

Case Study: Renovating a Computer Teaching Laboratory for Active and Cooperative Learning

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1. ABSTRACT

For many years engineering educators have been trying out new ways of teaching in their classrooms and seeking to go beyond the traditional lecture. It has been shown that students benefit from instruction that includes active, cooperative and inductive approaches. However, most of the time when we build a computer laboratory classroom it is set up to be optimum for the traditional lecture approach, with all the desks facing the front of the classroom.

We recently renovated one of our computer classrooms focusing on alternative forms of instruction. We took a classroom previously setup with all the desks parallel to the front of the classroom and modified it to a “workshop” format where all the desks were perpendicular to the front of the classroom. In addition the room is equipped with a range of technological aids including a classroom network. This set up:

1. allows the instructor to easily scan three quarters of the monitors in the classroom from one position and to scan all monitors by moving around the front of the classroom
2. allows for the instructor to easily circulate among the students
3. allows for cooperative learning exercises
4. removes student anonymity and therefore discourages improper use of the computers
5. improves instruction through additional technological aids.

The overall classroom environment was also upgraded by making simple changes to the aesthetics of this room. A side benefit of this change was to increase the capacity of the room by 20%.

In this paper I review the design changes made to this classroom, describe the technology aids included, summarize our experience to date using this room and discuss additional improvements that are planned. Initial response to these changes has been very positive.

2. INTRODUCTION

Many studies have recognized the benefits of using alternative approaches to lecturing in presenting undergraduate material (Felder, *et. al.*, 2000). In 1986, Chickering and Gamson, with support from a range of colleagues and organizations published the “Seven Principles for Good Practice in Undergraduate Education”. Their seven principles are listed below, as worded in a later paper (Chickering and Ehrmann, 1996).

Good practice in undergraduate education:

1. encourages contact between students and faculty,

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2. develops reciprocity and cooperation among students,
3. encourages active learning,
4. gives prompt feed back,
5. emphasizes time on task,
6. encourages high expectations, and,
7. respects diverse talents and ways of learning.

These principles encourage a classroom that is more interactive than a traditional lecture. Such a classroom would include: cooperative learning exercises that have students working together, easy interaction between the faculty and the student, and the use of diverse approaches to learning. The traditional structure of a computer classroom with all students sitting at a computer, facing front often with system units between students is not the best way to accomplish these goals.

Often students and/or faculty resist the change to something other than traditional lecture. Traditional lectures were the way many of us faculty learned and they are still a comfortable mode that does not demand too much of the students. How can we encourage our students and faculty to consider new and alternative modes of instruction? Buckminster Fuller (1969) noted “Reform the environment; stop trying to reform the people. They will reform themselves if the environment is right.” One option for encouraging greater use of the seven principles is to transform our classrooms so that they more easily accommodate these differences. Ten years after Chickering and Gamson published the Seven Principles, Chickering and Ehrmann (1996) noted that we could use “technology as a lever” to help implement these principles. Their article primarily focused on technologies used outside of the traditional classroom. In this paper we look at simple classroom changes that can help encourage the use of these seven principles.

2. SITUATION: A TRADITIONAL ARRANGEMENT

Our computer classroom took this traditional form with all rows facing front with computer system units on desktop between students. Figure 1 shows the previous layout of the classroom where the front of the classroom, with white boards, projector screens and instructor station, was on the left side of this figure. This classroom was used to teach classes where the instructors gave brief presentations of material and then students would do some simple exercises. This arrangement had several disadvantages:

1. It was difficult for instructor to quickly see how well students were doing on exercises.
2. It was difficult to reach students down the narrow rows.
3. The system units on the desks tended to prevent student interaction for cooperative learning exercises.
4. Students felt shielded by their computers and are therefore more likely to use the computers for web surfing and other activities unrelated to the class.
5. This arrangement fit a maximum of twenty students.

3. A SIMPLE ALTERNATIVE: A WORKSHOP ENVIRONMENT

To address these issues, in the summer of 2005, we completed a simple reconfiguration of our computer classroom into four rows perpendicular to the front of the classroom. This new

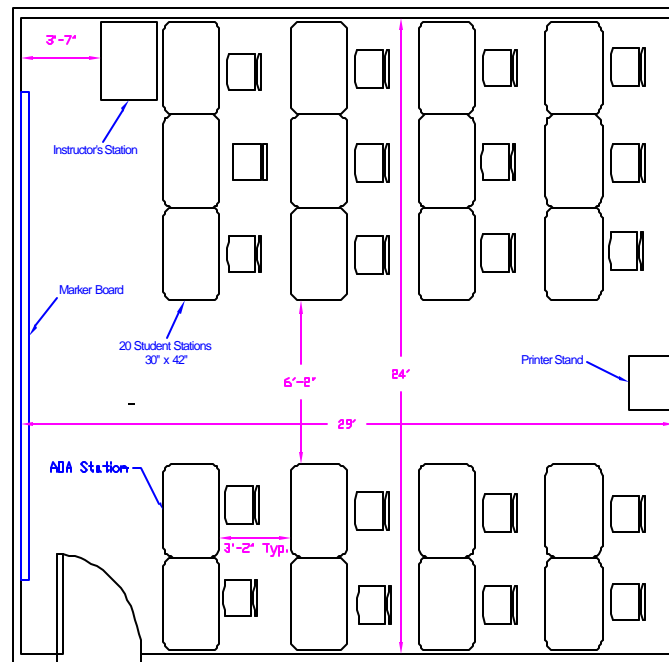


Figure 1: Original Computer Classroom Layout.

arrangement is shown in Figure 2. Computer system units were moved under the desks to improve sight lines and allow for cooperative learning exercises. Flat panel screens are also used minimizing obstruction of site lines. In addition, a new classroom network was installed in the classroom. This new set up:

1. allows the instructor to easily scan three quarters of the monitors in the classroom from one position and to scan all monitors from the front of the classroom,
2. allows for the instructor to easily circulate among the students using the two new larger isles,
3. allows for cooperative learning exercises with out barriers between students,
4. removed student anonymity and therefore discouraged improper use of the computers
5. increased capacity of the classroom from twenty to twenty-four students reducing the number of sections that need to be offered each year,
6. improved quality of instructor control of the classroom computers and projection through the upgraded classroom network system, and,
7. provided a showcase room for our first-year engineering program and various outreach activities.

This classroom is designed primarily to meet the needs of our introductory CAD and computer-tools classes. When not being used as a classroom it serves as the main open computing laboratory for the entire Department of Engineering. In addition it provides the School of Engineering, Technology and Computer Science with a computer classroom designed for active learning.

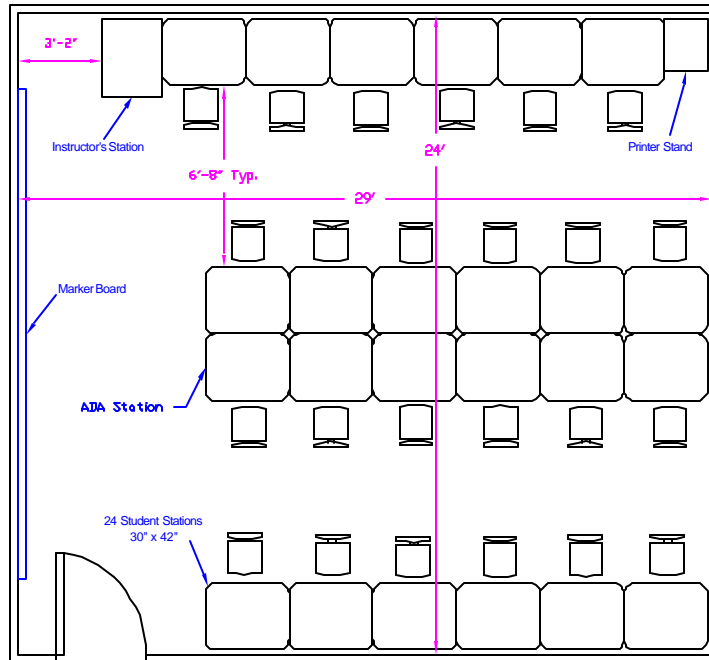


Figure 2: Classroom in New Workshop Arrangement

4. TECHNOLOGY & COSTS

This classroom is equipped with a classroom network that allows the instructor control of all the computers in the room. A “Mobil Hybrid Link System” (Applied Computer System, Inc., Johnstown, OH) was purchased for this purpose. This system includes the ability for the instructor to:

- blank all or some of the screens in the room,
- send the image from the instructors computer to all or some of the screens in the room,
- send the image from any student computer in the room to the projector, the instructors monitor, or to all the other screens in the room,
- take over the keyboard and mouse of any machine in the room, and,
- pose questions for the students to respond to.

These abilities help the instructor structure and run their classes. The ability to transmit to every screen in the room can be used when longer presentations are given so students do not need to turn sideways to observe visual aids being used. Projecting a student’s computer can be useful in illustrating a common problem that other students might encounter and how to fix them or for allowing students to give a brief presentation from their desks. The link system uses a separate proprietary hardwired network to transmit and switch the video images around the classroom. This avoids any bandwidth difficulties with using the campus Ethernet. The keyboard and mouse control is implemented using the campus Ethernet.

We have also have installed a Sympodium (Smart Technologies, Inc., Calgary, AB, Canada) interactive pen display for the instructor’s station. This display allows the instructor to naturally annotate slides or program screens with electronic ink during class, allowing for more possibilities in presenting the material.

The costs of the additional technology purchased are summarized in Table 1. The major cost is the Link System classroom network. We choose to go with a hardware network to accomidate the large bandwidth of CAD and other images used in this classroom. This cost could be reduced by using network based software classroom net, for example NetOp School (Cross Tec Corp., Boca Raton, FL) or SoftLINK (Applied Computer System, Inc., Johnstown, OH).

Table 1: Approximate Purchased Costs of New Equipment

Item	Number of units	approximate cost per unit	total cost
Mobil-Hybrid Link system	1	\$13,200	\$13,200
Under desk supports for computer system units	24	100	2,400
Additional student computers	4	1,200	4,800
Sympodium Interactive Pen Display for instructor	1	1,800	1,800
Instructor Podium	1	600	600
New instructor stool	1	200	200
			\$23,000.00

5. CLASS TIMING AND ENVIRONMENT

In addition to changing the classroom, we also changed the time structure of the computer tools course taught in this classroom. The computer tools class is a two credit-hour class taught to first-year engineering students. This class covers using computers to solve problems and is taught using MATLAB and EXCEL. The class was meeting for 50 minutes twice a week. This time was extended to 75 minutes twice a week to allow more time in class for students to practice the computer topics being taught.

We have also begun working on improving the aesthetics of the room. A wire raceway surface mounted on the walls is used to run the power and network cables. In the original classroom this raceway was an industrial gray that made the room look like a factory floor. During renovation vertical runs of the raceway were painted the same as the wall they were mounted on so that they blended in. While the horizontal run were painted to form an accent strip in the room’s color scheme.

6. OBSERVATIONS

One of the first things many people have commented on is that there seems to be more space in the classroom than there was previously, in spite of there being 20% more desks and computers. Combining the one main isle and 10 smaller areas between rows into two large isles has resulted

in a more efficient use of space where it is very easy for the instructor to get to any student in the room. It is interesting to note that a drafting classroom in the interior design program was reconfigured in a similar fashion and resulted in a similar gain in space. In addition there is much more direct access a variable height ADA station because it is directly across from the door (see Figure 2).

Moving the system units off the desktops does make student interaction easier. However, each student having a computer still tends to discourage interaction. I have found some success with giving out a single worksheet for each pair of students and having them fill it out together as a means of encouraging cooperative learning.

I have also used a cooperative exercise where the class is divided into groups of three students. Each group is assigned a different command to investigate and given five minutes to determine how it works. Then using the classroom network I can go around the room and have each group demonstrate how their command works. This exercise helps students develop skills at figuring out the commands themselves, in presentation and makes the presentation of encyclopedic information more interesting for the entire class.

As anticipated, the reconfiguration does help the instructor to observe how students are keeping up with his instructions or exercises. This configuration, combined with the classroom network, does help reduce the tendency of students to use the computers for non-class activities. I recently had a student in my office who thought that this was the whole reason we made the change.

A couple of additional changes to this room are under consideration. With the rows running from the front to the back of the classroom it is now possible to move the projection screen to the back wall. This would allow: the boards at the front of the room to be fully utilized at the same time as the projection system, the instructor to directly observe the screen that the students are seeing and the instructor to move around the front of the classroom with out worrying about blocking sight lines to the screen. We are also considering moving the printer to the middle of the room for easier student access.

7. CONCLUSIONS

When designing computer classrooms we need to consider alternatives to the traditional all-rows-facing front configuration. The simple alternative of turning the rows ninety degrees has many advantages. This arrangement often results in more efficient use of space and makes it easier for the instructor to reach every student in the classroom. This arrangement allows the instructor to observe how students are progressing. In addition, alternative placement of the projection screen becomes possible.

Moving the system units off of the desktop can help the implementation of cooperative learning. The use of a classroom network is beneficial in keeping things on track, offering an alternative projection mode and in allowing students to complete quick presentations.

8. REFERENCES

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