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1-1-2007

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Carnicom, Scott; Watson Harris, K.; Draude, Barbara; McDaniel, Scott; and Mathis, Philip, "The Advanced Classroom Technology Laboratory: Cultivating Innovative Pedagogy" (2007). *Honors in Practice -- Online Archive.* Paper 51.
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The Advanced Classroom Technology Laboratory: Cultivating Innovative Pedagogy

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The National Collegiate Honors Council suggests in its "Basic Characteristics" that honors programs and colleges should be at the forefront of pedagogical innovation, serving as a "laboratory" for new approaches to teaching and learning (Schuman, 2006, p. 66). One approach to this charge is the integration of the latest technology into the classroom. Implementation of technology is important to millennial students, who are digital natives, never knowing a world without laptops or compact discs. Not only do students tend to be very comfortable with technology, but they also tend to be the early adopters. In addition to piquing student interest and curiosity, the use of the latest tools can increase engagement, encourage multimodal learning (visual, aural, etc.), permit learning opportunities outside the classroom, and promote technological literacy.

In 2004, Middle Tennessee State University's Honors College, which dates back to 1973, took up sole residence in the new state-of-the-art Paul W. Martin Sr. Honors building. The Honors building is a 21,000 square foot facility that includes several small (≤ 20 students) multipurpose seminar rooms and labs designed to promote student-centered learning. Each room is outfitted with a computer, projector, document camera, DVD player, and small touch screen device that controls each individual piece of equipment. In the spirit of continued innovation, the institution decided in 2005 to construct and test a new experimental learning space in the Honors building.

The goal of this project was to create a new type of classroom utilizing advanced technology in a way that could flexibly support a variety of teaching and learning styles. Rather than recreating a traditional computer lab with rows of students tethered to monitors and engaged in clandestine off-task activities (e.g. e-mailing or instant messaging), this room was to be open and student-centered, fostering discussion, collaborative learning, and critical thinking. Instead of forcing professors to tailor their approaches to the limitations of the room, the room provided a dynamic environment limited only by the instructors' own creativity. In other words, the goal was not to adopt technology for technology's sake but instead to provide technology that could easily augment effective

teaching and ultimately increase student learning. Finally, an innovative classroom of this kind serves as a proving ground, with successful strategies stimulating change throughout not only the honors community but also the entire university.

These goals were cooperatively created by several campus groups and also vetted through a team of external consultants. In the end, the lab, entitled the Advanced Classroom Technology Lab (ACT Lab), was designed to:

- encourage discussion, critical thinking, small-group collaboration, and problem-based learning;
- foster technological proficiency;
- flexibly adapt and appeal to various learning styles and pedagogical approaches;
- be easy and intuitive for faculty and students to learn, adopt, and master; and
- serve as a testing facility for new teaching styles and new equipment for possible campus-wide adoption.

Planning for the ACT Lab began in 2005, and construction and installation were completed by mid-August 2006. The cost of the project including consultation, room renovation, equipment purchase, and installation totaled approximately $280,000, jointly funded by the Office of Academic Affairs, the Information Technology Division, and the Honors College. While certainly a major investment, this plan was viewed as a prudent expenditure that paled in comparison to the potential price of blindly adopting unproven technology across the campus.

The ACT Lab measures 24′ x 29′ and is designed for smaller classes (see Figure 1). Traditional computer labs contain long rows of desks with individual student workstations, which are restrictive in their layout and isolate students, making collaborative learning difficult. The ACT Lab contains seventeen upholstered tablet chairs (fourteen right-handed and three left-handed) on castors, allowing for portability and flexibility of configuration. The chairs also contain small storage areas under the seat for books and bags. The open design of the classroom and its furniture also allows the teacher to freely circulate, creating more opportunities for interaction.

This flexibility is also supported by an 802.11g wireless router, allowing for internet access anywhere in the room. A small closet in the back of the room houses sixteen tablet laptop computers (IBM X41) with wireless networking capability, allowing students to work, retrieve data, and assemble in different areas of the room. Tablet computers also provide students the ability to input information using an included stylus; the stylus can be used to draft equations, create notes, or annotate documents on the screen of the laptop. To further support student collaboration, the ACT Lab uniquely contains four 42″ plasma monitors (NEC PX-42VP5A) mounted on the walls. Individual tablet computers can be plugged into each plasma display allowing data to be viewed within smaller groups. Small 2′ x 2′ tables are located under each plasma screen.

Figure 1. The ACT Lab

Similar to other classrooms in the Honors building, the ACT Lab has an instructor's computer linked to a central projector (NEC MT1075), which casts a six-feet-wide by five-feet-tall image on the front wall, painted flat white. This central projector is linked to a VCR (JVC HR-53902U), a DVD player (SONY DVP-NS55P), and a high resolution, 30 fps document camera (WolfVision VZ-9), allowing for the presentation of a variety of material. Sound can be projected through nine monaural in-ceiling speakers (JBL 26CT), complementing the multimedia experience. The instructor can also quickly and easily pull images from any of the individual plasma screens to the central projector for sharing with the entire class on the front wall.

Unlike other classrooms, the instructor's computer (IBM X41) sits on a cordless mobile lectern (PolyVision CL17) with its own battery supply capable of powering two devices simultaneously for up to nine hours. The lectern is topped with a fifteen-inch tablet display that also enables the instructor to annotate documents. Once integrated with the display, the computer's cursor can be controlled by the stylus or an included remote control from anywhere in the room. Wireless video transfer to the central projector, coupled with the battery supply, allows the lectern to be rolled anywhere in the lab, lending freedom to the professor. Using this setup, a professor could, for example, outline a topic, annotate slides from the mobile lectern tablet, show a video clip, focus small-group collaboration on a central problem, circulate around the classroom, and ultimately review and analyze group solutions presented to the entire class through the central projector.

Additionally, a ceiling mounted camera (Sony EVI D70) can pan and zoom to any location in the ACT Lab, sending real-time video across the room to the central projector. Video data can also be archived for transmission across the internet. A DVR (JVC SR-DVM70) allows for recording from the camera and six ceiling-mounted microphones (Shure MX202BP/C); playback is possible through the central projector. Any portion of a class session, including student presentations for example, can be recorded, shared, and reviewed. Six video iPods (60 GB) are also available to be lent to faculty to review class recordings or podcasts of course-related material.

Complementing this array of equipment is the Thunder Virtual Flipchart system, an enterprise collaboration tool that provides a digital hybrid between a traditional flipchart and an interactive whiteboard. The system consists of a self-standing easel supporting a fifty-inch flat-panel monitor that swivels between portrait and landscape orientations. A stylus can be used to digitally write or draw free-hand on the surface of the monitor. Using the same stylus, the user can choose different "ink" colors and line sizes plus erase any previous marks. Information can also be entered via a wireless keyboard.

Unlike a single interactive digital whiteboard, this system allows for the simultaneous projection of multiple flipchart pages by three additional ceiling-mounted projectors (NEC MT1075). When in landscape mode, three flipchart pages measuring six feet wide by five feet tall can be simultaneously projected onto the front wall, creating an overall image 18′ x 5′. Portrait mode offers six 3′ x 5′ images, visually surrounding the class with content. In addition to displaying handwritten class notes, information from any of the audiovisual sources can be pasted into the flipchart pages allowing for integration and annotation (see Figure 2). Additionally, input is available via a color scanner (HP 5590) that directly connects to the easel.

Using the stylus, the content and position of individual flipchart pages can be easily edited, rearranged, moved off the front wall, saved, and reopened in future classes. Class notes can also be quickly printed or emailed to students who, by downloading free software, can view them at any time outside of the lab. Notes and video can also be shared in real time with another Thunder-enabled classroom. This setup has the potential to free students from slavish note transcription. Thus, rather than racing to write copious notes of every class detail, students are able to think, talk, synthesize, and create marginalia of higher order concepts, moving the learning experience further away from passive memorization and regurgitation to proactive participation, critical thinking, and scholarly discovery.

The instructor can easily control the entire room, including all of the audiovisual components, the projectors, the lights, and even the window shades by means of a ten-inch Crestron (TPS-4000) touch pad (see Figure 3). This integrated interface allows new users to control each piece of equipment intuitively with minimal steps. After about five minutes of training, novices are able to switch quickly and seamlessly between all of the audiovisual sources. The system is also flexible enough to allow the display of the instructor's computer,

VCR, DVD, or document camera while simultaneously projecting flipchart pages from the Thunder system. All of the equipment is integrated using a custom-configured server (PolyVision) running Windows XP. The server, which is housed in the same closet as the tablet computers, manages the multiple video outputs and serial connections.

Figure 2. Flipchart pages projected onto the wall

The ACT Lab at MTSU is a unique classroom, generating a great deal of interest and suggesting that users might feel especially privileged and committed if given the opportunity to use it. Such interest may create great demand for the ACT Lab's use. Thus, a Room Wizard (PolyVision), located on the outside wall at the entrance to the ACT Lab, can be used to schedule and track the room's use. The Room Wizard contains a six-inch touch screen displaying room occupancy and availability. Scheduling can also be accessed and managed remotely via a dedicated webpage. Such advanced equipment, unfortunately, may also attract the attention of less studious and more nefarious individuals, so the room and storage closet are secured with card access locks while a hallway camera records traffic.

Despite the ACT Lab's relative ease of use, it was necessary to devote a full semester (fall 2006) to testing the equipment and hosting numerous open-houses and pilot classes for administrators, faculty members, students, and even benefactors (the lab was a featured site in a development event, demonstrating the institution's continued commitment to technical and most importantly, pedagogical advancements). Any innovation fails if it mystifies or malfunctions. Without proper training or smoothly operating equipment, students and faculty

could soon become frustrated and shy away from tapping into the full potential of this classroom. Overall, pilot users have confirmed the lab's intuitive setup and short learning curve. As expected, the training sessions have created great interest around the campus and in the community.

Figure 3. Crestron (TPS-4000) touch pad

Indeed, several faculty members wishing to teach courses in the ACT Lab in upcoming terms have already submitted proposals describing how the room's equipment will be used to meet student learning objectives. For example, an applied analytical chemistry course on pollution detection will use the room to remotely access online instrumentation resources. Students in a research methods course will collaboratively generate and analyze behavioral data using statistical software. Participants in an advanced genetics and bioinformatics course will research case studies using an online national database of genomic information and tools. Students will also use the room to engage jointly in computational modeling of DNA, RNA, and proteins, creating visual representations of ribosomal messenger RNA expression. While different in content, each course will pedagogically focus on active student engagement, discussion, and analysis, turning the classroom into a laboratory where new ideas (and scholars) are created.

Consistent with the goals stated above, the relative effectiveness of the lab will be gauged by quantitatively and qualitatively assessing student learning outcomes. While remaining on the cutting edge of technology provides

marketable opportunities for students, this lab is first and foremost a teaching tool meant to provide an adaptable, enriched, reliable learning environment. We hope that, like any traditional approach, this lab, with its boundless capabilities, will be an asset to good teachers, cultivating and optimizing student learning. Assessment by both teachers and students will help to determine which technologies to adopt more widely and which new technologies to add to the lab in the future.

ACKNOWLEDGEMENTS

Many thanks are owed to Sidney McPhee, Kaylene Gebert, Lucinda Lea, Steve Brooks, Ian Hutchinson, Lee Hicks, Spencer Holman, Greg Schmidt, and Becky Seipelt for assistance with this project.

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