An Active Learning Complex: Can space be used to foster student interaction?

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Abstract

Over the last ten years the engineering academic community has experienced increased pressure to modify educational practices so their students would be better able to meet the challenges of engineering in the future. A special emphasis has been placed on the students' development of teamwork skills, multidisciplinary work, and development of life-long learning skills as characterized by independent, self-directed efforts in their own learning. This educational focus has an obvious pedagogical impact on engineering faculty members, but this focus also raises questions concerning student issues. Specifically, to teach students these skills, the students need a place to practice them. So, the question raised is what impact does the students' *environment* have on the educational process and achievement of student learning outcomes? The Electrical and Computer Engineering (ECpE) department at Iowa State University created a drastically different area for student learning, a student-centered learning space, to facilitate student learning. The design team consisted of faculty, staff, students and an architect.

I. Introduction

Iowa State University along with the Department of Electrical and Computer Engineering has adopted the active learning paradigm [1,2,3] by working to change the way faculty teach and students learn. It became evident to some faculty that not only the way the material is delivered has to change, but the environment in which the students work has to change to meet the new demands of teamwork and group interaction. While Iowa State has made some changes in the standard classroom to help facilitate cooperative learning, the students did not have places to work together outside the classroom setting. In the fall of 1997 several faculty members and administrators in the EcpE department started talking about developing a space for students. This led to the formation of a small team of faculty, staff, and students who were charged with development of the concept for the Active Learning Complex (ALC).

One strong piece of evidence that the students wanted space for teaming was the usage of the space that was earmarked for the complex. This space was a large room that the department made available to students. The department placed about 20 computers in the space on large tables. What we soon observed is that a majority of the activity in this space was students working in groups at the tables with the computers largely being ignored. This reinforced the concept that if we provided space for teaming the students would use it to work together.

This paper describes the concept, design, construction, implementation and usage of the space.

Student's responses to the new space will be presented along with a discussion of how technology is used to support teaming.

II. The Concept

The department placed almost no constraints on the design of the space. A large, mostly unused, space was chosen as the site of the complex. The space was originally designed as an electric motors lab and then more recently it was used as a space for students to study. An early decision was to not only use the space for student teaming, but also integrate the teaching assistant space with the students' space. We hoped this would create an environment where the teaching assistants and students could interact. A decision was made early in the process to involve an outside architect who could help create a space that would capture the vision of the group. During the first meeting, the architect was given a tour of the space and a brief description of the usage envisioned was discussed for the space. Most of the discussion centered on the way students worked together and the concepts surrounding cooperative learning. Another design constraint was that the space should be a place were the students wanted to be and that it should not look like a "standard" classroom or study room. The architect was also told that price was not a major concern at this stage of the project and was asked to provide us with several concepts so that we could begin to make a decision about the final appearance.

The architect spent several months talking to students, faculty and staff about the usage of the space. He returned with several possible layouts for the space. The group struggled with the amount of technology to be used in the room and how to integrate the teaching assistants. Early plans ranged from a separate space for the teaching assistants that is adjacent to the teaming space to a concept of integrated space where the teaching assistants and the students were intermixed within the room. The technology discussion centered on the amount and type of technology. A group of faculty wanted the space to be the equivalent of a computer lab while another group wanted technology to support the teaming. It was decided to have a limited amount of technology that would support teaming activities and would also be non-obtrusive to maintain the home like atmosphere.

It was envisioned that the space would be utilized by the students for many different activities. The space would be space controlled by the students in that faculty could not schedule the space for formal classes, or for non student meetings. The faculty was encouraged to meet with students outside of class in the space. Many of the classes taught in the department are based on the active learning paradigm that encourages students to interact in groups outside of class. It was hoped the Active Learning Complex would help facilitate this interaction. The high-tech clusters could be utilized by students to prepare for group presentations for such classes as our senior design sequence.

III. The Design and construction

A key to the design of the Active Learning Complex was the use of innovative technologies during the initial stages. The active learning complex was modeled using the Virtual Reality applications Center (VRAC) [3] that allowed designers and others to walk through the space before it was built.

The unique aspects of the existing space influenced the design. The design takes advantage of the high ceiling and open room to provide a feeling openness while also providing privacy for the groups. Once the space was modeled in the virtual environment guided tours were held of the virtual space for the faculty, staff, and some student representatives. A video tape was also produced from the virtual environment that was used to show others who were interested. These steps helped create faculty support for the complex.

The model for the Active Learning Complex has nine clusters to support student interaction and teaming. Four of these clusters (referred to as the "high tech" clusters) contain electronic white boards and large screen computers, and are furnished with soft seating and low tables to create a comfortable environment for the students. The remaining five clusters support conventional group interaction. All of the furniture and dividing partitions were designed to be movable thus allowing the students the ability to rearrange the furniture based on their current needs. The Active Learning Complex also provides space for 28 teaching assistants. This integration of teaming space and teaching assistant space creates an environment that will enhance student learning.

After the virtual environment was created, the design team was reduced to just two people from the department plus the architect. This new team moved forward with creating the final design plans. The next step in the design was the selection of the furniture for the space. The architect required the furniture be specified before the final design. During the summer of 1998 a group from ISU went to Chicago to visit displays from three major furniture vendors. One vendor was willing to work with the design requirements specified. In October of 1998, the final design of the space was completed. It is shown in the Figure 1. The space consists of nine teaming areas with movable partitions between some of the areas. This allows groups of up to 30 in two of the areas and up to 60 in the center area. There is space for 28 teaching assistants grouped in 6 villages each with their own lockable storage space and work surface. Space was also added for a computer with a scanner, color printer, and laser printer. This gave students a space that could be used to create reports, presentations, or anything requiring that type of technology. The space also contains a copy machine that works with the university debit card system.

The construction began in January of 1999 on the 3200 square foot facility, with a scheduled completion date of June 1999. The only major hurdle to construction was the displacement of current functions. The students were unhappy that they were losing the space they used for studying, however by keeping them informed as to the schedule and final outcome they did not complain much. A video camera was installed to track the construction on the web. While this was thought to be useful to help keep everyone up to speed on the progress, some resistance was encountered from the construction workers. They were afraid that there boss would be able to spy on them and watch every move. It was only after we showed them how the system worked and that a picture was captured every 2 minutes that they accepted the idea.

The cost estimates for the construction and the furniture were approximately $750,000. The mechanical portion of the construction was approximately $450,000 since the space was not air conditioned.

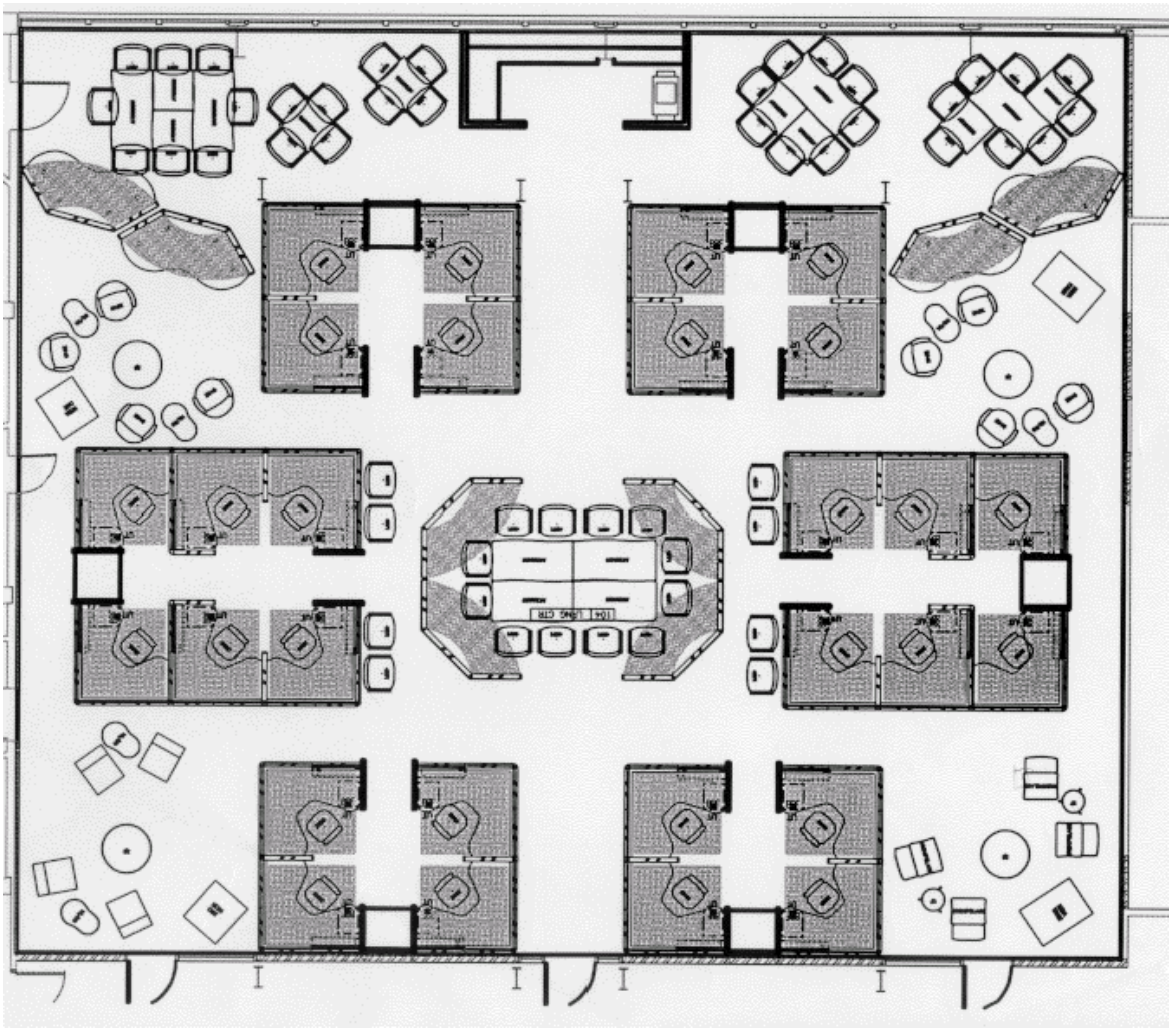

Figure 1. Layout of the space

The active learning complex was completed by the start of the fall semester 1999. The first set of issues came from the use of the space and reserving the space. Numerous requests have been received from faculty and even the deans office to use the space for meetings or for scheduled classes. During an open house for the faculty, a one page usage sheet was distributed that outlined the usage of the space. Other issues became apparent once the space was opened. The first major issue was access to the space and the computers in the high tech clusters. We wanted a space that was open as many hours as possible, but there were also safety issues associated with 24 hour access. The teaching assistants however required 24 hour access since this space was used as their office. It was decided that the room would be open from 6am to 2am Monday through Thursday with reduced hours Friday through Sunday. During those hours, a lab monitor would be present in the building to handle any problems that might occur. The teaching assistants were given keys that provided them with 24 hour access. A group of three or more students can reserve one of the high tech clusters for an hour at time. The rest of the space is a first come first served basis. Students

can also use the "high tech" clusters if they are not reserved.

Whether food and drink would be allowed in the active learning complex was discussed before the space was opened. The department has a policy of no food or drink in the labs and has provided a space with table down the hall that is used for food and drink. It was decided that no food or drink would be allowing the complex. This has be met this some resistance by the students and by primarily the teaching assistants, however the students have adapted to the constraint and we have very little problem with conformance.

Figure 2 shows an aerial view of the space from the main door. In the center one can see the large space in the middle of the complex. In the back the area with the computer and copier are visible and in the upper left and right are two of the six villages for teaching assistants.

Figure 2 Aerial view of Active Learning Complex

The tents over the villages were designed to provide privacy while allowing an open feeling. Indirect lighting was also used to create an inviting atmosphere. This design extra did cost more, but added to the overall feeling of belonging and helped create a sense of place for the students.

A picture of one of the high tech clusters is shown in Figure 3. The large screen computer and electronic whiteboard that make up the clusters are available to the students working in the cluster and are connected to a networked laser printer. The computer also has team work software that gives the four computers the ability to share views of the whiteboards or views of the screens to create an electronic conference. The clusters have soft seating which can be easily moved which

allows the students the freedom to create an environment that is best suited to the activity at hand.

Figure 3 A High Tech Cluster

IV. Student Reaction

At the time of authorship the space has been in use three months so hard data are not yet available; however the authors have gathered informal feedback from students through student forums and direct interaction. The utilization of the space has increased steadily since it opened in fall 1999. The first month there was limited use do in part to the normal study patterns found at the start of any semester and also due to the uncertainty any new environment provides.

The undergraduate students have taken to the space and we now find the space used at all hours and at sometimes there are students in every cluster. An interesting thing we have discovered is that most of the time we see students in groups working on a project, or homework. There are always a few single students spread throughout the complex. Students have begun to identify with certain parts of the room, and it is not uncommon to see the same students gathered in the same cluster everyday. The group sizes seem to range from three to eight. We have not noticed a preference for using the high tech clusters over the standard clusters. It depends on the type of work the students are trying to do. We see more homework type of activities taking place in the

conventional clusters with tables and chair, while we see more discussions taking place in the soft seating found in the high tech clusters. We have not seen much use of the computers and white boards in the clusters.

One interesting situation was observed shortly after the space was built. Jacobson (first author) walked back to one of the high tech clusters where a group of five students was working. The students were working on a circuits problem for a beginning circuits course. One student was writing on the whiteboard while the other students were talking through the solution. This course uses a web based tutorial to help with homework assignments. The students can submit their answers to be checked by the computer. These five students were observed working on the problem for a couple of minutes in a very collaborative environment. Once they thought they have the right answer one of them typed it into the computer and when they found out the answer was correct they were very excited and then proceeded to go on to the next problem. It was at that moment true learning was observed taking place. The active learning complex provided an environment where the students could work together. This group spends a large amount of time in the complex and is frequently seen working on problems together.

The space has also become a place where students and the teaching assistants can meet. The teaching assistants did not take to the space as quickly as some of the undergraduates did. About 15 of the teaching assistants were moved from offices they shared with three or four other teaching assistants into space which to them looked like they would have a loss of privacy. What they soon discovered is that they have more privacy than they had before. The canvas tents over the teaching assistants space provide a high level of noise abatement yet allow an open and spacious feeling in the cubicles.

We have not had any major problems with the space since it opened and with the usage increasing the only problem we see might be the need to provide more space that can be reserved in the future. We also see several of the senior design teams using the space to meet with outside sponsors and to have team meetings. At the most recent student forum there was no negative feedback concerning the space, other than we forgot to provide a place for the teaching assistants to store their coats.

V. Conclusions and Lessons Learned

The Electrical and Computer Engineering (ECpE) department at Iowa State University set out to create a drastically different area for student learning and to facilitate student learning through space.

Several lessons were learned during the design and construction over the last couple of years. The primary lesson is to create a team of people with a vision and empower them to make it happen. This space would have never been created using a conventional committee structure. This small team approach allowed us to create truly unique space that is now the envy of many departments on campus. One word of caution with the small group approach is let the larger group accept the concept once it is created. This was helped through the use of virtual reality that allowed us to give tours of the space before it was built thus allowing others to see the vision of the small group. Once the rough design concept was finalized the group had to get a final design and get the faculty

and students to endorse the project. The most difficult group to convince was the faculty, many faculty members wanted half the space to become another computer lab and the other half to become a room full of desks for the teaching assistants. By using technology we were able to show the faculty the vision for the space and how we saw the space being used.

Another lesson is that space can facilitate learning and students will use the clusters for teaming if they are convenient and provide a safe and warm atmosphere for collaboration. This space has become the student's space and they have taken ownership of the space and are now spending more time in the building interacting with other students. This interaction and sense of place is very critical to the development of the entire person.

The final lesson is to make it a show case space. Since its creation, the ALC has now become a regular stop on the campus tour for new students. This space has become space that students, faculty, and staff are proud of and take great pride in showing others. One question that is often asked after undertaking a project of this size is "would you do it again?" The answer is yes, the feedback and reactions we have gotten have been nothing but positive and you can sense the difference it has made in the environment. The students feel like they are part of the department.

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