

Redesign of a CADD Facility to Nurture Interactivity

by Robert Cobb, Jr., Arjun Kapur, Craig Rhodes, & Elinor Blackwell

Introduction

Teaching is the implementation of strategies to deliver and present information to stimulate behavior. Learning is an observable and measurable change in behaviors. Instruction is the creation of an environment allowing the application of skills, knowledge, and attitudes promoting positive behavioral changes. Opportunities in the classroom should simulate a mental and/or physical place in which the desired behaviors exist.

The design of effective instruction requires constant and consistent analysis, design, development, implementation, and evaluation of materials, activities, equipment, and environment. Room design influences the social context of the classes, student-instructor and student-student relations, instructional design options, and overall effectiveness of instructional technologies (Chism, 2002).

The learning environment plays an important role in enhancing the desired changes in behaviors that impact the learning process. Weinstein (1981) argues that learning is optimized only when the physical environment is treated with the same care as curricular materials and teacher preparation. Chism (2000) said room design influences the social context of the class, student-instructor and student-student relations, instructional design options, and overall effectiveness of instructional technology.

Drs. Robert Cobb, Jr., Arjun Kapur, Craig Rhodes and Ms. Elinor Blackwell felt the existing physical arrangement of the computer aided design and drafting (CADD) lab at North Carolina Agricultural and Technical State University (NC A&T SU; Greensboro, NC) was in need of a change to promote a more optimal learning environment. The layout of the facility impacts content, student, and instructor interactions; it was the authors' intent to eliminate problems related to visibility and network connectivity. It was the contention that redesigning the lab would have positive repercussions on the acquisition of skills, knowledge, and attitudes pertaining to solving problems relevant to design and drafting.

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The Initial Lab Arrangement

One of the CADD laboratories in the School of Technology at NC A&T SU has been used to provide instruction to learners in several capacities. This facility has been utilized to conduct training workshops for professionals in the field of graphic design and graphic communications.

It is used to provide problem-solving experiences using CADD software applications. Students who utilize this facility major in Graphic Communication Systems and Technological Studies, Electronics and Computer Technology, Construction Management, Manufacturing, Computer Science, Engineering, and the Arts and Sciences.

The initial arrangement of the lab appears in Figure 1. The monitors for the computer systems are on tables arranged in rows in the middle of the classroom. In many instances, there are two monitors on each table. The towers for the computers are located on the floor under the tables. There are also computer systems aligned along two adjacent walls to the left and in the back of the laboratory facility. The computer systems are allocated to the students for completion of design and drafting documentations.

Demonstrations are used to illustrate concepts, the application of concepts, and the use of psychomotor skills. This strategy is highly utilized because of its flexibility in a variety of contexts and accommodates a variety of learning styles. The instructors use demonstrations to present conceptual and theoretical information as well as demonstrate procedures used to manipulate the CADD software because it is the most appropriate at the higher levels of the cognitive domain (Weston & Cranton, 1986). The students are able to actively engage in synchronous demonstrations and interact as the information is being presented.



Figure 1: Initial arrangement of instructional equipment in CADD lab



Figure 2: Demonstration monitor located at the front of the CADD lab

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This allows the students to execute commands and manipulate the software to solve simulated design problems. To project the demonstrations, the lab is equipped with three 21 inch monitors connected to a single computer system by way of a video signal splitter. The demonstration monitors are located at the center of two rows of tables (see Figure 1) and a cart at the front of the lab (see Figure 2).

The Problem

Skill and Young (2002) expressed careful observation and analysis of environmental factors that encourage or inhibit learning are essential tools for identifying meaningful patterns that will inform design for learning spaces. The students' ability to interact with the equipment used to demonstrate concepts, apply concepts, or use psychomotor skills applicable to using CADD software was one tier of student-content interaction that created concern among the instructors who utilize the facility. It was observed that the demonstration monitors were not easily visible for all students.

There were instances when a student would inadvertently hinder another student's visibility of a demonstration monitor and they were forced to view a monitor that was further away. Students positioned with their backs turned to a demonstration monitor had to turn toward a nearby monitor, see what was being demonstrated, turn back to their assigned computer and execute the procedures. Students' body movement, frequency of questions during demonstrations, and number of times procedures were asked to be repeated were indications of a problem between the positions of the students relative to the demonstration monitors.

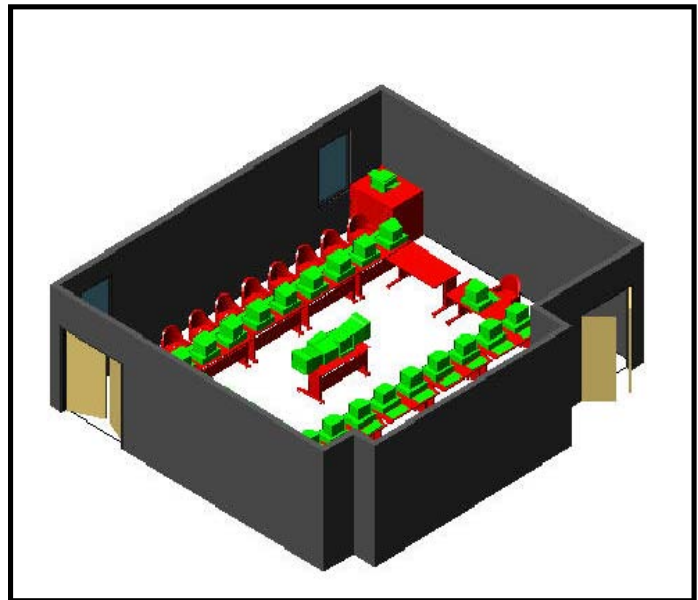


Figure 3: Three-dimensional computer generated model of proposed CADD lab layout

Promoting Interaction

Student-Content Interaction. Using Autodesk Architectural Desktop, Dr. Cobb developed a computer-generated model for one of several proposed solutions to address the visibility problem (see Figure 3). The number of demonstration monitors increased from three [in the initial set up] to four arranged on an "island" in the middle of the laboratory. The monitors are arranged facing the north, east, south, and west of the facility. The tables are in

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a U-shape orientation enclosing the island of demonstration monitors. The students are facing towards the demonstration monitors. The line of sight distances from the student's seat to the demonstration monitors ranges between seven and 11 feet. This distance would be reduced approximately four to six feet in comparison to the previous layout where the distance from a demonstration monitor to a student was in excess of 15 feet.

Demonstrations provide real-time, synchronous interaction with instructional content and instructional materials. Of the CADD lab's 24 computer systems, nineteen systems are located on tables in the center of the lab. The other five computers are along the west and north walls of the facility (see Figure 1).

In the floor of the CADD lab, there are 20 covered openings. Each opening provides access to four electrical power outlets and two network connections (see Figure 4). Students using one of the nineteen computers in the center of the classroom have Internet accessibility. The network connections are positioned from the east (right) wall in rows and columns to the center of the room. The five computers on the west (left) and north (back) of the lab do not have Intranet/Internet access (see Figure 1). Students assigned to these computers have to attain instructional materials stored within the Blackboard course portal prior to entering the facility to engage in the day's instructional experience.

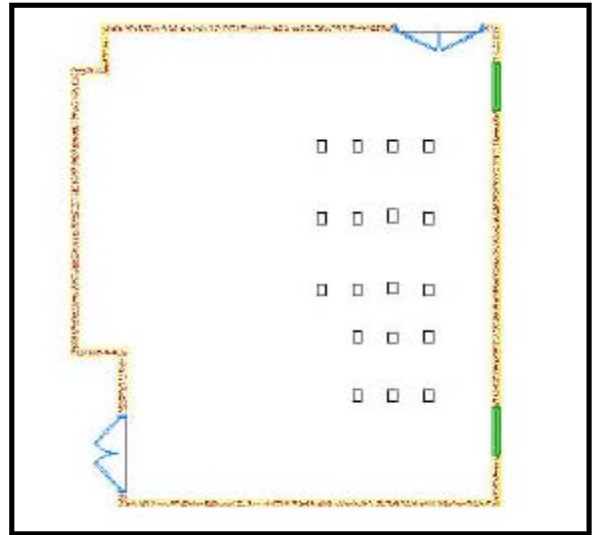


Figure 4: Location of power outlets and network connections in the floor of the CADD lab

Full classroom technological capabilities and connectivity allow teachers and students greater opportunities for a wider range of teaching and learning tools which appear to support academic programs (Salomon & Almog, 1998). In the CADD courses offered in the School of Technology at NC A&T SU, students access Blackboard to download prefabricated demonstration files, view presentations, engage in threaded discussions, chat, and assess their mastery of skills and knowledge related to computer aided design and drafting concepts and principles.

However, students assigned to the five computers (see Figure 1) to the left and back of the facility do not have immediate access to web-based instructional materials because the computers are not connected to the Internet. This creates a "virtual disconnect" between those students and the instructor. The students cannot interact [in real-time] with all instructional materials available in the web-based, virtual environment. The proposed

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redesign efforts include the once isolated five computers [and students] among the learning community physically and virtually by putting them in proximity to the network connections located in the floor of the laboratory.

Student-Instructor Interaction. Student-instructor interaction is also essential in the creation of a positive learning environment. Interaction between the student and instructor is created during classroom discussions as concepts and theories are covered in the classes. Much of the interaction occurs in the aisles between the rows of tables as the instructor assists students in applying the skills and knowledge discussed to solve practical design issues. There are approximately five aisles in the lab allowing movement throughout the facility. Figure 5 illustrates one of the aisles existing in the CADD lab. Some observers of today's college-age learners contend that they are most eager to learn when they can become deeply immersed in a learning environment (Tapscott, 1998). When the instructor or a student moves through the aisle, the students seated are required to move to allow the student or instructor to pass. This interrupts their time on task causing a disruption in their learning experience and the learning environment.



Figure 5: An aisle in the initial arrangement of the CADD lab

Student-Student Interaction. In the redesign of a learning environment, consideration should be given toward building student-controlled spaces where faculty can comfortably engage in conversation with students (Skill & Young, 2002). The U-shape orientation creates better movement about the classroom. The instructors would be able to place themselves among a greater number of students at one time increasing the likelihood of interaction with a larger group of students. The new arrangement would reduce disruptions during the delivery of and engagement with instruction. Sufficient space has been allocated between the students' chairs and the walls for the instructor [or other students] to move about the facility and interact with each other.

Consequently, this arrangement promotes active student engagement as well as improves student-student interaction. The students are facing each other. They are able to discuss and exchange ideas more freely without being forced to move about the laboratory. If movement is necessary, the new arrangement allows for ease of movement with minimal disturbance or disruption added to the learning environment.

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Student Reactions to Interactions

During the fall 2003 semester, several arrangements were proposed to Dr. Kapur, associate professor in the Graphic Communications System and Technological Studies (GCSTS) department. Through consultation and discussion among other faculties in the department, an arrangement was agreed upon (see Figure 3). At the completion of the fall 2003 semester, Drs. Cobb, Kapur, Rhodes, and Ms. Blackwell rearranged the equipment in the CADD lab in room 3009 in Smith Hall (see Figure 6). The “renovated” CADD lab was unveiled to the students in the spring 2004 semester.

The rearrangement of the equipment in the CADD lab was done so to promote interactivity among instructional content, instructor, and students. To assess the accomplishment of this goal, students participated in an online survey through the Blackboard course delivery system. The survey provided a forum for students to express their attitudes and opinions concerning the impact the new layout had on their interaction with the instructional content, the instructor, and other students. Ninety percent of the students who participated in the survey had taken courses in the CADD lab prior to the spring 2004 semester.



Figure 6. New arrangement in CADD lab

The participants were asked to comment on the positive and negative attributes of the lab regarding the location of the demonstration monitors. Tashyka Ledbetter, a double major in Graphic Communications and Fashion Design said, “. . . I can see the demonstration monitors much better. Before, I had to do a lot of adjusting to be able to see. This made it very uncomfortable and hard to dictate notes.” Janelle Jackson agreed, “The old setup had computers positioned where the demonstration monitors were behind the students. The new arrangement allows all of the students to see the monitors regardless of where you are seated.”

When asked about the interaction between the students and instructor, Nakiya McAdams, a senior Graphic Communications major, commented, “The new arrangement allows the instructor to move about the room to assure students are on task and completing the assignment.” Jasper Brown added, “. . . it is easier for the instructor to walk around and lecture, while keeping our attention. We get more personal attention from the professor.”

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Consequently, the common responses from students regarding collegial interactions reported the new arrangement allowed eye contact to be established among the majority of their colleagues. The arrangement increased the likelihood of peers within the learning environment to “get to know” each other. All of the students who participated in the survey reported the new arrangement had a positive impact on the learning environment and their learning experience in the CADD lab.

Conclusion

The implementation of technology to enhance instructional design efforts is becoming more of the norm in classroom and laboratory facilities. Due to this fact, its impact should not be overlooked in the learning environment. Designed physical environments within which formal instruction occurs plays an important role in student learning when physical properties are considered and individual factors are controlled under particular circumstances (McGuffey, 1982).

Evidence from many environmental psychology studies note physical environments may have positive or adverse effects upon users when their responses are measured in a limited or controlled way (Heft, 1997). The redesign of a CADD laboratory at NC A&T SU was initiated due to an identified concern with students’ ability to interact effectively with instructional equipment. In the development of a resolution, interactions (i. e., student-content, student-student, and student-instructor) were identified as a focal point to creating an optimal learning environment.

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