MAXIMIZING COLLABORATIVE PROBLEM SOLVING WITHIN HIGHER

EDUCATION DESIGN STUDIOS WITH A MINIMAL OPEN FLOOR PLAN

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MAXIMIZING COLLABORATIVE PROBLEM SOLVING WITHIN HIGHER EDUCATION DESIGN STUDIOS WITH A MINIMAL OPEN FLOOR PLAN

Marise Meredith Evans

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MAXIMIZING COLLABORATIVE PROBLEM SOLVING WITHIN HIGHER EDUCATION DESIGN STUDIOS WITH A MINIMAL OPEN FLOOR PLAN

Marise Meredith Evans

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Signature of Author

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Date of Graduation

VITA

Marise Meredith Evans, daughter of Bennie and Anna Evans, was born September 30th, 1981. In the ninth grade she received an opportunity to study abroad in Ulft, Netherlands. This gave her a taste of the world outside of the United States and set in motion her love for travel. She graduated from Pike County High School in 2000 as one of the top of her class and class president. In the fall, she enrolled at Auburn University and majored in Interior Design. Junior year, Marise studied abroad for a semester in Ariccia, Italy with the College of Human Sciences. In May 2004 she moved to San Francisco to work for two companies. The first was Kwan Henmi Architecture and Planning, an architecture firm specializing in education and transportation. The other was Kelly Associates, an interior design firm specializing in residential design. In May 2005, she entered the program for a Bachelors degree in Environmental Design. During this time she learned that she had a unique design style and attitude because of her education history and travel experiences. She graduated the following year and was accepted into the Industrial Design graduate program. She has participated in corporate-sponsored studios for national names such as Emerson Tool Company, Broan Nutone and Phi Kappa Phi. She has been inducted into several honor societies including National Scholars, Delta Epilson Iota and Golden Key. She received 4th place in the International Design Institute Competition in June 2008 for her thesis desk design. August 2008 she graduated with her Masters in Industrial Design with Magna Cum Laude honors.

MAXIMIZING COLLABORATIVE PROBLEM SOLVING WITHIN HIGHER EDUCATION DESIGN STUDIOS WITH A MINIMAL OPEN FLOOR PLAN

Marise Meredith Evans

Master of Industrial Design, August 9, 2008
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(Bachelors of Science in Interior Design, Auburn University, 2005)

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Past research has determined a number of new teaching methods which enhance student learning. Yet most of this research revolves around course content and teaching techniques rather than modification of the environment in which the students are learning. Changes in the learning environment have been slow to develop due, in large part, to budgetary constraints. Many departments on campus find themselves teaching in cramped classrooms built and furnished thirty years ago or more. Schools are often faced with the debate of new construction versus retrofitting of the present facilities to meet the needs of their students.

Within creative majors, industrial design is no exception to the enormous surge of technological advances. In a major where drafting tables, stools and T-squares have been used for years, the computer has become the tool of choice. Detailed hand drawings

have been replaced with quick sketches that translate easily into exquisite software programs allowing students to create near flawless and realistic models of their concepts. Creative curriculums that presently require stationary individual workstations are now in need of flexible collaborative spaces where students can interact as a team. By requiring students to work together on projects, design education aligns itself with the design process utilized in the workplace which ultimately will transition industrial design students smoothly into the work force.

A lack of funding is the main deterrent to updating and integrating the latest technological advances into classrooms on most university campuses both public and private. So, how can universities save space, time and money to create a quality technologically enhanced educational environment? This thesis will address one method for retrofitting furnishings to educational design studios with minimal square footage in order to maximize collaborative problem solving skills and better accommodate emerging computerized technology.

Creative curriculums that once required individual static workstations now require more flexibility and collaborative spaces so students can better interact with one another. By requiring students to work together on projects, design education models itself closely after the design processes employed in the workplace. The reasons for this seem to be two-fold: to better prepare young professionals in adjusting to their future workplace and to maximize the productivity for the employer by minimizing the learning curve of a new employee.

So how can universities save space, time and money on efficient furniture that makes industrial design students better employees? This thesis will address how the educational design studio class can be designed to better accommodating computer technology and foster collaborative learning with minimal square footage.

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CHAPTER ONE: INTRODUCTION TO PROBLEM

1.1 Problem Statement

Many of the most successful products on the market today have been designed by teams of designers rather than individual designers. Working collaboratively, the design team struggles to bring a new product through a very specific set of developmental phases prior to production. Teaching students to be creative in a collaborative situation such as the classroom prepares design students for the 'real' working world. Balancing this teamwork approach while assessing a student's individual talent is the benchmark of the school's ability to turn out successful graduates. Creative programs need to attract the best incoming students and prepare them for a realistic competitive workplace. A symbiotic relationship is established when the best student meets the best educational experience.

Depending upon the educational goals for the course, well designed, flexible studio furniture in a classroom can lead to improvements in individual creativity and collaborative efforts. If the workspace supports creativity and learning, it stands to reason that it will improve motivation, utilization, skill, and production. The basis of this thesis is to help industrial design schools create this supportive space for their students. It will explore how studios can be altered in order to maximize collaborative problem solving in order to produce the best graduates for a realistic and successful work environment and ultimately the best products for a world market.

1.2 Need for Study

While the need for increased funding and decreased costs is a constant goal for higher education institutions, it must accomplish this within the overall goal of improving the quality of education itself beyond the course content. Universities across the United States are becoming more competitive while their purse strings are getting tighter. Universities find themselves looking at retrofit construction as one way to accommodate much of the new technology that abounds in our world today. Although advances in technology have made the biggest impact on changing today's education, other things affect it as well. The overall educational environment has a major influence on the quality and type of productivity a school can expect from their students. The caliber and experience of the instructor notwithstanding, the classroom site itself is a force of its own in determining outcome and success. Without proper studio space and equipment, industrial design students will not reach their full potential. An inviting learning environment will lead the creative minds to a productive result.

Positions in the industrial design field are extremely competitive; any assistance which the school can give the students toward a real working world experience will tip the competitive balance to their students' favor. If the educational setting is successful at simulating the working world they will create a smooth transition from school to work place. An inviting studio will beckon students to stay and practice sketching, work on computer programs or swap ideas with others. As the old saying goes, 'practice makes perfect', and 'perfect' will become marketable skills for a successful future.

1.3 Definition of Terms

Brainstorming - A conference technique of solving specific problems, amassing information, stimulating creative thinking, developing new ideas, etc. by unrestrained and spontaneous participation in discussion.

Collaboration – To work together, especially in a joint intellectual effort.

Contract Furniture – Furniture leased out by a company to another company. Many contract furniture companies have contracts with their clients for a minimum time period as well as the option to change furniture when the contract is renewed.

Control Group - A group of subjects closely resembling the treatment group in many demographic variables but not receiving the active medication or factor under study and thereby serving as a comparison group when treatment results are evaluated.

Creative Majors – Any major in college that primarily uses the right side of the brain or is fine art based.

Culture – The behaviors and beliefs characteristic of a particular social, ethnic, or age group. The quality in a person or society that arises from a concern for what is regarded as excellent in arts, letters, manners, scholarly pursuits, etc.

Change – To transform or convert. To transfer from one (conveyance) to another.

Emerging Technologies – Any technological device or system that is in development and has not been released to the general public.

Environment – The surroundings of a person which affect their mood in any way. An indoor or outdoor setting that is characterized by the presence of environmental art that is itself designed to be site-specific. The social and cultural forces that shape the life of a person. Some synonyms: ambiance, setting, set, atmosphere, feeling, vibe, character, air, space, etc.

Higher Education – Any post-secondary institution/university/college offering a degree earned by attending for a minimum of 2 years. Education beyond high school, specifically that provided by colleges, graduate schools, and professional schools.

Learning Process – The process a person uses to learn. It varies from person to person and differs dependent upon the person's left or right side brain skills.

Lifestyle - The habits, attitudes, tastes, moral standards, economic level, etc., that together constitute the mode of living of an individual or group.

Private Spaces – Spaces used by people for alone time, sleep and non-group studying, etc.

Public Spaces - Spaces used by the general public for socializing, collaborating and brainstorming, etc.

Quiet Pods – Big chairs, sometimes with desks, which surround a person so they can think freely without distraction. Often used during individual brainstorming.

Real World – The realm of practical or actual experience, as opposed to the abstract, theoretical, or idealized sphere of the classroom, laboratory, etc.

Spatially Challenged – Rooms that are used to their fullest capacity. People in these rooms often need more room and come up with creative solutions to their problems with storage, desk space, etc.

Technology - The branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society, and the environment, drawing upon such subjects as industrial arts, engineering, applied science, and pure science. The sum of the ways in which social groups provide themselves with the material objects of their civilization.

Third Place – Refers to social surroundings separate from the two usual social environments of home and the workplace.

Utilitarian - having a useful function; having utility often to the exclusion of values; someone who believes that the value of a thing depends on its utility.

Volume Planning - Similar definition as space planning, but used to address the volume of the room as cubic feet being used in a space.

1.4 Assumptions

Several assumptions will need to be made in order to conduct the experiments in the study. Some of these assumptions are opinions from the author's own professional and educational experiences. The personal history and background of the researcher and author of this study may influence the outcome. The person responsible for this study is an industrial design student and has worked in an architectural firm as an interior

designer, a position that was a creative, collaborative job. The purpose in researching this area was to help gather an understanding of the needs of industrial design students and teachers in higher education. The goal of this thesis is to make a list of criteria that would be used when designing furniture for industrial design students.

The assumptions that are made without proof in this study are that human beings are basically creatures of habit. It is assumed that creative individuals get bored very easily and need stimulation. People are flexible, adaptable creatures and they need a space that accommodates different modes of life. Changing furniture for specific needs increases interaction with the furniture and with the other people sharing the space. People need personal space and storage, but many utilitarian things can be shared. If students are treated like adults they will act like adults. They will use tools and materials, be willing to share them and put them back in their proper places.

These assumptions are made because it is believed that students have the right to choices. This includes something as small as more flexibility in a design studio space. Creative design atmospheres let go of the strictly 'individual' space and lean towards sharing studio space and supplies. A school's studio space should be run like a business, but still be a learning environment. If the professor is seen more as a 'design director' of a company, the learning becomes more 'work world' realistic. The atmosphere will not be as intimidating and it will inspire self-confidence in the student. If treated like an adult they will feel like an adult, taking responsibility for themselves and what they are learning. By being given a classroom that mimics a workplace, students will act more professional and be more prepared for the workplace when they graduate.

1.5 Scope and Limits

Scope of Study:

This study will cover the design of "maximizing collaborative problem solving within higher education design studios with a minimal open floor plan." This thesis will be set up as a guideline for industrial design programs in higher education. This study will cover the following:

1. Space waste
2. Flexible furniture
3. The comparison of Industrial Design programs around the United States
4. A controlled experiment involving one group of students in a studio space that has changed and a second "control group" where the furniture is kept the same.

Limits of Study:

1. Location –Auburn, Alabama is a small town. Would the results be different at a different school or a school in a large city? Perhaps, and how do we take this into consideration?
2. Size of program – Based on enrollment, Auburn is a medium to large sized program yet it has a small space allowance compared to other schools around the country. What would be the results in a program with smaller or larger student enrollments? What would the results be in a program that had larger space available?

3. This thesis will be a guideline. Every space is different, and the individual school's program needs are different.

1.6 Procedure and Methodology

- Procedure #1:
  - Survey and visually document the current space/furniture setups within various industrial design programs around the country.
- Method:
  - Conduct a survey on different industrial design studios around the country (30 different programs, half public, half private in hopes to get at least 10 back).
  - Do Library and internet research.
  - Analyze the surveys.
  - Draw conclusion from the surveys.

- Procedure #2:
  - Visually document the current space/furniture setups at Auburn
- Method:
  - Take pictures of current set-up at Auburn and notice student's behavior as a result of the current set up.
  - Analyze the data collected
  - Draw conclusion from the data

- Procedure #3:
  - Research space planning/furniture trends in higher education and this business category in contract furniture.
- Method:
  - Collect research and data from the major contract furniture companies around the United States (Steelcase, Herman Miller, etc.)
  - Do Library and internet research
  - Analyze the research and data collected
  - Draw conclusion from the research and data

- Procedure #4:
  - Determine how higher education and industries create collaborations in each of their spaces.
- Method:

        - With all the research and data collected, find links and similarities in research and design methods
        - Find differences in the data and determine what can be used and learned from them.
        - Design a course of action and guidelines that must be followed in order to run a successful studio/design business

- Procedure #5:
    - Determine how much storage space a student really needs
- Method:
        - Take photos of all rooms and cricket cages
        - Determine a percentage amount for the "fullness" of a cricket cage
        - Analyze the data to determine the actual amount of storage needed by students
        - Talk with students about what kind of storage is needed (i.e. – cricket cages, flat files, lockers, etc.)
        - Design alternative storage solutions

- Procedure #6:
    - Plan/schedule a research study that probes how an industrial design studio works
- Method:
        - Build/purchase the furniture needed to be installed for the study
        - Install the new set of furniture, storage and lighting
        - Survey and interview the students and faculty throughout the study; including before, during and after to get their thoughts and feelings on what makes a good design studio, what they liked and disliked about the space.
        - Tie visual/verbal data to patterns and themes
        - Change the room up (i.e. – move people's chairs around and see if they go to their chair and are territorial or don't mind sharing their space)
        - Develop design implications for the patterns and themes discovered.
        - Synthesize all data from the study
        - Create a document that visually and verbally explains the problem definition/need for research, research methods, research findings/patterns, and design implications.
        - Using the design implications developed from the study, design a series of furniture, storage and lighting concepts that promote collaboration and creativity within a "spatially challenged" industrial design studio

- Complete the documentation of the research study, patterns, design implications, and design solution examples.

1.7 Anticipated Outcome

The aim for this thesis the generation of design criteria for use when design schools are looking to start or update their studio spaces. With this guide, schools would decide what guidelines fit their specific program, needs and space allowance. There are some consequences in this project that could happen within a long term period.

The first problem that is foreseen is Auburn University's Industrial Design program. This is a research project used to help guide schools, not a project aimed at improving Auburn University. Auburn's Industrial Design program needs improvement; there is always room for improvement including all other industrial design programs around the country. Yet, that is not the focus of this project. Building new furniture for the school once the project is completed would require additional resources.

Another problem is the change in teaching style and curriculum. Thirty years ago a teacher would stand at the front of the classroom giving a lecture and the students taking notes, not on a computer, but by hand. Today the best teaching gets students involved in interaction with the teacher as a guide. The teacher is encouraged to sit back and let the students think for themselves instead of 'force feeding' information which is then regurgitated on a test. So what lies in the future for teaching and technology? We only have ideas, not definite facts and we can only hope our new flexible furniture system can accommodate the future.

A problem that can arise as a result of a program's success is an even larger lack of space. For a program confined to small spaces, a growth in the number of students would tax an already tiny building.

This thesis' outcome will be to create a guideline for industrial design schools across the country. It will help studios to run to the best of their abilities and help the students to become collaboratively 'work world' ready when they graduate.

1.8 Literature Review

The current spaces provided at Auburn University for industrial design students have both positive and negative qualities. These assets and liabilities in studio spaces have a direct effect on the student's quality of work and life.

Research has shown that altering class layout and furniture can cause the class to have different outcomes as a result.

> "Studies suggest that the same group, given different learning environments and tools, will achieve different results" (Learning Environments, 2000).

There have been research studies done on how college students act, study, play, relax and sleep. All of these studies seem to come to one conclusion; that students need a well rounded mix of public spaces and private areas. Public spaces are for socializing, collaborating and brainstorming.

> "Social spaces keep minds, voices and project moving" (Creating Collaborators, 2006).

Private spaces are used by students for alone time, sleep and non-group studying.

> "People want a place in the workplace to call their own and a lot of work and product knowledge is being focused on allowing them to do that is new ways" (The State of the Cubicle, 2005).

Higher education programs, especially public universities, are lacking the space needed for a well rounded education regarding both of these areas.

Contract furniture companies have done studies on higher education and creative majors, such as industrial design, and their needs. They have formed space plans using the furniture the company manufactures. Unfortunately, most of these furniture plans call for large open structures where the 'walls' are actually part of the furniture system. Most public universities are somewhat outdated in regard to their buildings. By the time public universities have determined their changing needs for instructional space and have initiated proposals, and secured funding for a finished building the proposed space is practically out of date with emerging technology and teaching needs. Current buildings on campus do not have large, open floor plans but are strapped with 'make do' situations such as smaller rooms with structural walls separating the spaces. With university budgets tightly guarded there is simply no room for construction of new buildings. So what are public universities, to do? How can they make the best use of the facilities on hand and make work space available for the changing needs of students, products and emerging technologies?

> "Since the teaching process and learning process has changed, the space that supports the process must change" (Cornell, 2003).

If the buildings cannot be changed, then the way that we work, the type of furniture and the style of education must change in order to make it more conducive for students, allowing an easier transition into the working world.

There are several principles which professors could apply to improve their lecture halls and studios with only a minimum amount of effort. One of these is the transition of individual schoolwork to collaborative group projects. Collaboration in the world of industrial design is imperative and this principle should become a much larger part of industrial design education.

> "Time was, if we 'collaborated' while learning, it was called cheating. Now, we realize the value of, in fact the need for, collaboration among learners of all ages." (Learning Environment, 2000).

Designing, developing and installing a collaborative work space for students, which fosters their combined creative energy is an essential part of design stimulation and learning. Collaborative design spaces must be incorporated as an essential part of learning and creativity in the industrial design curriculum. The challenge is found in the types of furniture used to help promote this behavior. An example would be the use of a rectangular table. Psychologically rectangular tables make people feel less cohesive as a group than a circular table which allows the designers to sit near each other and share ideas with ease. People sitting at a rectangular table traditionally look to the 'head' of the table for guidance. For design purposes, all members of the team should feel comfortable in submitting their ideas as equals. The shape, size and mobility of the furniture should reflect that principle.

> "New learning environments simply provide more options" (Learning Environments, 2000).

By having easy, flexible furniture that easily moved around it can accommodate current and emerging needs.

Industrial Design is a complex major. It requires grueling hours of work which does not allow much social time with friends outside of the building. It is not uncommon for students to come in early in the morning and stay well past midnight, never leaving the building except perhaps for meals. For this reason, it is important that industrial design departments include areas similar to the working worlds such as 'break rooms.' This area could be incorporated within the studio itself or as additional space within the building where students can both mentally and physically remove themselves from a project for rest and refreshment. However, particular care needs to be paid that distraction to other work areas is not a problem. As is seen in all art careers, design fields also tend to immerse all areas of life. The break room space should be an excellent source of inspiration through rest, refreshment and socialization and the savvy school needs to mindfully assign space which will allow that to take place.

> "Education, work and life activities are becoming integrated. Increasingly they will become "fused" (Cornell, 2004).

Cornell's comment shows the need for such environments. Providing spaces which support the formal, informal and social actions of life is a significant part of the learning process. In another reference he comments on freedom of choice for the user:

> "The environment should allow greater end user flexibility, permitting people freedom of choice" (Cornell, 2005).

In the working world, companies are becoming increasingly more liberal with their work environment. Offices are allowing employees to arrange and decorate the office as they please. Some companies are providing furniture like ping pong tables and "quiet pods" in an effort to tap into the relaxed creative mind. An industrial design firm, IDEO, recently

allowed their employees to buy an airplane nose for the office, in Palo Alto, California, for mere decoration and amusement.

> "Enlightened companies are discovering that making work more like life actually makes work more productive" (Metro and Jump LLC, 2003).

Companies which have adjusted the work environment by allowing their employees to become more comfortable have found that the quality as well as the quantity of the work produced has improved. This improved quality and quantity of work is directly measureable in the profitability of the company.

> "We will seek out those environments that are not only conducive to learning but provide community and human interaction. This will provide opportunities for informal learning, which by its nature is unplanned and fortuitous. The physical environment can do much to enhance or impede this process" (Cornell, 2004).

So, by allowing fun to take place in an educational setting spontaneous learning will take place as well. This concept has been utilized by kindergarten teachers for decades. There is every reason to believe that spontaneous learning can take place when the physical environment has been deliberately enhanced in order not to impede the learning process. Assessing the current facilities with this concept in mind is very important for the success of design education.

In doing research for this thesis, a tremendous amount of information was found on how to improve learning in higher education. Some articles address modern approaches to teaching while others point out building accommodation 'needs' for the twenty-first century. The gaping hole in all of this research is how to achieve better education in the space that already exists.

CHAPTER TWO: INTRODUCTION TO RESEARCH

2.1 Changes in Economics, Education, Lifestyle and Technology

Change, a word that is thrown around often and something that happens every minute of every day, sounds so ominous that it almost seems startling. But change is for the better; especially when it applies to education. By evaluating where we have been, we will have a better chance at planning where we are going. Fifty years ago educational techniques and course content were very different. Today, what we know about how students learn has changed dramatically. Unfortunately, the environment in which students learn has not changed very much. The evolution of the classroom has been slow to catch up to other aspects of our ever evolving world of education.

With ever-tightening budgets, private institutions and public universities are seeking more efficient use of existing and newly designed spaces in an effort to minimize costs when faced with reduced funding. Despite their tight budgets, universities find themselves in the position of needing to keep up with new construction and technologies on campus in order to attract the best students, faculty and secure future funding.

> "Competition for the best and the brightest among students and faculty is a reality" (Efficient, effective and inspirational, p.7).

Educational reform is no longer in the future but is very much with us in the present. The institutions that are best at implementing educational reform become cutting edge competitors for the best students. Colleges and universities are constantly contending for corporate and government funding that is rewarded for outstanding research and teaching. Potential students and their parents are 'educational consumers' and have started shopping for colleges. It has become increasingly important for colleges to make the right impression.

> "Education is the number one non-residential buildings market for both new and renovation projects" (Not your parents' campus).

In 2005, $13.9 billion was spent on new construction on campuses, and another $14.5 billion began in January 2006. One of the major problems with new buildings and all the money being spent on them is that the structures are technologically out of date before they are even finished.

Technology is the leading dynamic in the change of today's world. Pens and paper are now replaced with laptops; PowerPoint presentations on projection screens replace chalkboards. Papers and tests are now submitted electronically. In the last eight years the average amount of time a student spends on the internet has quadrupled. In an age where classroom teaching methods are evolving, the spaces in which they are taught are prehistoric at times. Structures are being retrofitted to accommodate the technological devices being used. A clear cut example is the rising need for more power outlets in a space. Classrooms designed years ago have an average of three to four wall outlets per room. With the growing popularity of electronic devices, such as laptops, the

demand for electrical outlets within easy access has grown in direct proportion to the technology in use.

Another change has been in our culture. Culture is defined as the quality in a person or society that arises from a concern for what is regarded as excellent in arts, letters, manners and scholarly pursuits (dictionary.com). Twice as many students are attending college today as compared to twenty years ago. The large boom in college attendance started after World War II when President Roosevelt passed a bill declaring that all returning soldiers were allowed to attend college free of charge as compensation for the their service in the military. College enrollment numbers have continued to increase due to many other factors including: financial aid, scholarships, more women and minorities going to college, adult generations returning to college, population growth and economic status in conjunction with a college degree. Different environments need to be provided to support the varying learning styles, generational and cultural differences and preferences.

A college degree, in many social circles today, is seen as a rite of passage.

> "The need for learning is a basic fact of life, a fundamental rule of business and a critical element of success" (Learning Environments, Steelcase, pg. 17).

Higher education is no longer a luxury but a necessity in the achievement equation for today's society.

The lifestyle of Americans is becoming increasingly casual. This does not stop at table manners or how we dress, but in our educational practices as well. Lifestyle is defined as the habits, attitudes, tastes, moral standards, economic level, etc., that together constitute the mode of living of an individual or group (dictionary.com). Boundaries

between the classroom and life outside the classroom are blurring. Study areas are not limited to the library now but include coffee shops, dorms, student unions and outdoor settings. Once condemned to a life of monotonous lecturing, teachers are now serving as facilitators and mentors in the classroom. Paul Cornell acknowledges this as the shift in teaching methods from the 'Industrial Age' to that of the 'Knowledge Age.'

"From Industrial Age Model:

- Students as passive receivers of information
- Instructors as leaders
- Memorizing facts and Content
- Learning everything in advance and then applying it
- Learning as an individual act

To the Knowledge Age Model:

- Students as actively engaged and accountable
- Instructors as facilitators and mentors
- Learning facts and processes
- Learn some things in advance and others just in time" (Cornell, Formal Learning)

While the need for increased funding and decreased costs is apparent for higher education, there is also the effort to improve the quality of education itself beyond the course content. In recent years new research into how students learn has altered teaching methods in universities. Still, configuration and technology shifts in the learning environments have been slow to catch up, due in part to a lack of funding. Many departments on campus find themselves teaching in conventional environments established fifty to sixty years ago. In some cases, students are required to work in conditions that professionals in comparable environments would find totally unacceptable. There is a clear desire by higher education to advance learning not only

through course content and “real world” collaborations, but also by giving students a “real world” physical environment.

As with any complex design issue; the cost, revenue generation and improvement of educational process constitute tradeoffs in what can be accomplished. Nevertheless, it seems clear that both contract furniture companies and institutions of higher learning can mutually benefit from a closer, more collaborative relationship with each other. Developing cost-effective, efficient environments that promote creative thought and collaboration in higher education is the ultimate goal to be achieved through:

- Competition for the Best and Brightest Students and Faculty
- Support of Diverse Teaching, Learning, and Working Styles
- Reducing Expenses
- Accommodating Fluctuating Numbers of Students and Faculty
- Shrinking Endowments
- Dated Architecture with Inflexible Infrastructure
- Global Reach

Institutions of higher learning take on a responsibility both noble and tremendous in preparing students for the challenges of the increasingly global and interconnected human experience. The particular design and planning of the physical environments that support teaching and learning will come to shape not only buildings and classrooms, but also the very culture and distinct values of the community each university seeks to both build and serve.

2.2 Design Studio Phases

Unlike lecture classes, there are no tests in a design studio. Everything done in a design studio revolves around developing a product concept. To achieve the end product, the studio is divided into three distinct phases. Each of these phases differs in collaboration needs, types of work and end deliverables expected from the student (Figure 1).

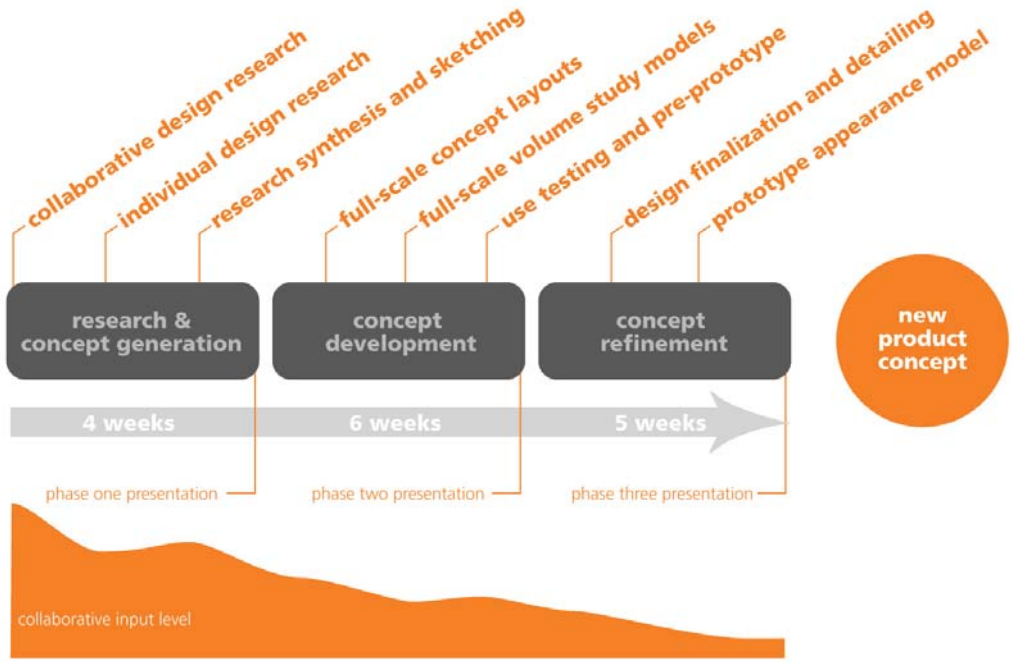


Figure 1: Three phases of a design studio and their collaboration level

The first phase, termed "Research and Concept Generation," is the most critical for collaboration and colleague feedback. Research is divided among the students working together in groups. Information is gathered on a number of subjects such as user research, company background information, consumer reports, major competitors and

branding. The majority of the time is spent in the studio discussing the client's needs, brainstorming ideas, building user scenarios and sketching multiple design ideas.

Sketches are placed on the tack space, discussed and critiqued by the professor and fellow students. Once the refined concepts are chosen, students meet with the clients who sponsor the studio project. Through presentations, concepts are chosen collaboratively by the client, professor and students for further development in the next phase according to which concepts best fit the needs of the company.

The next phase is identified as "Concept Development." The concepts chosen are further developed through full scale sketching, volume studies, testing and pre-prototype models. This phase starts out collaboratively and slowly tapers. This tapering of collaboration is due to more individual work as the concept progresses and more time being spent in the studio since full scale models are being built in the workshop. When testing the model, attention to size, mechanics and ergonomics must be made to ensure the product is accurate.

The final phase, "Concept Refinement," has the least amount of collaboration. Most of the studio time is spent in the workshop building an appearance model. Students have major mechanics and form figured out by the end of the second phase and now the focus is attention to design details. Particulars such as how the product will be manufactured, product color, finishes and graphics must be decided. The studio space becomes a storage space for supplies and an escape when needing a break from the shop.

2.3 Three Places: Work, Home and 'The Third'

Industrial design students spend most of their college years inside their building. Studio classes run several hours, and it is not uncommon for students to spend long hours in the studio space at night and early morning in the classroom working on projects. It is found that people typically live in three places; home, work and a "third place." This "third place" could a church, a local bar, bowling alley or any other social surrounding that is separate from the two usual social environments of home and the workplace.

> "The less time that we spend in home places and third places, the more we begin to see vital signs of the rest of life appearing at work" (Metro, Familiar Places in New Spaces).

Since students rarely see home, seldom go out elsewhere and the studio is their workplace, the studio needs to serve as all three areas. The "third place" is defined by Oldenberg as:

> **Neutral Ground** "…places where individuals may come and go as they please, in which none are required to play host, and in which all feel at home and comfortable.
>
> **Conversation is the main activity** "…the talk there is good; it is lively, scintillating, colorful, and engaging."
>
> **Accessibility and Accommodation** "One may go alone at almost any time of the day or evening with assurance that acquaintances will be there." "…Traditionally, third places have kept long hours."
>
> **The Mood is Playful** "Here joy and acceptance reign over anxiety and alienation."
>
> **A Home Away from Home** "The third place is often more homelike than home." (Oldenburg, 1989).

Fostering a place that serves so many responsibilities requires flexibility and multiple options. Though most design studios have open floor plans, the furniture is often static

and hard to move once in place. To help achieve the most flexibility and meet the needs of home, work and a "third place," furniture must be provided that can move to suit the needs of the students.

2.4 College Life versus the Working World

Companies have been recognizing the need for interdisciplinary teams that use collaborative spaces. While experts have identified research labs and residence spaces as needing shifts in design criteria, little has been done to mirror the creative, collaborative spaces which are being created in professional business.

> "Students need a workplace where people could work in the same way that real world business teams do" (Creating Collaborators, pg.1).

Yet designing a space that mimics professional life can be challenging with the current furniture provided. The new 'collaborative design themes' which are being integrated into research labs on campuses nationwide are creating an edge in gaining corporate and government funding and grants for universities. So how should a product development design studio be reworked to be considered "collaborative" and "interdisciplinary?" If the furniture is reconfigurable it makes the environment more livable and more collaboration can occur amongst the students.

> "Enlightened companies are discovering that making work more like life actually makes workers more productive" (Metro, Familiar Places in New Spaces, p.2).

By providing an environment that students want to work in and if that environment mimics professional life, students will be better prepared for their first jobs.

CHAPTER THREE: EXTERNAL RESEARCH AND SURVEY

3.1 Study Guidelines

To better understand the needs of industrial design programs across the country a verbal and visual survey was developed. By asking faculty of thirty prominent universities and colleges across the United States to answer questions and take pictures of their existing spaces, it was possible to monitor the condition of existing spaces and the furniture used within them. This tool helped to pinpoint exact needs, trends, themes and differences among the varying design programs. Thirty schools were chosen out of a possible fifty according to a number of factors including: national ranking, duration of the program, public versus private institutions, the age of the program and geographical location of the school. The ultimate goal was to have as diverse a representative population as possible.

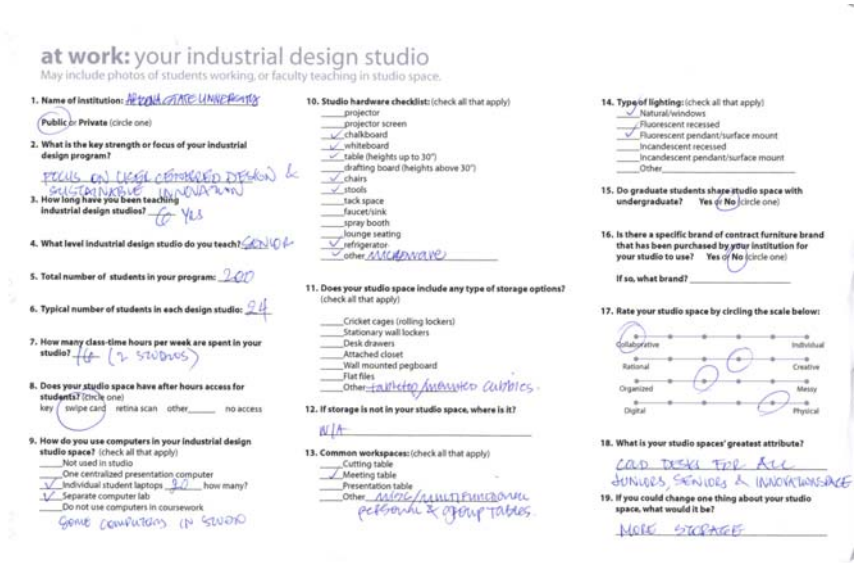
Surveys were sent to the following Industrial Design Programs and Departments:

Auburn University, Arizona State University, Carnegie-Mellon University, Cranbrook Academy of Art, Kendall College of Art & Design, University of Cincinnati, The Ohio State University, University of Notre Dame, University of Illinois-Urbana Champaign, University of Kansas, Purdue University, Illinois Institute of Technology, Milwaukee Institute of Art & Design, Pratt Institute, Rhode Island School of Design, Syracuse University, Virginia Polytechnic Institute, The University of the Arts, Georgia Institute of Technology, North Carolina State University, University of Louisiana-Lafayette, Art Center College of Design, Brigham Young University, California College of the Arts, California State University - Long Beach, San Jose State University, Savannah College of Art and Design, University of Houston, Art Institute of Fort Lauderdale and Academy of Art University in San Francisco.

In the Fall of 2006, the faculty members of thirty industrial design programs across the country received a mailing tube that contained a tape measure, a disposable camera and a survey entitled The National Educational Studio Survey (Figure 2).

Figure 2: Educational Studio Survey Kit

Each school was asked to take pictures of their spaces and measure certain components of their classrooms, i.e. desks, chair heights, etc. The survey also asked questions about their existing space and classroom dynamics (Figure 3).


at work: your industrial design studio

May include photos of students working, or faculty teaching in studio space.

1. Name of institution: [illegible]
Public or Private (circle one)

2. What is the key strength or focus of your industrial design program?
FOCUS ON USER CENTERED DESIGN & SUSTAINABLE INNOVATION

3. How long have you been teaching industrial design studios? 6+ YRS

4. What level industrial design studio do you teach? GRAD

5. Total number of students in your program: 200

6. Typical number of students in each design studio: 24

7. How many class-time hours per week are spent in your studio? 16 (2 STUDIOS)

8. Does your studio space have after hours access for students? (circle one)
key swipe card retina scan other_____ no access

9. How do you use computers in your industrial design studio space? (check all that apply)
____Not used in studio
____One centralized presentation computer
✓ Individual student laptops 32 how many?
✓ Separate computer lab
____Do not use computers in coursework
SOME COMPUTERS IN STUDIO

10. Studio hardware checklist: (check all that apply)
____projector
____projector screen
✓ chalkboard
✓ whiteboard
✓ table (heights up to 30")
____drafting board (heights above 30")
✓ chairs
✓ stools
____tack space
____faucet/sink
____spray booth
____lounge seating
✓ refrigerator
____other MICROWAVE

11. Does your studio space include any type of storage options? (check all that apply)
____Cricket cages (rolling lockers)
____Stationary wall lockers
____Desk drawers
____Attached closet
____Wall mounted pegboard
____Flat files
____Other FABRICATED MATERIAL CABINETS

12. If storage is not in your studio space, where is it?
N/A

13. Common workspaces: (check all that apply)
____Cutting table
✓ Meeting table
____Presentation table
____Other MOVE/MULTIFUNCTIONAL PERSONAL & GROUP TABLES

14. Type of lighting: (check all that apply)
✓ Natural/windows
✓ Fluorescent recessed
✓ Fluorescent pendant/surface mount
____Incandescent recessed
____Incandescent pendant/surface mount
____Other_____

15. Do graduate students share studio space with undergraduate? Yes or No (circle one)

16. Is there a specific brand of contract furniture brand that has been purchased by your institution for your studio to use? Yes or No (circle one)
If so, what brand?_____

17. Rate your studio space by circling the scale below:
Collaborative – Individual
Rational – Creative
Organized – Messy
Digital – Physical

18. What is your studio spaces' greatest attribute?
COLD DESKS FOR ALL JUNIORS, SENIORS & INNOVATION SPACE

19. If you could change one thing about your studio space, what would it be?
MORE STORAGE

Figure 3: Educational Studio Survey Questions

The following is a list of questions asked in the National Educational Studio Survey.

Name of institution:_____

Public or Private (circle one)

What is the key strength of your industrial design program?

How long have you been teaching industrial design studios?

Total number of industrial design students in your program: ____

Typical number of students in each industrial design studio: ___

What level industrial design studio do you teach?

Class time hours per week in studio?

Does your studio space have afterhours access for students? (circle one)
key swipe card retina scan security guard other_____ no access

How do you use computers in your industrial design studio space?
(Circle all that apply)
Not used in studio
1 centralized presentation computer
Individual student laptops _____ how many?
Separate computer lab
Do not use computers in coursework

Studio hardware checklist:
_____projector
_____projector screen
_____chalkboard
_____whiteboard
_____table (heights up to 30")
_____drafting board (heights above 30")
_____chairs
_____stools
_____tack space
_____faucet/sink
_____spray booth
_____lounge seating
_____refrigerator
_____other_____

Does your studio space include any type of storage options?
Cricket cages (rolling lockers)
Stationary wall lockers
Desk drawers
Attached closet
Wall mounted pegboard
Flat files
Other_____

If storage is not in your studio space, where is it?_____

Type of lighting: (circle all that apply)
Natural/windows
Fluorescent recessed
Fluorescent pendant/surface mount
Incandescent recessed
Incandescent pendant/surface mount
Other

Common workspaces:
Cutting table
Meeting table
Presentation table
Other

Do graduate students share studio space with undergraduate? (circle) Yes No

Is there a specific brand of contract furniture brand that has been purchased by your institution for you use? If so, what brand? (Contrast public versus private versus firms)

Does your space dictate any unique student rules or policies?
(ex. No aerosol spraying, shirt and shoes required, etc.)

Rate your studio space…
Collaborative…….Individual
Rational……...Creative
Organized……..Messy
Digital……Physical

What is your studio spaces' greatest attribute?

If you could change one thing about your studio space, what would it be?

Approximate dimensions your studio space:
length_____ width_____ ceiling height_____

Approximate dimensions of student work surfaces:
depth_____ width_____ height_____
(Include measuring tape in photo)

Approximate height of student seating:
height_____

Once the survey was completed and the disposable camera used, respondents were asked to mail the information back to Auburn University for review. Once received, the disposable cameras were processed and the photos attached within the survey booklet in the designated places (Figure 4). The data provided by the schools was entered into a spreadsheet document so the survey answers could be compared and averages could be determined.

Figure 4: Completed Visual/Verbal Educational Studio Survey

Two-thirds of the universities asked to participate in the study responded, allowing a diverse set of data and a comprehensive look at industrial design schools from across the United States.

The information gathered provided a foundation upon which a study was built, showing how to develop both environmental and furniture recommendations based on educational trends in active learning.

Although several major contract furniture companies have published studies on how furniture and space planning affects learning styles, most have not addressed the issue of reduced square footage as a constraint. This study intended to discover active learning solutions that could be achieved in environments with limited square footage.

3.2 Figures and Findings

The following is a summary of the key findings (Figures 5 & 6) from the National Educational Studio Survey:

Average studio space area
1389 sq/ft Public
1607 sq/ft Private

Typical number of students in studio space:
16.9 Public
17.5 Private

Studio space per student breakdown:
82.1 sq/ft Public
91.8 sq/ft Private

Computing
44% public studios use laptops (10.75 out of 17.5 students in the classroom)
69% private studios use laptops (9.1 out of 16.9 students in the classroom)
In no studios were computers completely absent.

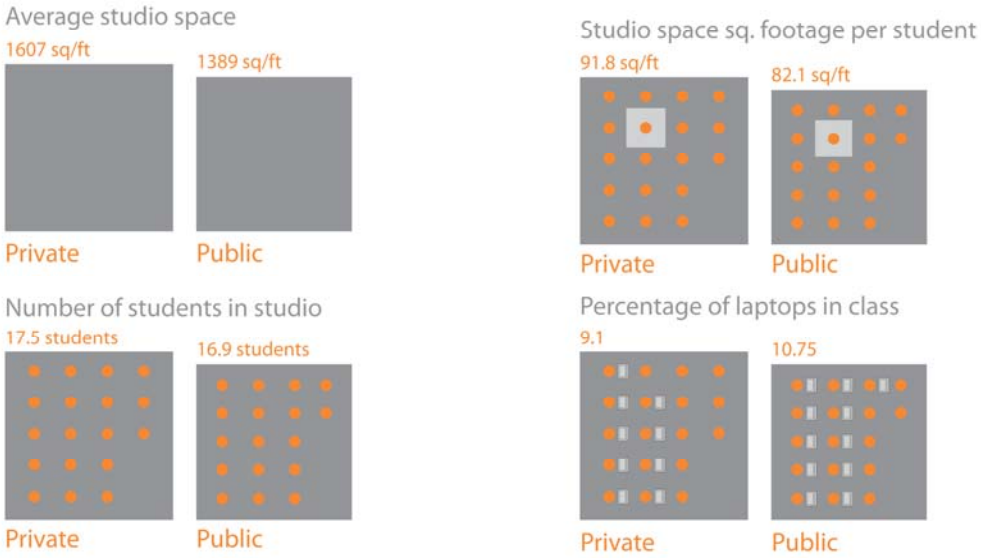


Figure 5: Survey Statistics: Public vs. Private

Class time hours per week within studio space:
10.0 hours Public
11.4 hours Private

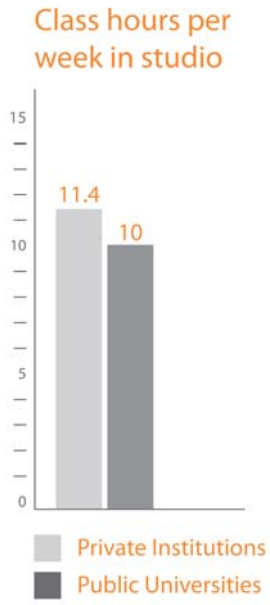


Figure 6: Class hours per week in studio: Public vs. Private

Workspaces

Approximately half of the educational studio spaces used standing height work surfaces (above 30") as their primary work surfaces for students (Figure 7). These workspaces are usually in the form of some type of drafting board and stool combination.

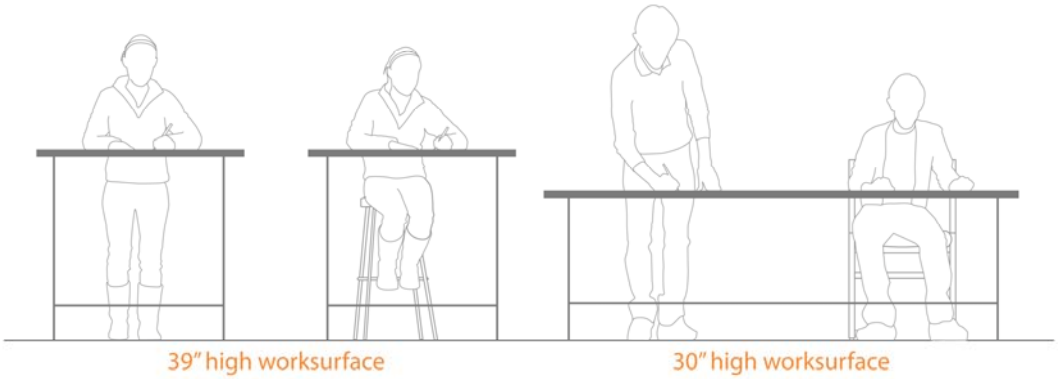


Figure 7: Example High and Low Work surfaces

Lighting

All but two studios have some form of natural lighting.

Fluorescent lighting was present in all 22 studios (Figure 8).

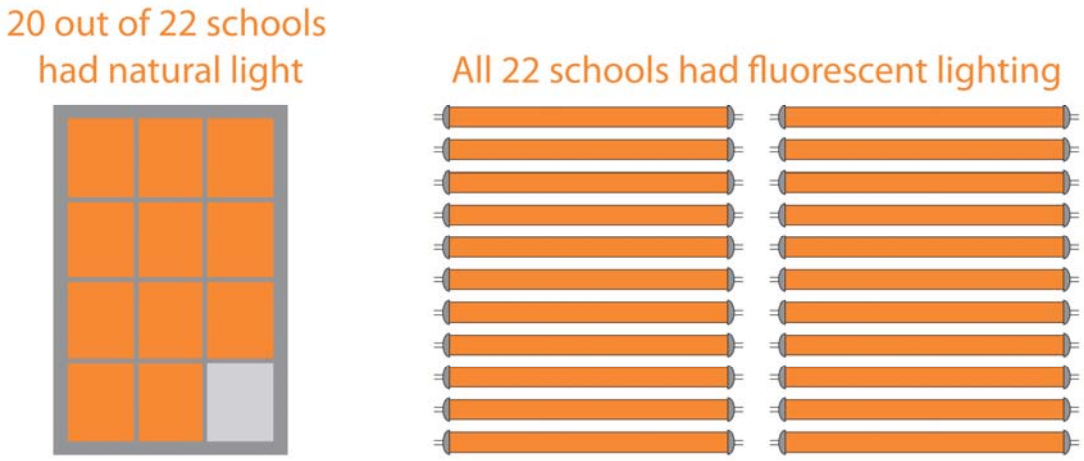


Figure 8: Lighting in Universities and Institutions

It was found that private institutions provided more space for each student and were more likely to have lower work surfaces (below thirty inches). This could be due to higher tuition revenue and private donations allowing them to procure larger spaces with more modernized furniture and equipment. Private institutions were also found to have more 'loft like' atmospheres that were built with the design programs in mind. Public university design schools, on the other hand, were often housed in spaces originally occupied by other programs or disciplines. Because these buildings were older and originally designed for programs other than industrial design, they had to be retrofitted to meet the design program's needs. A good example of this is Auburn University's Industrial Design program. Over a span of sixty years the design program has been

located in three different buildings on Auburn's campus (See Appendix A). All of these buildings have had previous tenants and therefore did not meet all of the specific needs of the program and had to be retrofitted. While it may be unreasonable to expect major universities to dedicate entire building designs to small programs, like industrial design, these programs nonetheless require working space which meets the unique needs of their projects and workflow in order to provide an adequate education to their student population.

CHAPTER FOUR: INTERNAL DEPARTMENT SURVEY AND ANALYSIS

4.1 Auburn University: Facts and Figures

As data was collected from the national survey, it was analyzed and used to compare Auburn University to other industrial design programs around the country (Figures 9 &10). A few key points show surprising differences and similarities between Auburn University and the other design schools participating in the survey is as follows:

Average studio space area
1389 sq/ft Public
1607 sq/ft Private
531 sq/ft Auburn University

Typical number of students in studio space:
16.9 Public
17.5 Private
16.0 Auburn University

Studio space per student breakdown:
82.1 sq/ft Public
91.8 sq/ft Private
33.2 sq/ft Auburn University

Computing
44% public studios use laptops (10.75 out of 17.5 students in the classroom)
69% private studios use laptops (9.1 out of 16.9 students in the classroom)
43.75% Auburn studios use laptops (7 out of 16 students in the classroom)

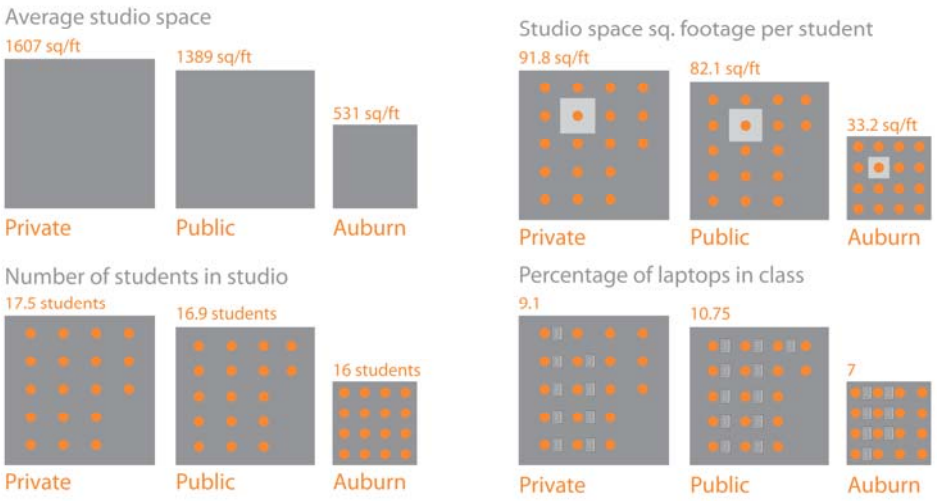


Figure 9: Survey Statistics: Public, Private and Auburn University

Class time hours per week within studio space:
10.0 hours Public
11.4 hours Private
10.5 hours Auburn University

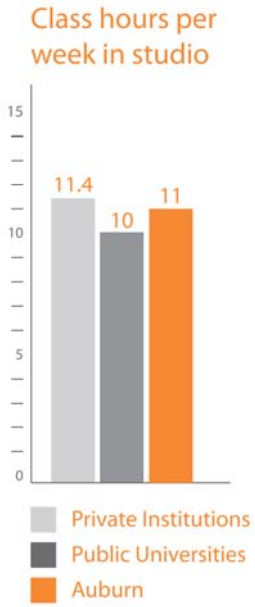


Figure 10: Class hours per week in studio: Public vs. Private

Challenges with workspaces at Auburn University.

Auburn was recently ranked as one of the top design schools in the country (Design Intelligence, 2007). That being said, Auburn is faced with a very difficult task of accommodating a large number of students in a minimal space. One conclusion drawn from the analysis of the survey data is that while the student population of Auburn's educational studio is similar to others schools across the country; students and faculty operate with less than half the space of other schools. This makes collaboration between students and teachers somewhat more difficult to achieve due to the lack of reconfiguration options with furniture that requires maximum efficiency in a static arrangement. This presented the researcher a unique opportunity to design furniture for a studio with limited square footage and still meet all the needs of the students in the space.

Like many of the other schools, Auburn's studios use high workspaces with elevated stools for each student. These workspaces are typically large and heavy making it difficult, if not impossible, to modify or adjust the room layout during the term. Studios are generally set up at the beginning of the term and remain the same throughout. In addition, none of these workspaces employ rolling casters that could make them more mobile.

Auburn's industrial design program has also witnessed a shift in gender demographics. When Auburn's industrial design program began in 1947, there were very few females in the program. Today between thirty and forty percent of the students in the industrial design department at Auburn are female. Yet these higher work surfaces and

seating do not adequately accommodate the needs of female users or use of mobile computers (Figure 11).

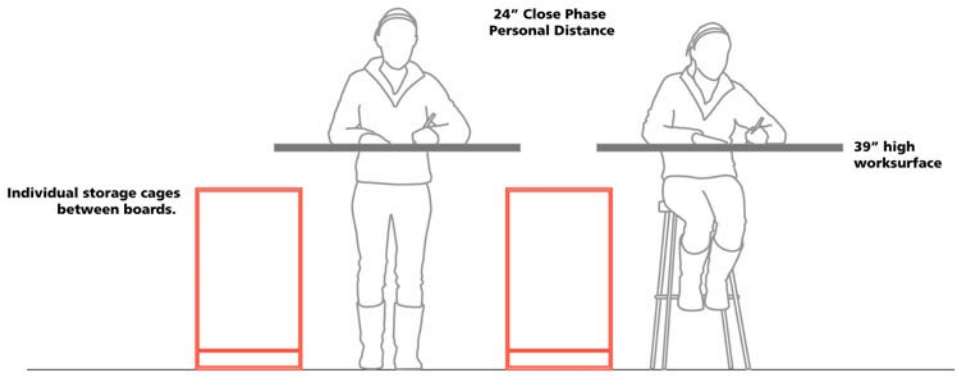


Figure 11: Typical design studio workspace height and proximities with drafting boards and stools at Auburn University.

In addition, Auburn is one of only two schools in the survey that do not have windows in the studio. With all classrooms being on the inside of the building the only access to natural light would be to install skylights, which are both expensive and still do not give access to natural surroundings. Interestingly, when asked where they find their inspiration, many students would say from nature.

The studio spaces in which students are asked to perform their 'real world' projects fall far short of what is used in the workforce today. Many professional design offices and studios incorporate multi-use furniture and spaces, while school studios are relatively static. Auburn's studios are often industry sponsored collaborations that involve actual corporate projects. This collaborative effort between design school and industry affords students critical industrial experience by working with corporate professionals on specific design projects. This collaboration may even lead to students having their products manufactured before they graduate.

4.2 Individual Storage Space Survey

Based on a review of the use of Auburn's studio spaces and the challenges surrounding the lack of square footage, an assessment was made of the use of student storage spaces. Auburn's current method of individual storage in studios includes large rolling metal boxes with the front being a wooden panel serving as an access point to the items inside. Holes in both the top and side panels serve as finger holes for lifting as well as a location to place a lock for security. These boxes are lovingly called 'cricket cages' due to the perforated metal sides which appear to mimic smaller cages that store these insects. Auburn students claim that these storage spaces provided lack the amount of storage needed for their belongings. Yet, upon further investigation it was discovered that these cricket cages were seldom used to their full potential. In fact they were seldom used at all.

To better understand how much space was being wasted by the bulky cricket cages a survey was conducted. All ninety cages across six studios were included in the study. The study included opening each cage and photo-documenting the contents. Once this was done the allotment of space was measured and approximated. It was found that seventy-four percent of the allotted space was being wasted inside the cricket cages. So why is it that the students were complaining about lack of storage space when there was clearly enough? This was probably due to the fact that there indeed was enough storage space, but the space was not readily usable.

Observations made during photo documentation and conversations with students were as follows.

Access Points: Cages can currently be accessed from the top or from the front by way of wooden doors. The front wooden panel has a hole cut for one's finger to pull the panel upwards. The panel does not stay in the up position on its own accord so students must hold it while retrieving an item or take the panel completely off. The height of the boxes is such that it forces the student to squat down to see inside or lean over in an extreme position; both of which are neither comfortable nor natural to the human body. Students who regularly use their boxes usually take the panel off while working and replace and lock it before they leave. The cages are shorter in depth than the desks in use, so students must pull the cages out past the depth of the desks in order to open them.

Shelf space: most students complained that if there was a shelf inside the cage they would be more likely to use it. Yet, on inspection of the photos most cages with shelves were not used anymore than cages without shelves (Figure 12).

Figure 12: Storage Cage with Shelf

Need for flat media storage: In design based majors posters are printed out for discussion on tack space or mounted on foam core for presentations. It was found that these posters were often crammed into the lockers at odd angles and were often too large for the space which made them stick out of the cages (Figure 13). An area where the students could lay the posters flat would ensure they were not damaged. This problem is also attributed to a lack of tack spaces in studios due to drafting boards blocking wall space.

Figure 13: Flat Storage Media in Cricket Cages

Protection for hardware: A number of students used the cages for temporary storage of expensive equipment such as laptops and power tools (Figure 14).

Figure 14: Expensive Equipment inside Cricket Cages

Box in Box: Many students use toolboxes and need a place to store them. They are large, bulky and take up most of the space in the cricket cage (Figure 15).

Figure 15: Tool boxes being stored in cricket cages

Secondary counter top: Often cages were used primarily as a desktop extension. Papers, drawing utensils, food containers, etc found their way onto the surface. When desks became too crowded or when students had something that might make a mess (i.e. – food, drinks, paint, etc.) they placed it out of harm's way (Figure 16). By having items on top of the cage it eliminated one way of accessing the items inside the cricket cage. Using the cages in this manner further reduced their mobility.

Figure 16: The top of the cricket cage being used as a secondary work surface.

Other problems that were found: Some of the wooden panels have warped over time making it virtually impossible to open them; others have locks on them from previous tenants; therefore, the current students have no way of accessing them (Figure 17). Some students have addressed their storage problems in creative ways such as putting in plastic trays and drawers so that things can be in separate compartments

(Figure 17). Also things such as aerosol cans, which are not permitted to be used in the studio space, are stored in the cages (Figure 17).

Figure 17: Other Storage Problems and Findings. Inside of cage was not used due to a lock being on the cage from previous student use (left). Some students came up with their own solution to the storage problem (middle). Spray cans are stored in the cricket cages though they are not allowed to be used in the studio (right).

A large poster was made to document the findings and displayed in the industrial design building so that students were made aware of the waste of storage space (see Appendix B). An interesting side observation was that students looking at the poster often could not tell which storage locker was theirs. This is thought to be because they do not look at them from eye level but from a downward angle.

For the study's purpose it was found that the amount of storage space was adequate, but the type of storage did not fit the student's needs. This lead to the conclusion that storage space needed to be redistributed instead of expanded. An opportunity arose to rethink design furnishings to be used wherever restricted amounts of open floor space were available.

CHAPTER FIVE: IMPLEMENTATION AND EXPERIMENTATION

5.1 Goals of the Change Out

In the Fall of 2007, after review and analysis of the national survey results, it was decided that a furniture change out for one industrial design studio was needed to better understand student behavior. This would allow observation of student's habits and behavioral changes. It would also offer concurrent monitoring and response to their specific needs in a new environment.

Some of the characteristics would be:

1. Study how the studio responds to less individual space and more shared spaces.
2. Install options that allow the studio to adjust and adapt through each phase of the design project.
3. Create improved conditions for individual computing (laptops).
4. Observe how lower work heights affect work in the studio.
5. Maximize use of collaborative wall spaces and tack board.

Guidelines for the studio included:

1. The project would run for one semester before it would be changed back to the original furniture.
2. The studio would try to encompass characteristics of a work environment as well as that of a 'third place.'

3. This experiment would take place in an Auburn Industrial Design studio. Auburn was selected because of the thesis proximity and because of its low space per student ratio. If it was successful in minimal square footage it would be successful in most other universities and intuitions around the country.

5.2 What Was Designed and Why

Prior to the start of the Spring 2007 semester all of the tables and seating were removed from a third year studio (Figure 18).

Figure 18: Old desks being exchanged for new lower desks.

The following were key adjustments made during the change out:

Shifted from 16 individual drafting boards to 4 large, shared tables. This allowed more face to face interaction between students by changing their orientation and reducing their proximities (Figure 19).

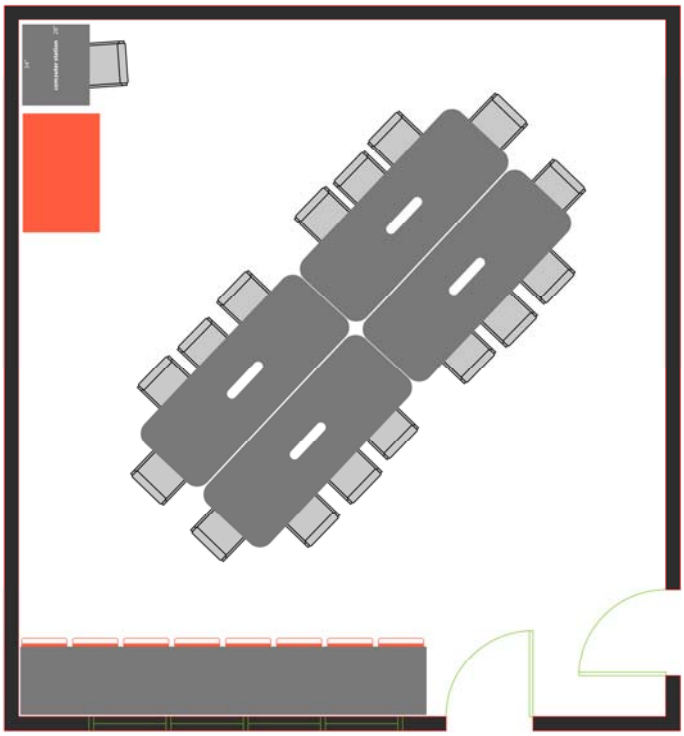


Figure 19: New desk layout: in conference table arrangement.

Lowered work surfaces to standard 30” table height. The desks were lowered to thirty inches. This allowed students to sketch more easily at arm’s length (Figure 20).

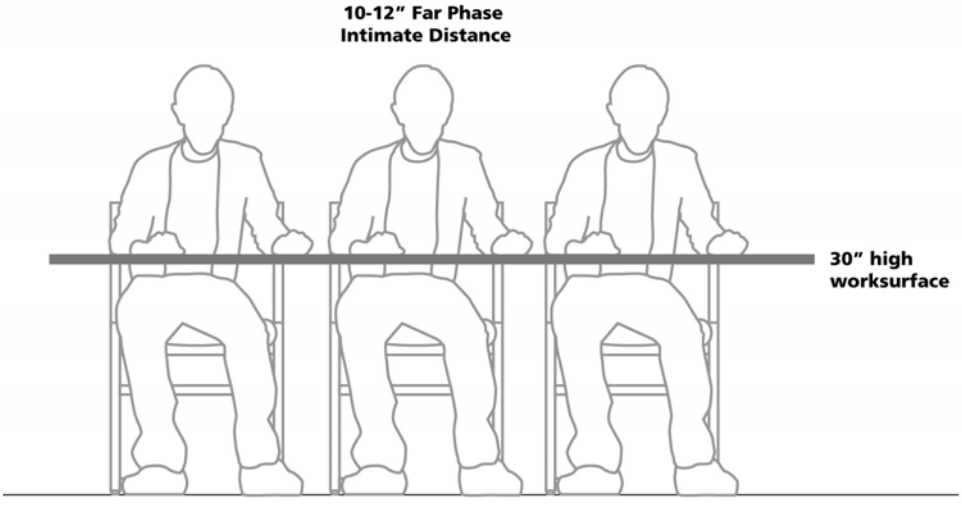


Figure 20: 30” work surfaces allowed students to sketch easier

Casters attached to tables. This allowed the tables to be reconfigured from one large conference table, to four smaller tables accommodating four students each. By placing the desks in the center of the room it opened the vertical tack space in the studio. One hundred percent of the tack space was able to be accessed compared to the two-thirds before when drafting desks were in place. This also made the tack space community space that had to be equally shared. It also allowed the arrangement of the room to change throughout the different phases of the design project (Figure 21).

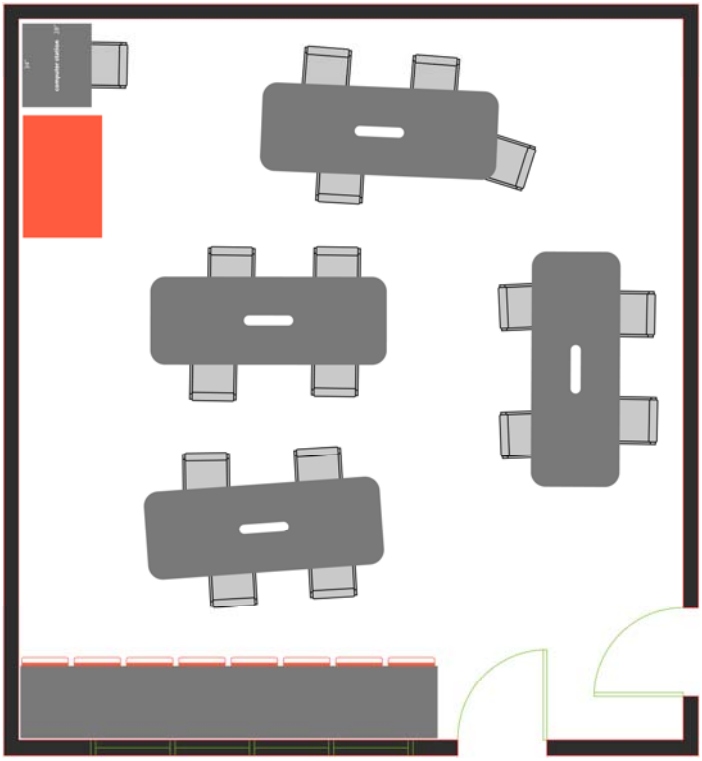


Figure 21: New desk layout: in arrangement set by the students. Cricket cages are located at the lower left hand corner of the room.

Shifted from elevated work stools to lightweight upholstered side chairs. This allowed a more comfortable work posture for longer periods of time in the studio and avoided the "perching" posture of stools. It further aided in making the studio a more

friendly ‘third space’ by offering the back support and comfort of more home style furniture (Figure 22).

Figure 22: Upholstered Chairs used during the semester

Reduced and consolidated individual storage. Each student was given one-half of a cricket cage which was shared with another person. This enabled the floor plan of the room to open up slightly and accommodate the larger tables. Once these storage cages were grouped together, it created an overflow community work surface on top (Figures 21 & 23).

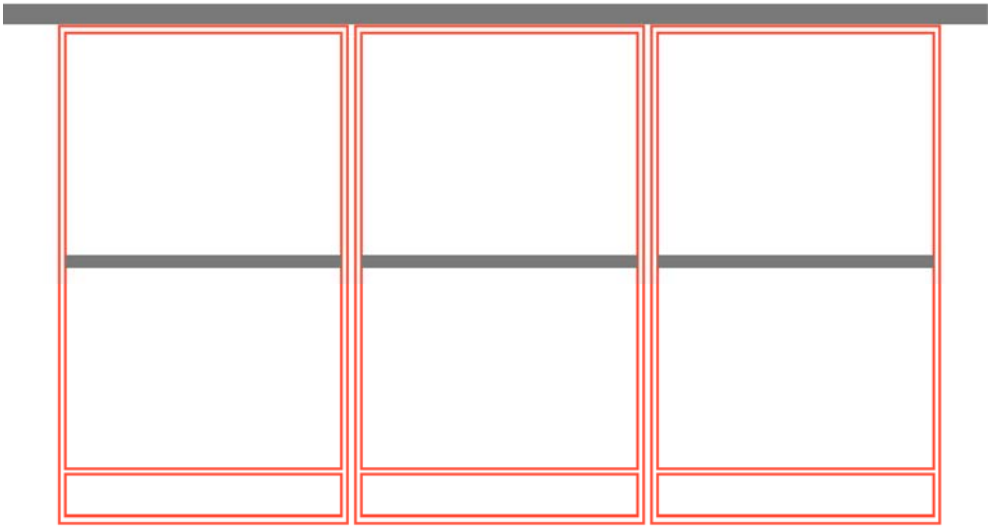


Figure 23: Individual cricket cages were divided into two by the use of shelves. The tops were covered with MDF and the cages were grouped together to create community overflow work surface.

Integrated power strips into tables. Power strip outlets were incorporated into each table as a convenience for accommodating technological uses such as laptop computers, pencil sharpeners, etc. Only one power cord ran from the table to the outlet avoiding the typical tangled mass that would have been created by multiple individual users. They were placed in a cut underneath the table to avoid tangled wires and accidents (i.e. – spilled drinks and dust in the outlets).

Integrated incandescent task lighting into tables. This allowed students and faculty to change the lighting and mood of the studio to several different levels rather than the single on/off switch of the overhead fluorescent fixtures (Figure 24).

Figure 24: Overhead lights are turned off and incandescent task lights are illuminated

The decision was made to equip this studio with furnishings completely different from any other studio space currently in use at the school of Industrial Design at Auburn. This moved the work space from being entirely individual to being entirely communal. It was felt that by changing the furnishings to a completely opposite style, it help uncover both the positives and negatives aspects of both spatial scenarios. A middle ground could then be found for the proposed design.

The Results of the studio change out:

When the room was placed in the conference table mode the mood of the students differed dramatically from when the tables were rolled apart. With personal space of only ten to twelve inches in conference mode the work surface was not productive for much beyond discussion. Once the tables were separated into individual groups it allowed for

ease in drawing and more personal space. While the conference style set up was in use students were more attentive to individuals talking than with the original individual desks. It was noted that when the overhead fluorescent lights were off and the incandescent lights were turned on student's voices tended to lower. The room also had a much more attentive feel with the incandescent lighting than it did with the florescent fixtures.

Interviews with the students provided feedback about their working arrangements.

What have you liked about the studio space?
"Feels more like a real job."
"I feel like an adult."

What have you disliked about the studio space?
"Need more space during class, but at night it is great because I have plenty of space."
"Tables are too narrow."
"Tripping on power plugs on floor and disconnecting cords."

Keeping with the current studio format, are there any changes or adjustments you would make?
"Take out the hole in the middle of the table."
"Put power strips somewhere else."
"We don't use the middle area."

Are there any adjustments or changes you would make to the workspaces?
"Modular, smaller pieces that come together and break apart."
"Shift tables slightly higher."
"Tables need more width, don't like having someone directly across from me."
"Tray bottom is too low (hits knees) and too small for paper. Maybe divide into four sections with lockable panels."
"Rethink leg placement…not enough leg room on the ends."
"Wish they were adjustable."

Are there any adjustments or changes you would make to the seating?
"Love having upholstered seats."

“Wish they had wheels.”
“Wish they were adjustable.”

Are there any adjustments or changes you would make to the shared surfaces?
“Liked having an island cutting board to ‘work around’.”
“Trash can needs to be closer to the cutting board.”

Are there any adjustments or changes you would make to the storage areas?
“Wished lockable areas were higher, so you don’t have to bend over and hold the door up.”
“Have it accessible from the top.”
“I don’t like sharing storage space, but the person I share with doesn’t use it.”
“Cricket cages just need to leave.”

Are there any adjustments or changes you would make to the lighting?
“Did not like having to ‘share’ a light.”
“Needs a small amount of ambient light when overhead lights are off.”
“Lights are poorly mounted and get in the way.”
“Would rather have suspended lights.”

Have you become aware of any changes in the way you work through this studio?
“More likely to come up to studio later at night so I can spread out.”

Has this studio affected your time spent in it? If so, how? (quality of time, amount of time, etc.)
“Come in earlier to ‘stake out’ my spot and have lots of space.”

If you could create your ideal studio space to work in, what would it be?
“Windows, windows, windows. Lack of natural light is detrimental to our creativity.”
“Larger room…a room like the one used for second year’s studio only with the number of people in the third and fourth year studios.”

At this point in the term would you prefer the studio to be switched back to the individual drafting boards or stay as it is? Or something else?
4 students - drafting boards
4 students - stay as is
4 students – something else

The students were split up evenly when asked if they wanted to keep the current formation of furniture or if they wanted to go back to the drafting boards. Four of the students said they liked the studio and wanted it to stay as is. This was because they liked the collaborative environment and the professional feel of the studio. The students that wanted to return back to the original drafting boards wanted to do so because they missed having their own individual space. Four students wanted a combination of the two studio set ups. It is from this feedback that a design was formed that met the needs of the individual while also making the studio collaborative.

CHAPTER SIX: GUIDELINES FOR DESIGNING ENVIRONMENTS FOR INDUSTRIAL DESIGN STUDENTS WITH A MINIMIAL OPEN FLOOR PLAN

6.1 Product Development

The start of the design process began by taking into account what desk shapes would promote collaboration. Table shapes that have curves or rounded edges, i.e. circles, octagons, pentagons, etc., evoke a sense of community and everyone being equal. Rounded shapes are also easier to work and walk around. Tables that are rectangular in shape might make the people sitting on the ends seem more important. Example: When your grandfather sits at the head of the dining room table and a boss at the end of a board room table, they are looked to as the leaders.

With all of the studies conducted and opinions gathered guidelines were formatted to best suit the needs of the students in design schools. The needs are as follows:

1. Encourage face-to-face interactions for collaborative team work.
2. Elevate collaborative learning above teaching
3. Provide furniture that can go from both shared to individual work areas.
4. Simulate the professional workplace.
5. Facilitate active learning and collaborative problem solving.
6. Foster a “third place” atmosphere where students will want to spend time.

7. Have flexible lighting options in order to create different moods and environments.

8. Design desks to be configured to meet the needs of the class as well as the needs of the individuals.

9. Design the furniture so that the desks are used in the center of the room so that the walls are freed for use. These uses include tack space, white boards and communal computer stations.

10. Have electrical power available at each desk for electrical device use and charging. Examples: Laptops, cell phones, pencil sharpeners, External Hard drives, MP3 players, drawing tablets, etc.

11. Create a desk that can easily go from laptop use to hand drawing use.

12. Provide ample storage for student's materials. This includes tool boxes, flat media and other materials.

13. Place every piece of furniture on locking casters for easy reconfiguration when necessary.

14. Allow for a standard 30" door width as the design standard through which all furniture must be able to fit.

15. Design furniture so that students have the option of privacy.

16. Design furnishings capable of supporting the needs of 20 students within a minimal open floor plan. The average class size nationwide is 17 students.

The design limitations for product development were: the size found in the study of thirty industrial design schools which was twenty-two feet by twenty-five feet. If the desks could work in the smallest space available they will reasonably work for the largest as well. Thirty inch doors are standard interior doors which puts constraints on the width of the furniture designed. Both public universities and private institutions need furniture that has a long, cost efficient life. Materials such as aluminium are more expensive, but

have more design possibilities. Steel is more cost efficient and stronger, but has limitations to its use. Using a combination of the two materials would provide a strong, durable desk leg with the aesthetic appeal lacking in current classroom furniture.

6.2 Final Concept: Determining and meeting needs with the Desk Design: Lighting, Flexibility, Private vs. Communal Space, and Collaborative Needs

The concept desk was designed in the shape of an enlarged pentagon capable of seating five students in a circle. A circle of five was chosen because it allowed the maximum amount of personal usable space in conjunction with the average number of students in a design school classroom which is seventeen. If the desks had been designed with a foursome configuration this would have allowed only sixteen students to be together and an odd student left out. With five, each configuration can easily seat students in a minimal open floor plan space of twenty-two feet by twenty-five feet which denotes the smallest studio space identified in the national survey (Figure 25).

Figure 25: Classroom Configuration for 20 students

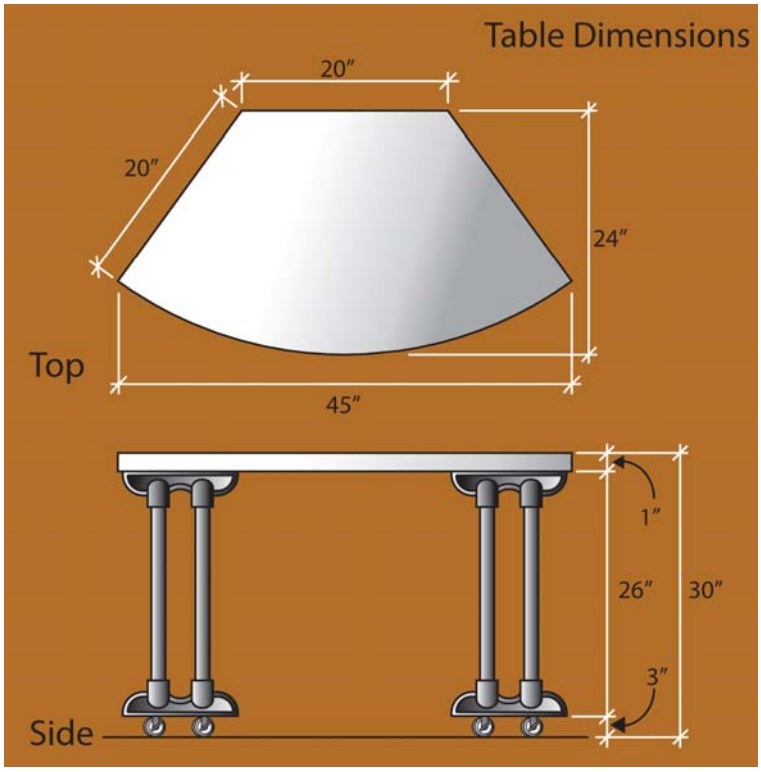


Figure 26: Desk Dimensions

Three of the four sides of the desk are equal lengths (Figure 26). This allows the desks to be configured in many different patterns (See Appendix C). A workstation tower was designed to accompany the desks when they were in a circular formation (Figure 27). The tower, which has five sides, corresponds with the width of the desk's three equal sides for maximum configurability. The tower was developed to house the electrical and storage needs of the students. In addition it also has tack space, lighting and glass partitions for privacy. When a combination of sketching and computer work is needed the students can use their laptop, then when finished close it and slide the laptop back into the workstation to free their desk space for sketching.

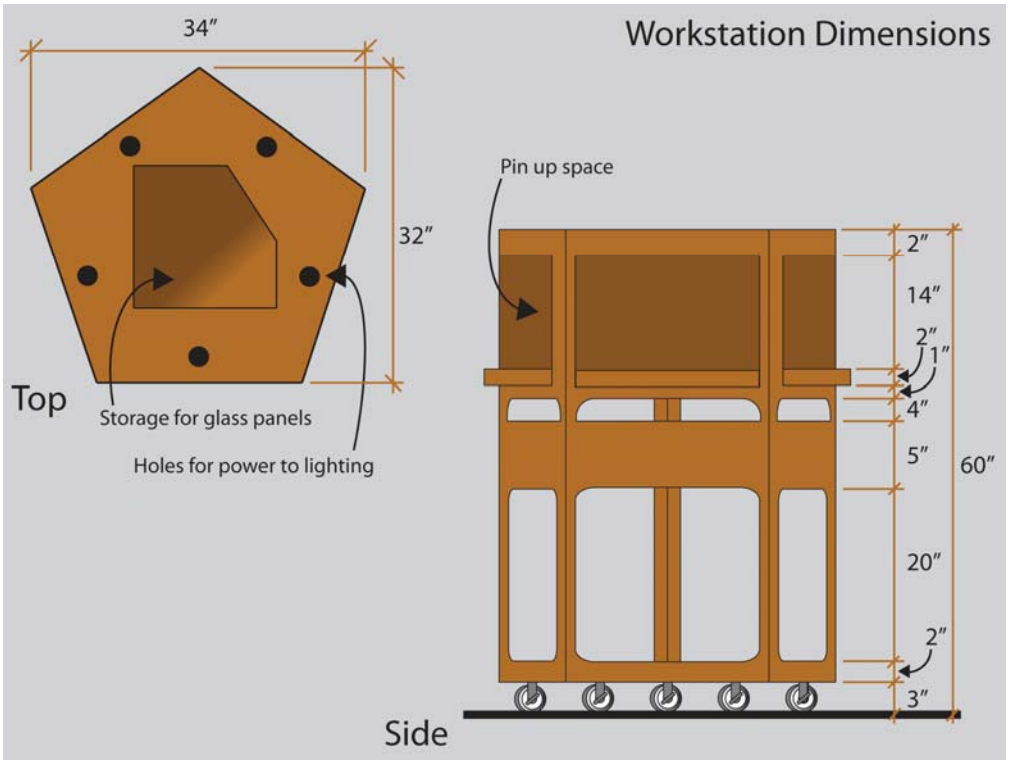


Figure 27: Workstation Dimensions

Having the furniture as small individual pieces instead of large conference-like tables allows for more configurations to be formed when moving the pieces around. The smaller pieces allow students to have individual workspaces they desire while also giving them flexibility needed to run a collaborative studio with minimal square footage.

CHAPTER SEVEN: CONCLUSIONS OF STUDY

7.1 Next Steps: Opportunities for Future Study

This thesis presents a process for designing furniture in higher education design studios with a minimal open floor plan. It contains a set of steps which can be adapted to the redesign of any classroom. Further development of this study would be to build the proposed desk design and have a trial run in a studio for a semester. This would allow any miscalculations in size to be discovered and further development of the design to be done.

This thesis presents a unique opportunity for other studio pieces to be rethought for design schools with limited floor space. Other pieces which are in need of redesign in order to meet the specific needs of industrial design students in higher education include: storage, tack space, white boards, flooring, lighting and seating. Color studies should also be done to understand how paint colors affect student mood and productivity.

Classrooms are not the only room that could be improved upon in the design education community. To further develop the idea of a 'third place' other areas of a building could be studied such as break rooms, gallery space, computer labs, conference rooms, shop spaces, and even professor's offices. All of these spaces collectively make up the environment from which students extract their educations. Given the guidelines

within this thesis, it is hoped that opportunities will be taken to improve furniture design which will benefit the education of many future industrial design students.

7.2 Closing Thoughts

The study for this thesis began with the identification of a need to promote collaboration amongst industrial design students by redesigning furniture for higher education design studios with minimal open floor space. It was determined that a set of guidelines needed to be established to help public universities, private institutions, teachers and designers create the best and most flexible classroom configurations possible. By attending to these needs, students become more attentive, absorb more knowledge and are better prepared for the professional world.

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www.dictionary.com - Online dictionary and reference guide.

www.hermanmiller.com – Herman Miller, Furniture Manufacturer, including designs furniture for higher education and office environments

www.ifma.org – International Facility Management Association

www.nacubo.org – National Association of College and University Business Officers

www.scup.org – Society for College and University Planning

www.steelcase.com - Steelcase, Furniture Manufacturer, including furniture designs for higher education and office environment.

APPENDIX A
The three different buildings the Industrial Design Department has been located inside since its origin at Auburn University.

Biggin Hall

SIZE: 52,716 square feet
BUILT: 1951
FLOORS: 4

Figure 28: Exterior Picture of Biggin Hall

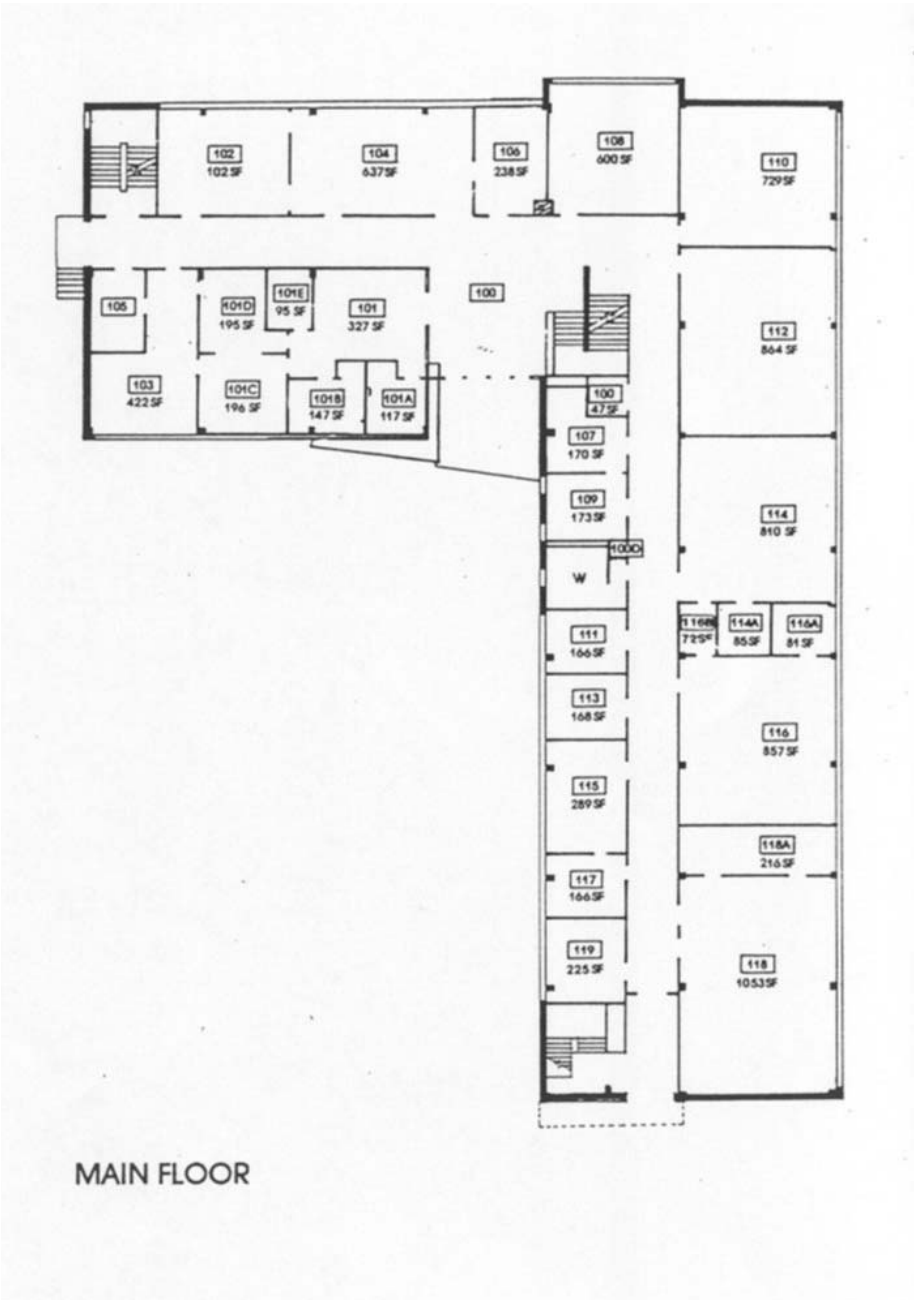

Figure 29: Biggin Fall Floor Plans, Main Floor

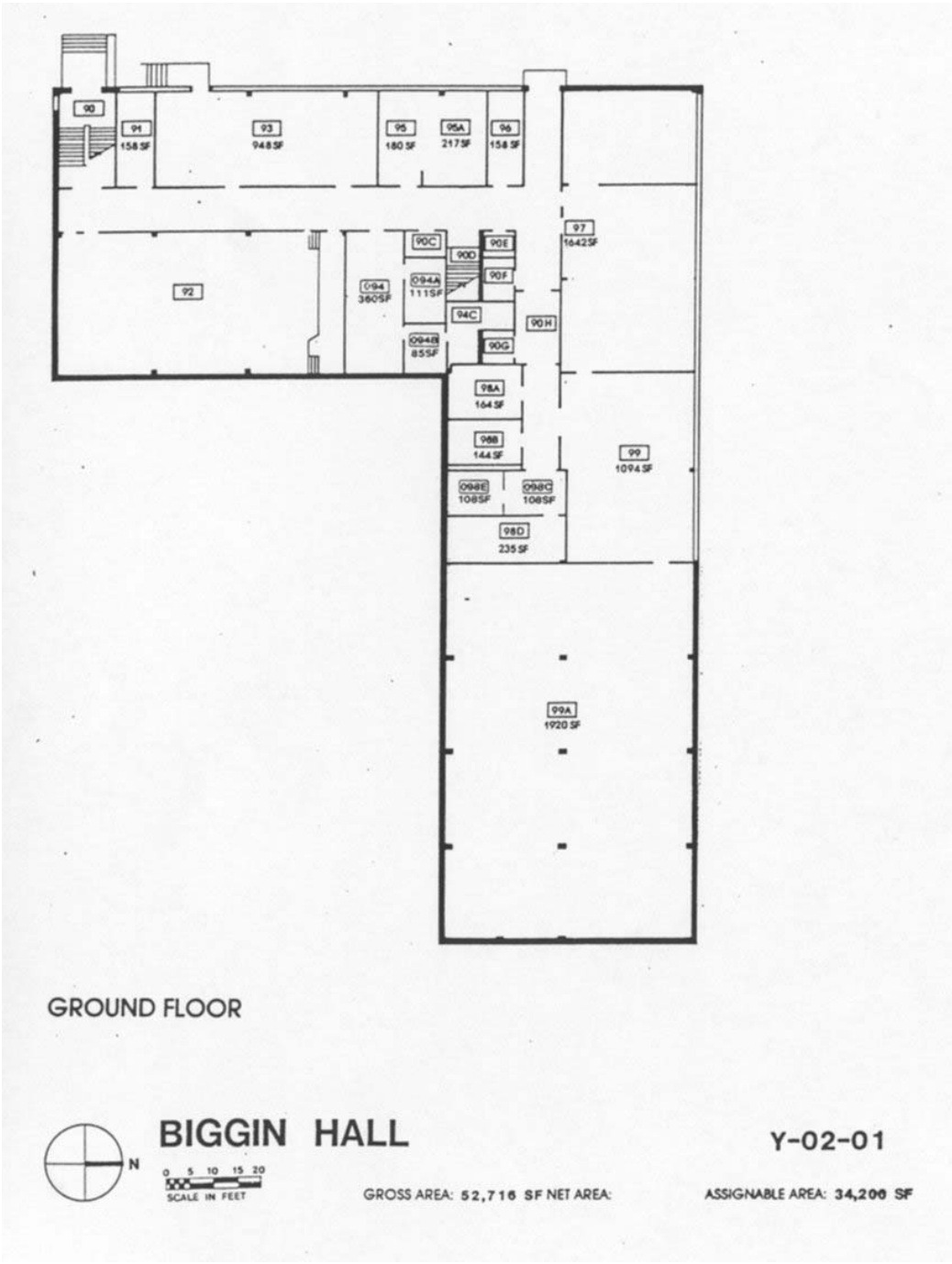

Figure 30: Biggin Hall Floor Plans, Ground Floor

Smith Hall

SIZE: 17,316 square feet
BUILT: 1908
FLOORS: 2

Figure 31: Exterior Picture of Smith Hall

Figure 32: Smith Hall Floor Plans, First Floor

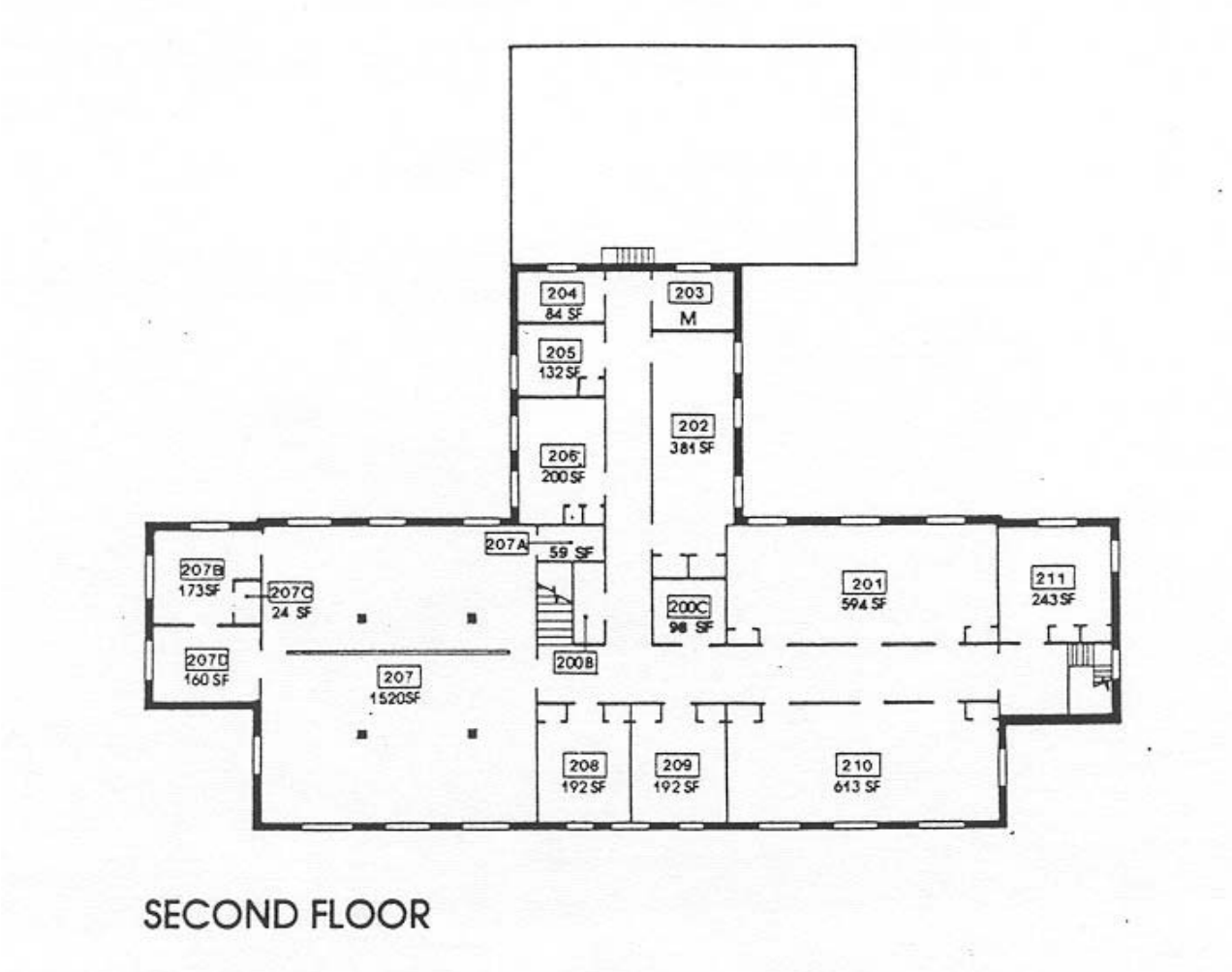

Figure 33: Smith Hall Floor Plans, Second Floor

Wallace Center

SIZE: 41,131 square feet
BUILT: 1984
FLOORS: 2

Figure 34: Exterior Picture of Wallace Center

Figure 35: Wallace Center Floor Plans, First Floor

APPENDIX B

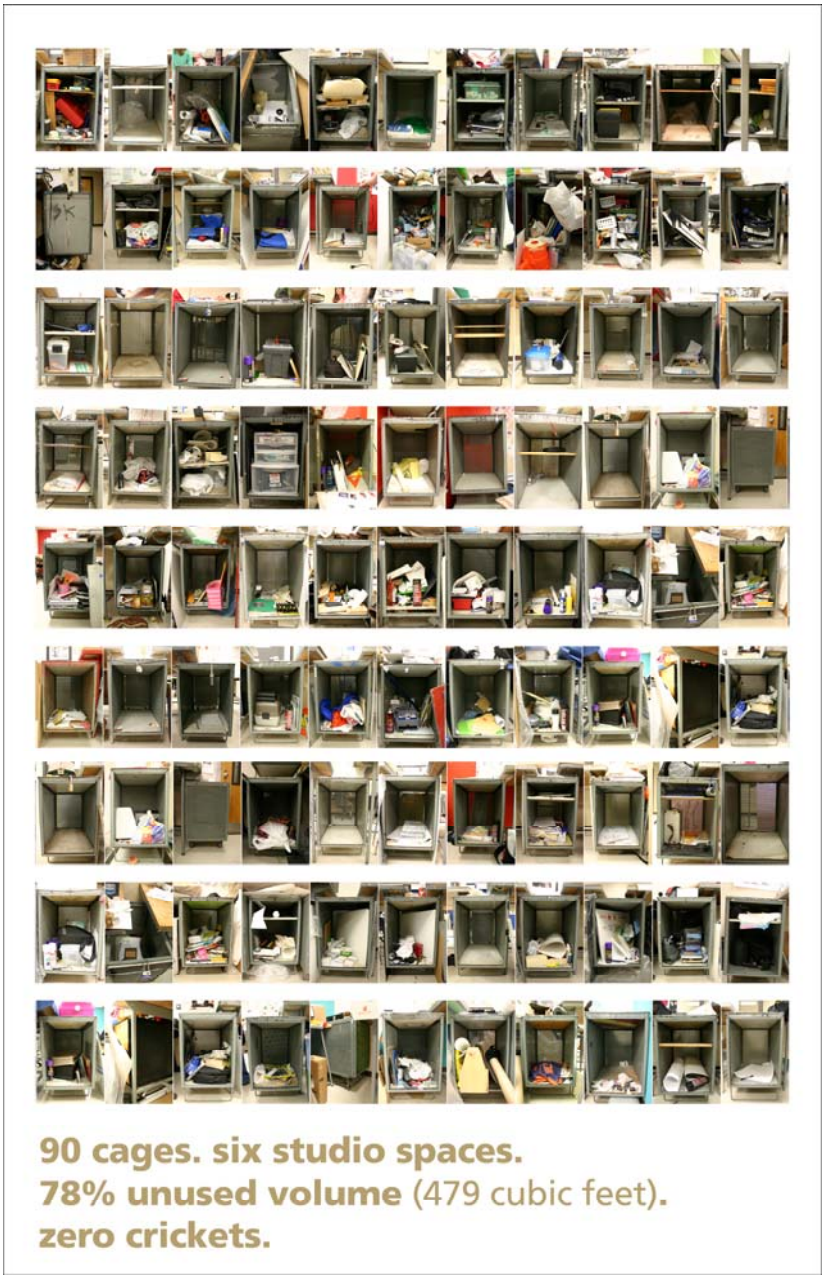

Figure 36: Picture of Poster Made with Cricket Cage Survey Results

APPENDIX C
Different Furniture Configurations

Figure 37: Configuration A: Traditional Classroom Set-Up with Towers in the Center

Figure 38: Configuration B: Tables Set-up for Group Collaboration

Figure 39: Configuration C: Four students share a storage unit and a table surface. Also removable glass partitions are installed for more privacy.

Figure 40: Configuration D: Class set-up if a lecture is needed or for a presentation.

Figure 41: Configuration E: Petal formation of the desks helps promote one on one or three person collaboration because the tables can be surrounded on three sides.

Figure 42: Configuration F: Furniture can be configured in random patterns to meet the needs of the students.

Figure 43: Individual task lighting at each desk.

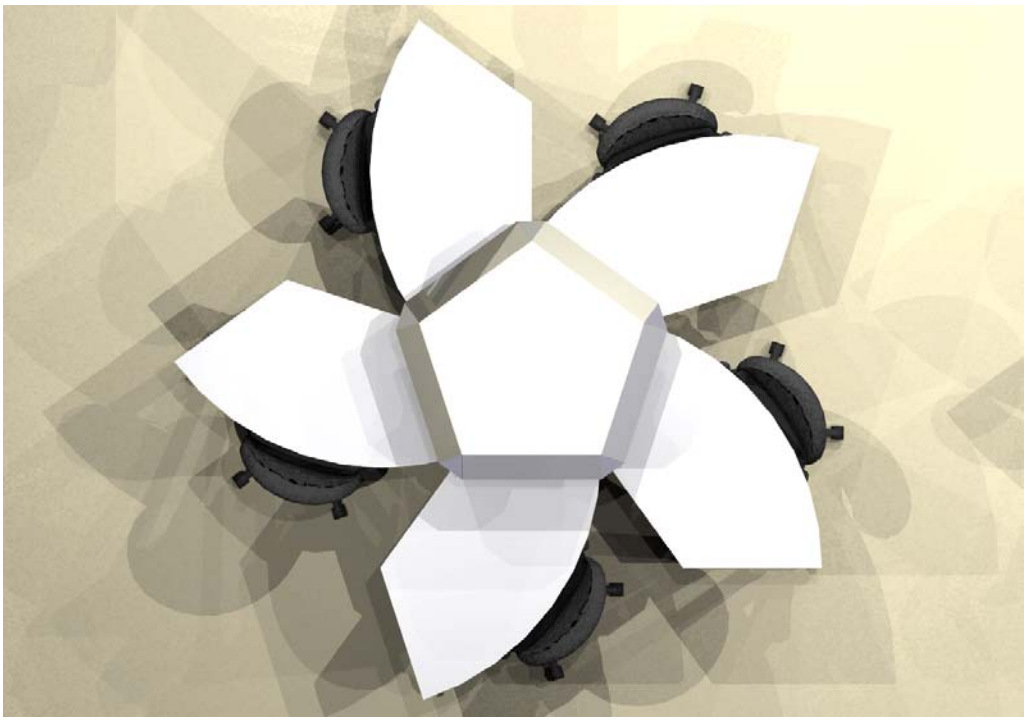

Figure 44: Overhead view of desks in the petal formation.

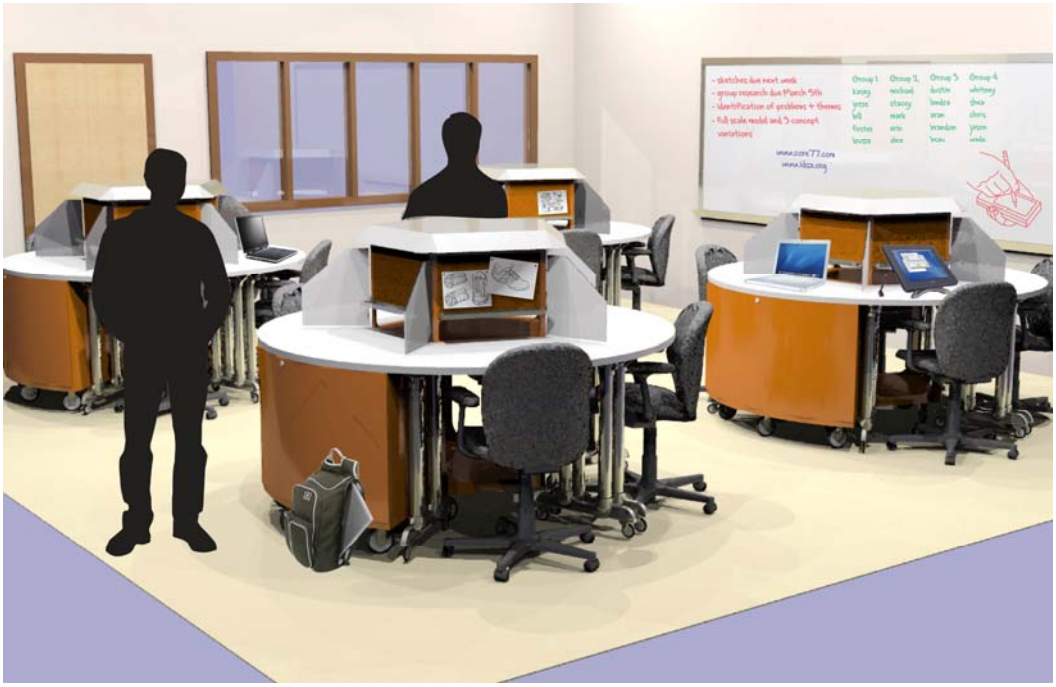

Figure 45: Room in Use