections, as well as cable paths and conduit to other locations.

- Podiums in eClassrooms must be appropriate to the size of the room and the technology components to be included in the room.

- The podiums to be included in each eClassroom will conform to the standards as established by the UPC-IT Committee, indicated on the attachment to this document.

- Switching and control for the eClassroom is to be mounted on or near the podium.

- Instructor-accessible connections (such as laptop connections, including power, VGA, video, audio, and network) are to be positioned in a convenient, easily accessible location on the podium so as to minimize wiring clutter.

- Components, such as VCR, DVD Player, amplifier, etc. are to be positioned in a location that minimizes the amount of bending down or kneeling required by the instructor to operate these components.
• For new construction projects, conduit for all A/V connections which terminate at the 
podium must be run in the floor at time of construction, prior to slabs being poured, to 
eliminate wall plates being added after the fact.

• For existing projects, wiring runs for all A/V connections which terminate at the podium 
must be run in such a way as to minimize wiring clutter in the room. Carpet tunnels or 
similar solutions are to be used.

Screens

• All eClassrooms require appropriate projection screens.

• Screen formats today (video format) are rectangular, in a 3 units high x 4 units wide ratio. 
A new 30% wider ratio of 3 x 5.3 (9 x 16) for DVD and HDTV will be necessary in the future as these technologies become more mainstream.

• Screens should be wall-mounted near the ceiling to minimize installation costs (recessed screens are significantly more costly than wall-mounted screens. Wall-mounted screens will also permit easy screen exchange in the future if wider proportions become standard.

• It is important to coordinate the distance the screen is mounted away from the wall to avoid touching the whiteboard or its eraser tray.

• Screen size and positioning must be appropriate to the room. Fit the screen to the size of the audience and the distance from the furthest seat.
  o The width of the screen (and the image width) should be no less than one-fourth the distance from the screen to the last row of seats;
  o The front row of seats should be not any closer than 1.5 times the image width (2 times is ideal);
  o The screen must be mounted high enough for the students in the back of the classroom to see the bottom of the screen; typical installations are 4 feet above the floor.

• The top of the screen should be no greater than 35° from horizontal from any seating position (screen size requirements and clearance from floor may compromise angle for the first 1 or 2 rows).

• Screens are to be mounted away from windows, doors, light switches and other controls.

• The minimum screen size is determined using a formula where the height of a video-format screen for any room is at least one-fifth (1/5) as high as the distance from the screen to the last row of seating. (e.g. in a classroom where the last row of seats is 30 feet from the screen, the screen would need to be 6-foot high by 8-foot wide.) The appropriate screen size, coupled with proper screen placement dictates minimum ceiling height.

• In ideal situations, the viewing angle should be about 90 degrees. To assure that those seated at the front sides of any room be able to properly see a projected image, a maximum viewing angle should not exceed 110 degrees. Care should also be taken to assure that there are no obstructions (i.e. columns, podium, furniture, etc.) between any seat and the screen.
• Screens should be mounted such that the entire image is visible from all seats in the room. Multiple screens, for simultaneous projection in a classroom, provide more flexibility than one screen.

• Screens are typically front projection with high-gain, reflective surface.

• Electric screens are preferred in all eClassrooms. They allow the instructor to control them using the integrated control system and are not subject to the possible damage of manual screens, caused by pulling them down and releasing them improperly.

• Screen controls must be located near the instructor podium, preferably on a wall perpendicular to the presentation wall and convenient to the instructor.

• Electric screens are to be wired in order to be controllable by a multimedia control system.

• At minimum, a typical classroom is supplied with a video-format screen (i.e. one with a height-to-width ratio of 3 to 4); however, traditional classrooms may require a square-format screen (i.e. one with a height-to-width-ratio of 1 to 1) to accommodate projection of either vertical or horizontal overhead transparencies.

Data and Video Projectors

• All eClassrooms require video projection systems.

• Projectors should provide the best possible image quality for composite video, RGB, computer, or other digital and analog sources. (Motion video should be free of blurring and artifacts. Text should be readable throughout the room.)

• Multimedia projectors are to be permanently mounted in the ceiling.

• Security devices are to be installed on all projectors to deter theft.

• Calculate 2.2 times the width of the screen to approximate the distance between the screen and the lens of the video projector (special order short-throw and long-throw lens can also be used.

• Today, LCD (Liquid Crystal Display) projectors are the most common and cost-effective. Although currently more costly and without the range of choices as LCD projectors, DLP (Digital Light Processing) projectors seem to do a better job of displaying display video sources. Each year, the choices of DLP projectors are increasing and prices are coming down.

• Projector resolution must be a minimum of XGA (1024x768).

• Projector brightness is measured in ANSI lumens. Output from projectors must be bright enough to see without having to dim the lighting in the room to a great extent.
  
  o For small eClassrooms (capacity of up to 44 students), projectors must have a minimum output of 3,000 ANSI lumens.

  o For large eClassrooms (capacity of 45 or more students), projectors must have a minimum output of 4,500 ANSI lumens.
• Projectors must have multiple video inputs, including VGA, DVI, and composite. Other inputs, such as component video and S-Video, are desirable.
• Network connectivity (Ethernet connection) must be available at the mounting point of each projector to ensure the projector can be connected to the network and monitored by Projector Gold, the University’s system for projector statusing and security.
• All projectors installed must be capable of being controlled (via RS-232) by a multimedia control system (such as AMX).

Document Camera
• Document cameras allow a presenter to display a 3D object, a photograph, a sheet of paper or any simple text document on a large screen. A document camera allows all students to have a “front-row seat”. The document camera requires an appropriate surface as its “target area” on top of the Multimedia Console.
• Document cameras to be installed in eClassrooms will be digital, using a VGA or XGA interface. The image quality of a digital document camera is far superior to that of an analog unit.
• Considerations should be made for removing the overhead projector from the eClassroom equipment list as instructors become more comfortable and proficient with the digital document camera.
• The document camera will be capable of being controlled by a multimedia control system.

DVD/VCR Combination Unit
• All instructor podiums will include a VCR/DVD combination unit permanently secured in each Console. The VCR can be also used as a CCTV/CATV tuner, making the VCR the receiver for cable TV programs.
• The DVD/VCR combo unit will be capable of being controlled by a multimedia control system.

Computers
• An eClassroom typically has a connection for a laptop computer. Specific rooms may have a permanently installed desktop computer or a thin client.
• Each computer should be networked to a local area network and to the Internet.
• With the connection for a laptop computer, faculty bring in a laptop computer, already loaded with the necessary configurations, applications, files, and appropriate cards or adapters to access still and moving images via the classrooms’ network connection. There is a VGA connection at the podium for the laptop, in addition to a stereo audio connection and an AC power outlet.
• Unique features of using a user-supplied laptop computer include:
Presentations require little set-up in the classroom;
- Laptop computers are powerful, user-friendly, non-intimidating hardware with choice of platform;
- Faculty using laptop computers are self-sufficient, so staffing costs are minimized;
- Connecting a laptop computer is simple as one cable connects the laptop at the Multimedia Console to the ceiling-mounted projector in the classroom;
- With a data port located on the outside of the Multimedia Console, connectivity is provided to network resources and the Internet.

**Multimedia Control System**

- A control system simplifies the use of a high-tech classroom and eliminates using multiple remote controls for each component. System control is made available to the instructor via touch panel technology which simplifies the operation of the entire system by offering an intuitive, visually-based, control panel for the presenter. The touch panel is designed to greatly reduce the complexity of system control which allows the user to concentrate the presentation instead of being distracted by a series of complex equipment control functions.
- Fixed LCD touch-panels are preferred for security reasons.
- Control systems should have the capability of controlling all aspects of an eClassroom, including lighting level, screen(s), video and audio inputs, and component power. The systems should also allow for remote monitoring and management of an eClassroom.
- Labeling and layout of control systems must be intuitive and consistent across all eClassrooms.
- Simplicity is the key; the number of remote controls/buttons required to operate the system is to be kept at a minimum. Remote controls tend to be lost during the course of a semester and should only be used as secondary control devices in the event that the primary control system fails.
- The multimedia control system can also be used by the instructor to contact Classroom Technology support personnel if they encounter any problems using the equipment in the room. The panel becomes an instant messaging console where text conversation can occur in real time. The support personnel can interact with the user, remotely control the equipment, and also go to the room if necessary.
- This control system can also be used for scheduling use of certain equipment, remote monitoring and control, preventative maintenance scheduling and recordkeeping, and inventory control.

**Microphone, Audio, and Amplification Systems**

- Installation of microphone systems is based on size of room, acoustics, and the need for recording or external transmission of audio. Typically, rooms seating more than 60 students should be provided with microphone systems.
• Wireless microphones should be provided, with some variety of wired backup (a fixed podium microphone, for example).

• Microphone audio works best when extended out across ceiling speakers. Speakers for microphone audio should be separate from speakers for program audio.

• Program audio amplification is typically required in any room with computer and video projection. Power, size and number of speakers depend largely on the size and acoustics of the space.

• Mono or stereo front-mounted speakers for program audio should be rated to accommodate 1.25 times the rated amplifier driving them.

• Audio systems will be compatible with the multimedia control system to be installed in the eClassrooms.

**Americans With Disabilities Act (ADA)**

• The ADA, enacted in 1990, prohibits discrimination against persons with physical and mental disabilities. Title II of the ADA states that public institutions can choose to follow either UFAS (Uniform Federal Accessibility Standards) or the ADAAG (Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities) standards. The goal for classroom designers is to keep in mind that appropriately designed facilities to facilitate persons with mobility, hearing, vision, and mental disabilities is not just important, it is mandated by Law.

• Mobility Impairments
  
  o Set aside 2% of classroom seating for wheelchairs. While fixed tables are normally 29” high, 31” clearance above floor is needed for wheelchair access. Locate and design the instructor podium, including the audiovisual controls, projection screens, and whiteboards, to be barrier free. A 60” diameter is necessary for wheelchair turnaround.

  o Controls for technology devices in classrooms cannot be higher than 54” or lower than 9” above the floor and must accommodate a parallel approach by a person in a wheelchair. Ramps must not exceed one-foot rise in twelve feet of run (1:12 ratio).

• Hearing Impairments
  
  o For new construction, if classrooms accommodate at least 50 persons, or, if they have audio-amplification systems, and they have fixed seating, they must have a permanently installed assistive listening system. These systems often broadcast audio as an infrared or FM signals that can be picked up by listeners wearing special receivers and headsets or earphones.
Staff Support (Classroom Technology)

- A cadre of professionals is necessary to support high-tech classrooms. The equipment has to be designed, installed, cleaned, checked, maintained and, when necessary, replaced. The staff must have technical expertise, but more importantly they must have a customer-service orientation.

Continuous Improvement

- Staff must make sure that systems work appropriately, and the installed technologies are dependable. The design and support team must constantly strive to improve the reliability of technologies from the instructors' perspective. Even when complex electronic installations are working reasonably well, there are always improvements that can be implemented in the future.

Preventative Maintenance

- All hardware should be regularly inspected, tested and cleaned. A weekly check ensures that all equipment will appear professional and meet the operational requirements of the instructor. During the first week of the semester, e-mails outlining the capabilities of the equipment and the procedures for accessing media center hardware are sent to instructors who are scheduled to teach in the media-equipped classrooms.

Planned Upgrades and Replacements

- Following an initial capital investment, funding is needed for replacement lamps and periodically for equipment renewal and replacement. Continuing equipment replacement will cut the labor-intensive costs of repair and maintenance, permit the staff to devote more time to faculty than to hardware.

- Assuming funding is available, eClassrooms will have a four year technology replacement cycle.