

ERS 250: Greening the Campus and Community

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1.0 Introduction

1.1 Context

In order to “green” sections of Environmental Studies building 2, the students of ERS 250, Greening the Campus and Community divided into groups; each group was responsible for a project that implied a distinct aspect of “green” building design to the space therein. ES2’s potential to house a “green” area presented the class of ERS 250 with an opportunity to integrate innovative and personal “green” concepts into a practical application of environmentally sustainable building design. However, as ES2 is not a new building, student creativity was limited by the design inherited from the buildings’ original structural characteristics. Current heating and cooling characteristics, window placement, lighting, room and roof dimensions, etc., determined to some extent the length to which students could incorporate their ideas into reality. Other challenges posed by “greening” ES2 included budget constraints, which placed boundaries on students choice of materials or the amount of any material that could be purchased. Overall, the class’ aimed to create a highly efficient, ecologically sustainable space, including lighting technology, maintenance, a green roof, green materials and indoor landscaping, modeled after other “green” spaces, such as the Adam Joseph Lewis Centre at Oberlin College.

1.2 Purpose and Objectives

Our group chose to broadly focus on the indoor working environment of one of the rooms in ES2, room 272 B. Specifically, we decided to focus on an important subsystem of any indoor working environment – interior design. The design of a room, including factors such as color and the manipulation of objects within a space can significantly impact a person’s experience of a room. Light colors, for example, can make objects seem lighter and larger than they are, while dark colors can have the opposite effect on size (Pile, 1995). In light of ERS 250’s emphasis on sustainable, green building design concepts, our group aimed to create a highly efficient, multi-purpose working environment that ERS students could enjoy.

Our project encompassed other components of a sustainable indoor working environment design, such as non-toxic wall paint, however, the bulk of our research was

aimed at determining 272 B's interior design including; space manipulation, desk placement, incorporation of technology with the space, wall color and floor texture. Cumulatively, we aimed to produce an innovative stimulating learning environment in which students could maneuver to work independently and in groups. We wanted the tone of our classroom design to be unique among other lecture room spaces on campus, which we observed to be uninspiring. Most lecture rooms, for example, have a traditional set-up within a rectangular space, in which the professor stands at the front of straight rows of desks or tables. Usually, no color is applied to the walls and no attempt is made to incorporate the physical or emotional comfort of the room's participants into its design. The psychological effects of light, color and space manipulation were incorporated into our classroom concept in order to produce a design that would enhance learning and work efficiency.

We decided to follow in David Orr's footsteps by opening our interior design process up to other ERS students and faculty. Particularly, we decided to include student input on factors that would influence our design of 272B. Some of these determining factors were: preferred writing surface, preferred desk or table set-up, preferred learning style, preferred wall color, preferred flooring and lighting preferences (see appendix A for questionnaire details).

2.0 Methods

2.1 Method Overview

As a group we decided to focus on the direct needs and wants of the students who are most likely to use the ES2 room, 272B. In conjunction with questioning students, we used literary sources that focused on interior design elements and principles that contributed to our goals. Understanding the psychological effects that room design has on its users became a topic for research as we aimed to establish how the design preferences chosen by the students in our questionnaire, would affect them as a whole. Our goal was to integrate students' desires with the design options that we determined would provide the highest level of comfort for all facility users. Once we understood the

desires of our respondents, as well as the design components relevant to our objectives, we focused on the research design options available for a productive classroom design. By including information gathered from case studies such as that of Oberlin College (Bartlett and Chase, 2004) we were able to establish whether or not some of our proposed ideas for the ES2 room would be feasible.

2.2 Student Questionnaire: Respondent Selection

In order to gather accurate information on the preferences students would have for an educational setting that is designed to incorporate the principles of environmental sustainability, the students had to fit into one basic category; they had to be enrolled in the Environmental Studies faculty. Students from all four undergraduate years, as well as a small number of graduate students were involved in the questionnaire in order to determine whether or not their university familiarity changed their room design needs and preferences. Our reasoning was that their understanding of environmental issues would inherently promote “green” design of 272B. None of the questions stipulated which choices were environmentally friendly because we wished to see if the respondents’ choices reflected an awareness of sustainability and “green” thought. If their choices did reflect an awareness of sustainability, the next task was to find out how their opinions could be incorporated into material cost, availability and design principles.

2.2.1 Questionnaire Formulation

We selected a group administered questionnaire, as this gave us the opportunity to clarify any questions by the respondents and it assured us a very high rate of response. The questionnaire was comprised of nine multiple choice questions and three yes or no questions. The question topics ranged from preferred wall color, to whether or not internet access is necessary in the room. Our close-ended questionnaire was based on our general knowledge of the classroom environment as gathered through our own experiences as students. We conferred with literary sources in order to determine which choices were available to us and which options were commonly used in educational settings. By providing only the most commonly used classroom design components we were optimistic that the respondents would have some familiarity with each of the

options mentioned in the questionnaire and would therefore be able to form an opinion based on their personal experiences. Our chosen form of questionnaire made it easier to quantify answers in terms of percentages and ratios. The results were graphed and comparisons were made in order to provide us with conclusive information on student preferences.

Please refer to Appendix A for the entire questionnaire. The graphed results of the questionnaire are discussed in results section 3.2.

2.2.2 Questionnaire Limitations

Some key limitations were encountered:

- a) The respondents noted that the addition of “other” as a category in the multiple choice questions would have been beneficial as a means of providing us with more options to consider in the room design. We believed omitting this “other” category was in the needed to determine the mean for each question. Allowing respondents to widen the category would not portray an accurate representation as the answers may have been too detailed.
- b) The ethical clearance through ORE can be a lengthy process, therefore we chose a simplistic format for the questionnaire in order to minimize the time between ethical approval and information collection.
- c) Respondent participation was limited by the cost of multiple questionnaire copies.

2.3 Literature Review

Our focus was on interior design as it affects the ambiance of an educational setting while adhering to sustainable environmental practices. Interior design books gave us information on aesthetic appeal as well as proper use of space for work areas. The principles of how to use light, color and furniture positioning was critical to determine the options we provided in our questionnaire, but also aided us in the type of products we should search for. Once we understood the design dynamics mentioned above, we needed to acquire information about which design companies adhere to environmentally sustainable practices and manufacture “green” products. This part of research was heavily concentrated on the internet, as manufacturers provide information that promotes

their product(s) on websites such as, www.expanko.com. We found information on product durability, installation, maintenance, and possibilities for retrofitting. Although many of the companies discussed in the Results section are not local, which means the purchase of their products may prove to be too expensive; they manage to provide an example of the possibilities available in environmentally sustainable interior design.

2.3.1 Literature Review Limitations

- a) Although information is abundant on environmentally sustainable materials, design and structure, most of this information concentrates on exterior construction, which was not applicable to our objectives. Interior design books rarely contain information on the environmental sustainability of the products/materials discussed.
- b) The cost of materials is not commonly listed in literature or on websites. For this information we would require a pricing brochure from the various manufacturers on all products listed in the Results section of this paper. The time frame we were left with after collecting results from the student questionnaires was not sufficient enough to do this.
- c) We were unable to find local companies that specialize as manufacturers of environmentally sustainable designs via the internet, although they may exist.

2.4 Case studies

The use of case studies was critical in pointing out what is possible in terms of “green” building technology. We referred to the case of Stanford University Guidelines for Sustainable Buildings (ERS Course Reader, 2004) as well as the Adam Joseph Lewis Centre at Oberlin College (Bartlett and Chase, 2004).

2.4.1 Case Study: Stanford University Guidelines for Sustainable Buildings

The Human Factors section in the indoor environmental quality chapter provided us with a guideline of what was required in order to create healthy and comfortable conditions in the ES2 classroom. Although the use of effective lighting and thermal conditions were not the direct focus of our study, we found it to be useful when

considering how these elements affect and interact with the aesthetics and ergonomics of designing a classroom.

2.4.2 Case Study: Oberlin College

The values of least cost, end-use analysis, full cost accounting as well as system analysis, as mentioned in the Bartlett and Chase 2004 article, guided us in integrating the design selections with the ability to efficiently incorporate them. Although we are not able to provide details on such costs in the case of the ES2 room, we believe this to be an integral part in determining the feasibility of any project initiative.

2.4.2 Case Study Limitations

- a) The case studies concentrated mainly on the buildings as a whole, with minimal focus on creating an optimum educational atmosphere from an interior design perspective.

3.0 Results

3.1 Result Overview

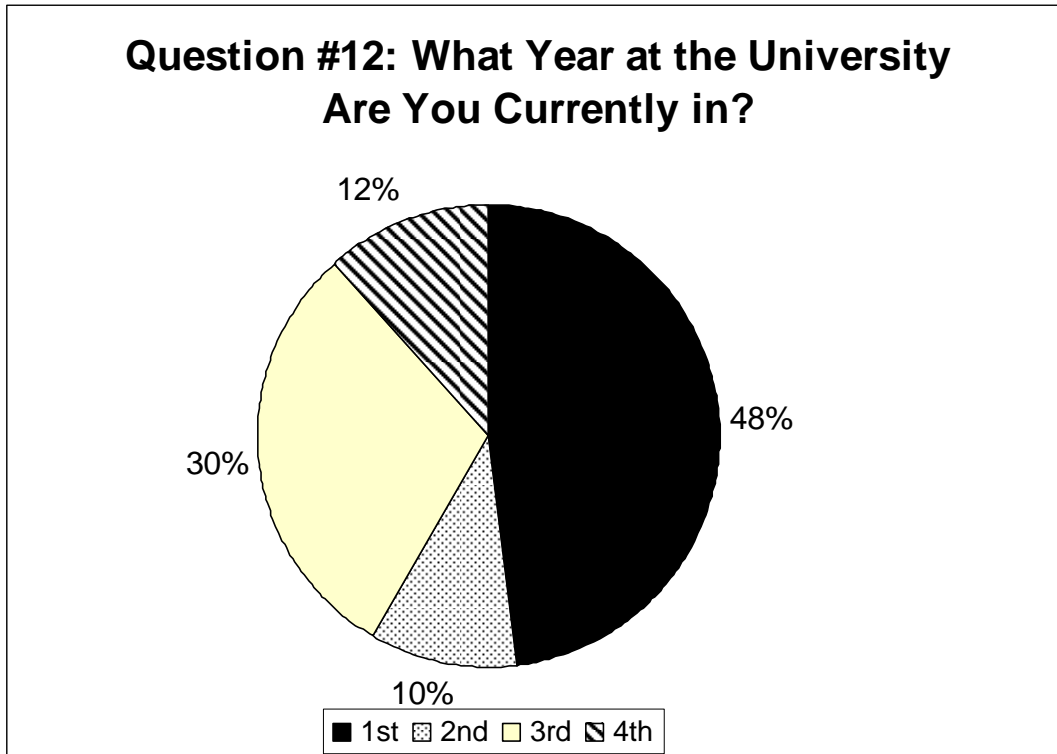
The results from our research were subdivided in to four categories: questionnaire, paint/colour, lighting and technology. These were found to be the most influential segments of creating a productive work environment.

3.2 Questionnaire

Characteristics of the Respondents

Seventy-seven students responded and completed the survey and all respondents were ERS students. The actual percentage of individuals who declined to respond was not recorded but the response rate was very high. Gender differences were not of interest in this study, though there were more female respondents than male respondents, which is consistent with actual gender differences in ERS enrollment. One characteristic of the students that was thought to be relevant was year of enrollment since time and experience at the university could have an impact on preferences for the room design. As can be seen in Figure 1, all four years were represented in the sample. Almost half were first year students and the remaining students were distributed among second, third and fourth years.

Figure 1



Interior Configuration of the Room

Four questions were used to gather information about the ways in which students would like to see the interior of the room arranged or designed. The four aspects of the room examined included student preferences in terms of the flexibility of creating multiple spaces in the room, arrangement of furniture, type of furniture and type of workspace for interacting with others. The students' preferences are shown in Figures 2 to 5. As can be seen in Figure 2, the majority of the students (68.8%) would prefer a room that is undivided and consisting of open space. Of the remaining students, the strongest recommendation was the use of movable room dividers (16.9%). The response to this question and all of the questions on the survey were also examined by year of enrollment. Where substantial differences in the preferences of the students in different years were found, these patterns are discussed. Figure 3 suggests that more senior students, those in second, third and fourth year, have a stronger preference for the open concept room configuration. First year students are more mixed in their response.

Figure 2

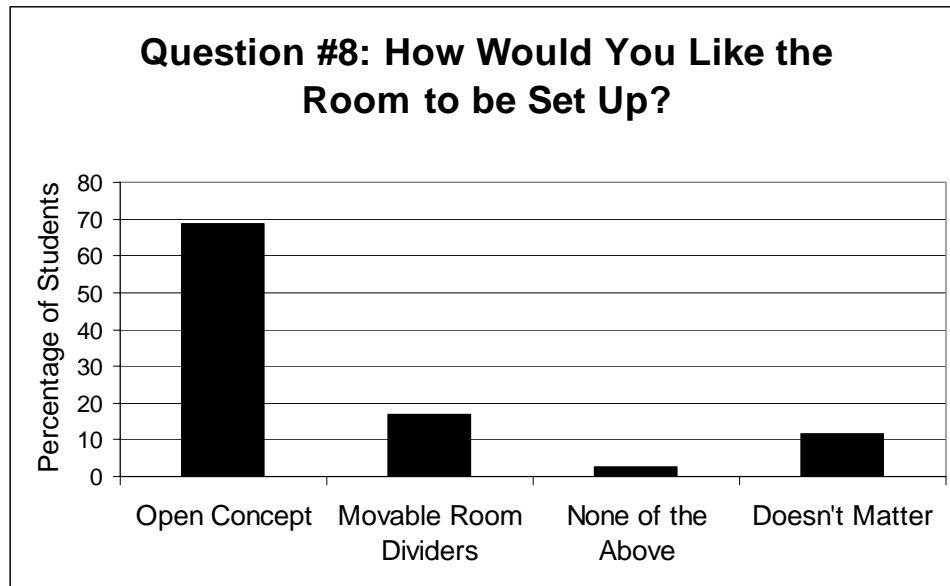
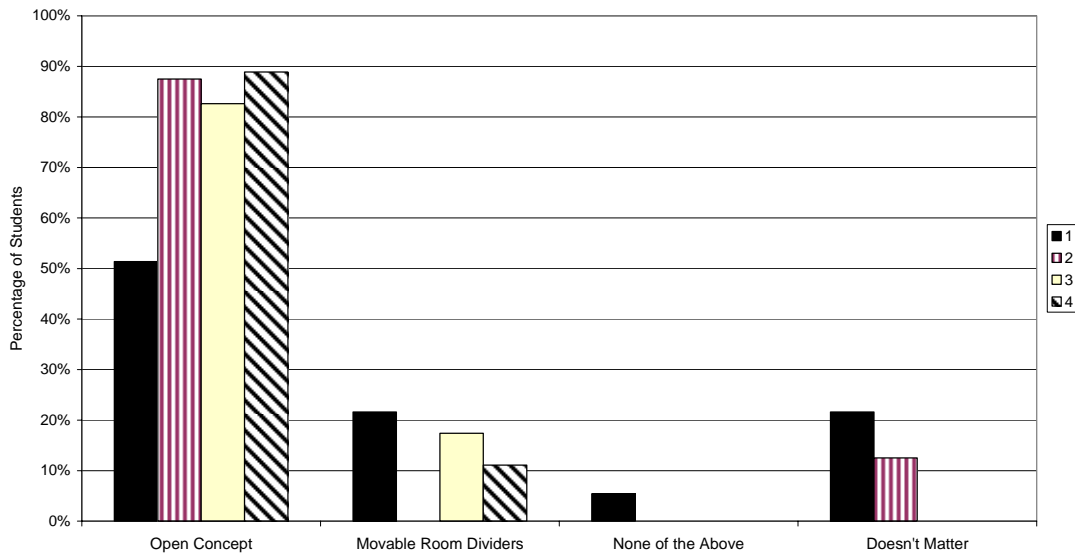


Figure 3

Question #8: Type of Room Setup By Year



Though the majority of the respondents preferred to have desks and chairs arranged in straight lines (40.3%), there was a diversity of opinion about furniture arrangements (see Figure 4). The furniture arrangements did not matter for some of the respondents (16.9%) but others felt that the furniture should be able to be grouped

(10.4%) or arranged in a U-shaped configuration (24.7%), which would likely encourage student discussion and interaction. Not surprising then, as with the range of opinions about the room arrangements, there were mixed preferences among the students about the extent to which they wanted space to interact with other students available in the classroom (see Figure 5). Thirty-nine percent of the students indicated a preference for arrangements that would allow them to interact with other students in the classroom setting. The desire for flexible arrangements was also shown by the fact that 29.9% of the students wanted the room arrangements to provide both individual space and group space.

Figure 4

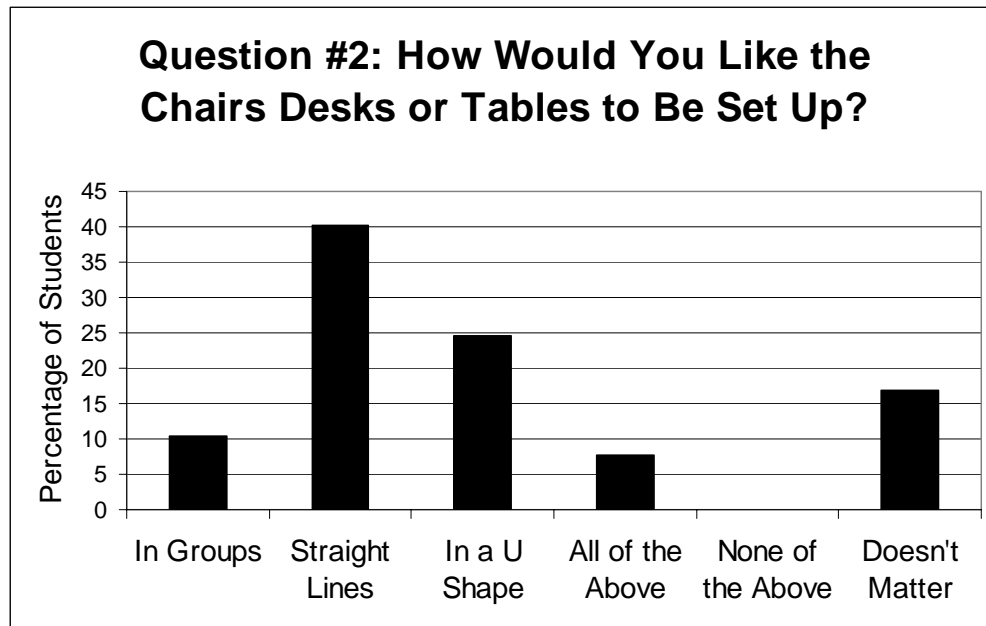
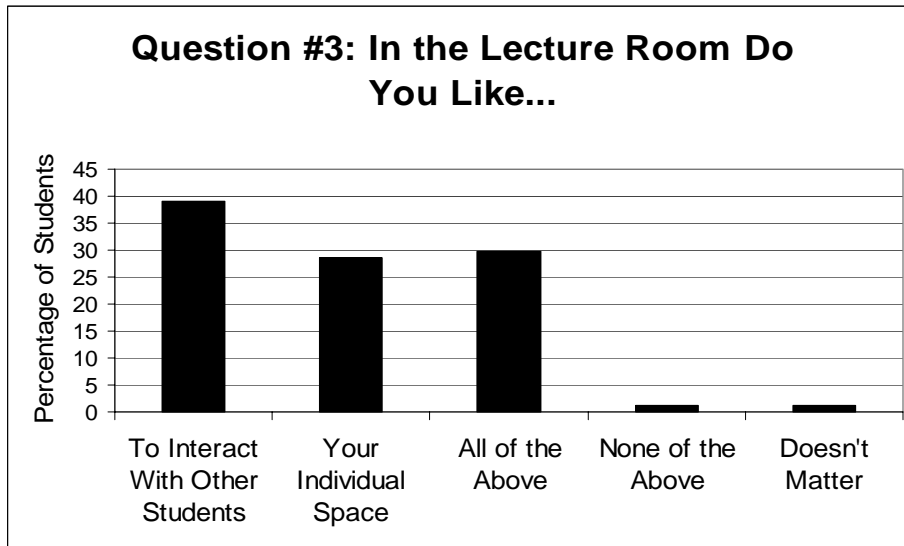
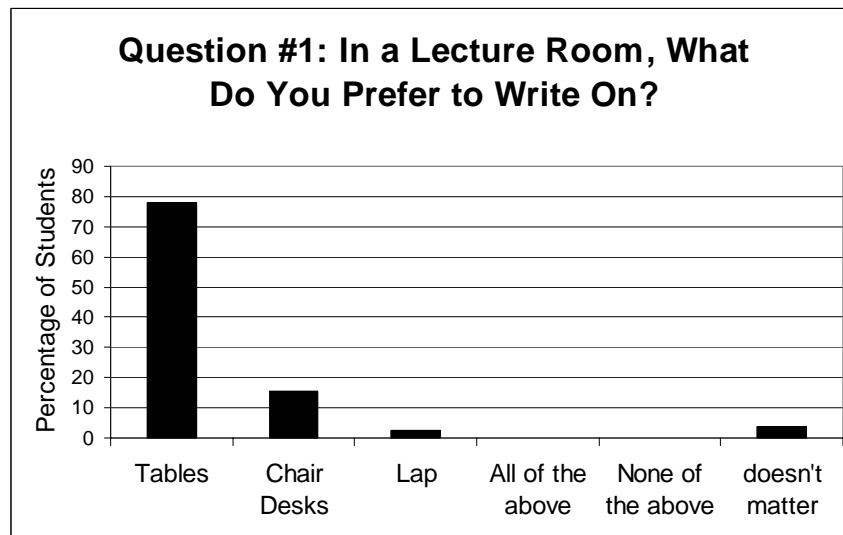


Figure 5



Finally, with respect to room arrangements, the majority of the respondents indicated that the type of furniture they preferred to work on was a table (77.9%) rather than a chair-desk (15.6%) (see Figure 6).

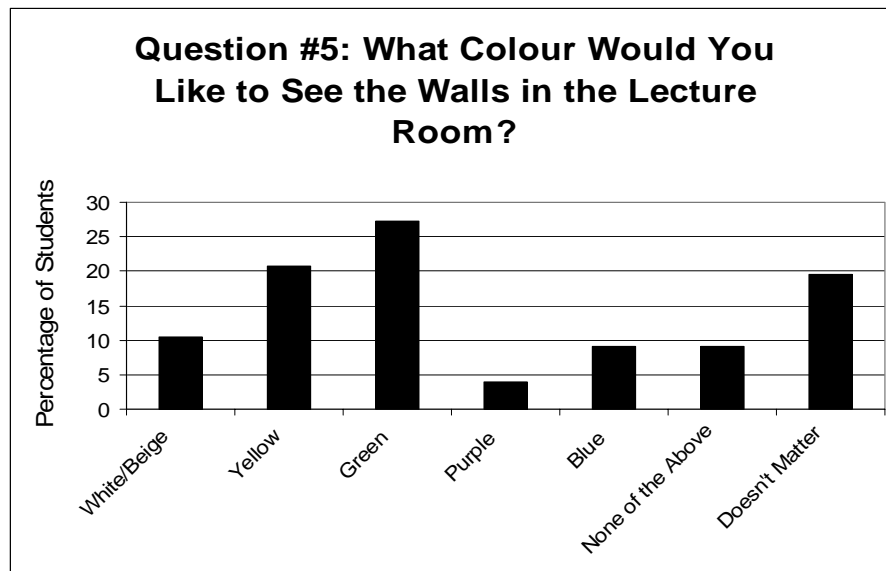
Figure 6



Interior Decoration

Three questions were used to determine if students had a preference for the way in which the interior of the room was decorated and lighted. Students were asked to indicate their preference for wall color, type of flooring, and type of lighting. As can be seen in Figure 7, of the wide range of colors suggested, green was the most popular color with

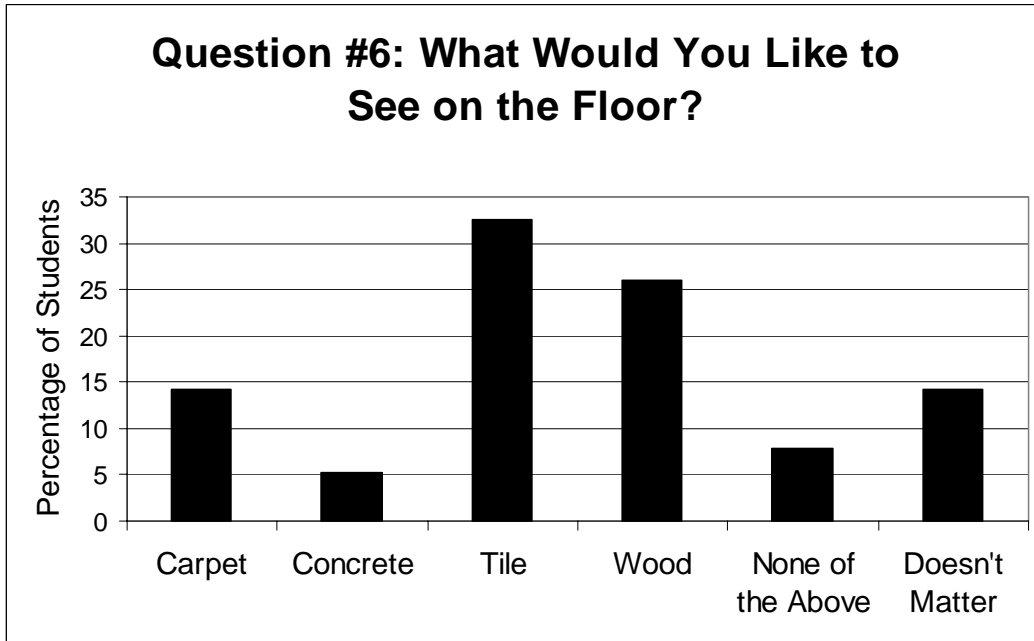
Figure 7



27.3% of the respondents choosing this color, followed by 20.9% preferring yellow. Color of the walls did not matter for 19.5% of the respondents.

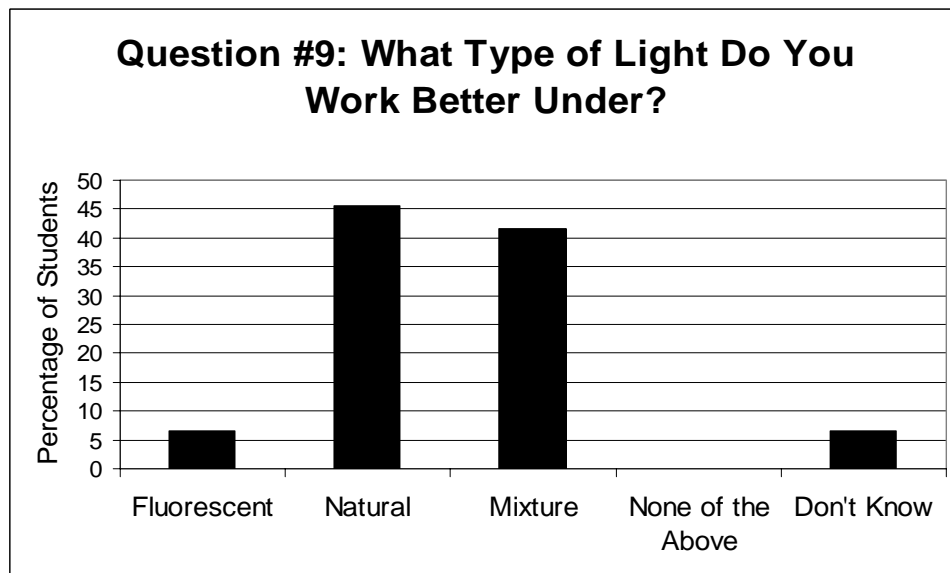
Another aspect of the decoration of the room was the type of flooring that should be used. As can be seen from Figure 8, tile flooring was the most popular (32.5%) closely followed by wood flooring (26%).

Figure 8



With respect to the lighting of the room, respondents were asked to indicate the type of light they best work under. As can be seen in Figure 9, natural light was the most popular choice among the students surveyed (45.6%). The popularity of this choice was closely followed by the popularity among students of a mixture of both natural and fluorescent light (41.6%). Fluorescent light by itself was not a popular option.

Figure 9



Instructional Features of the Room Environment

Three questions were used to solicit information about the types of instructional aides students prefer professors to use in their teaching as well as the features of the room they would find useful in the learning process. Specifically, students were asked to indicate their preferences for the type of medium to be used by professors to lecture, the desirability of having internet accessibility in the room, and the opportunity for eating in classroom. As can be seen in Figure 10, majority of students prefer their professors to use PowerPoint in their lectures (46.8%), which would be the installation of a data projector. This preference was followed by the use of overheads (29.9%) and all types of media (13.0%). Surprisingly, over 50% (50.7%) and 15.6% said that internet access was not important or it didn't matter to them respectively (see Figure 11). Third and fourth year students seemed to have less interest in having classroom access to the internet (see Figure 12). The majority of the students felt that eating should be allowed in the room (77.9%) (see Figure 13).

Figure 10

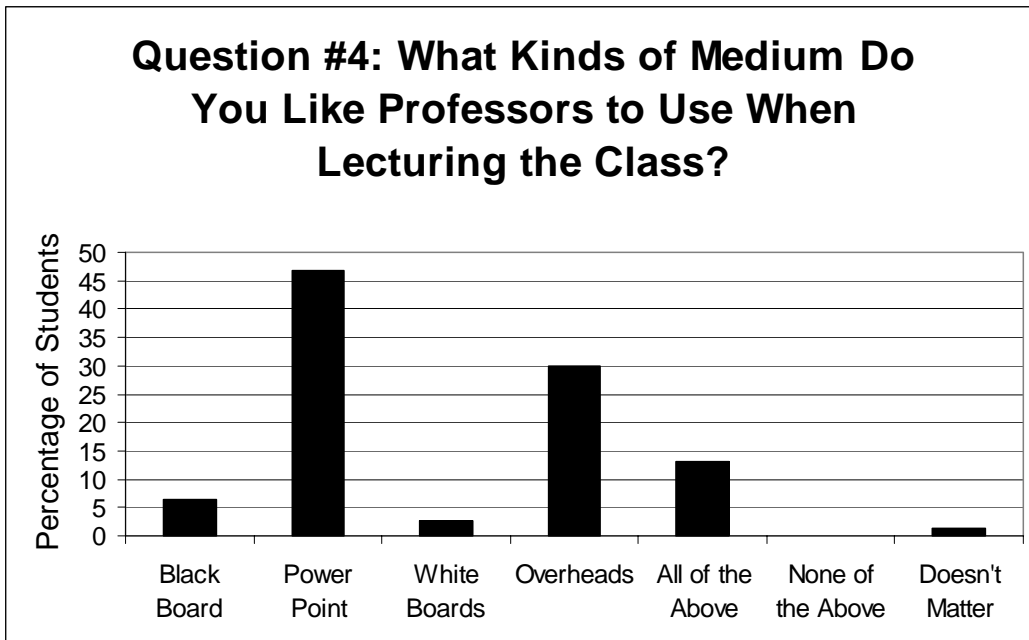


Figure 11

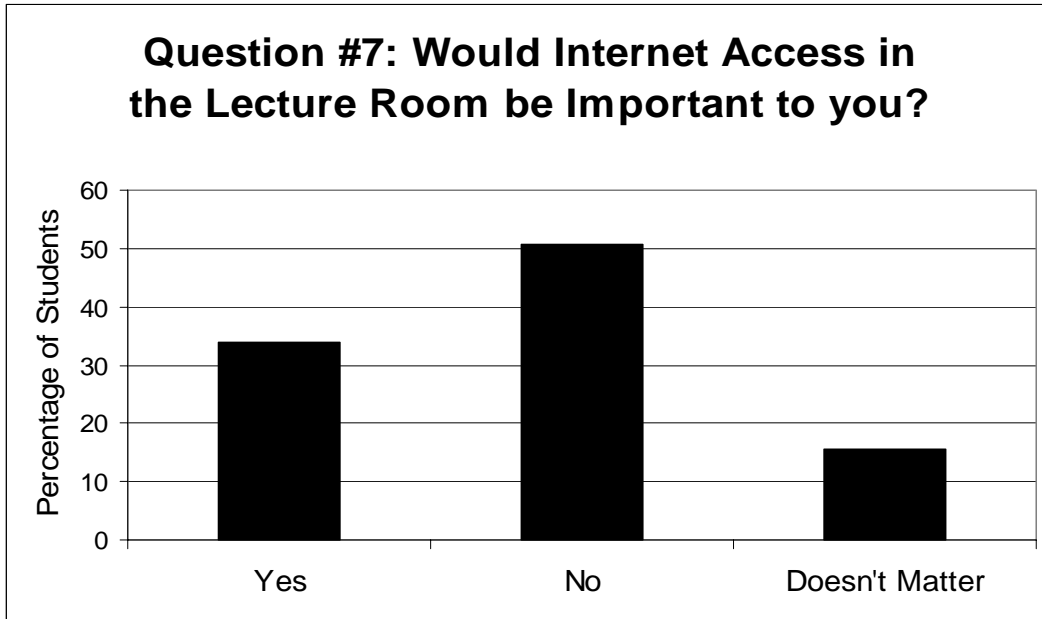


Figure 12

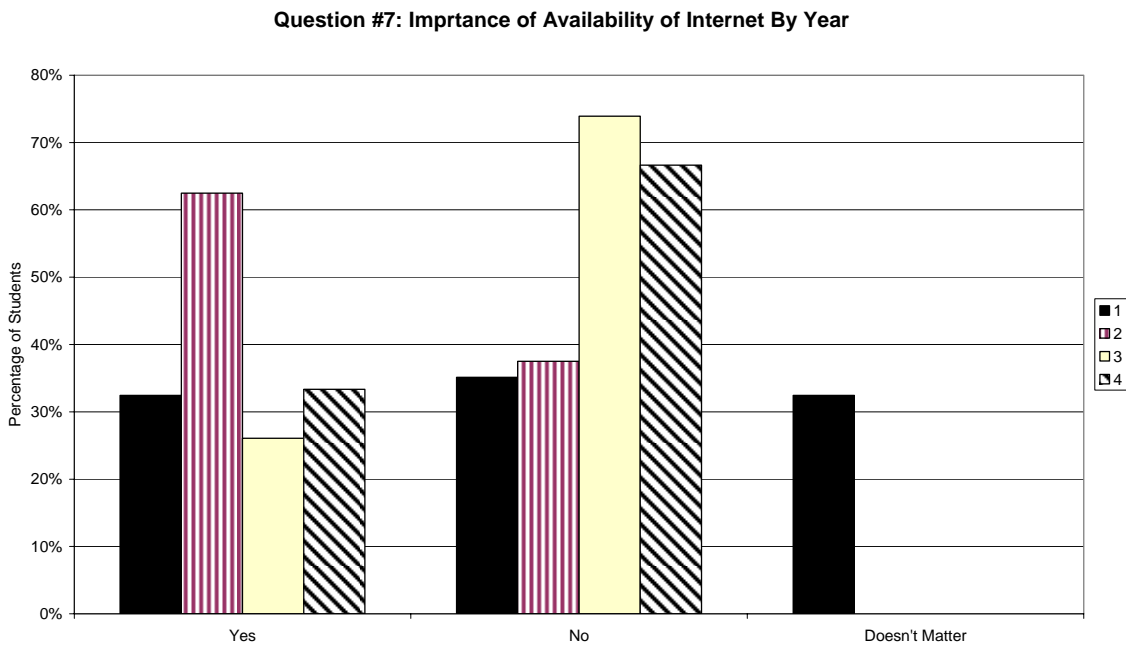
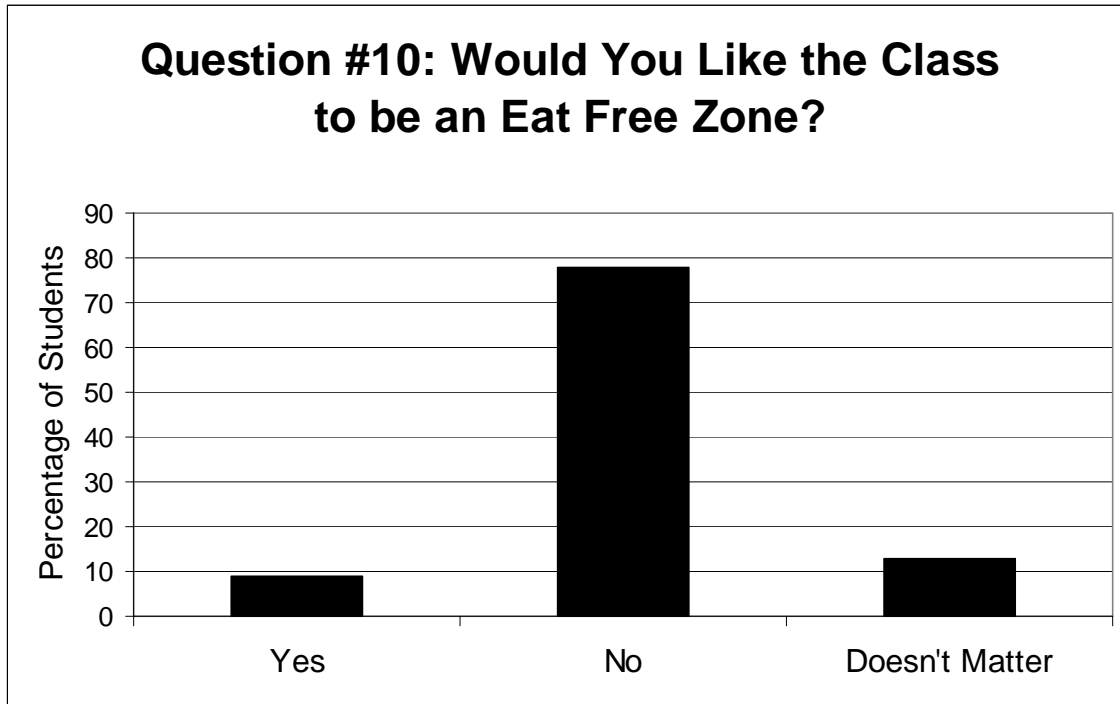


Figure 13



Design of the Room for Students with Special Requirements

One open-ended question was included in the survey to determine if students felt the room needed to be designed to meet any special requirements that some students might have. In particular, the question asked about allergies and disabilities. Very few respondents answered this question indicating that it was not a high priority for them. Of the 77 respondents, only 6 (7.8%) answered this question. The most frequently mentioned concerns were that the room be designed to ensure that dusts, molds and pollen as well as residue from artificial materials not contaminate the air. Also mentioned was the suggestion that the room be wheelchair accessible. Furthermore, one person suggested that an area be included in the room that would accommodate the hearing impaired. Lastly, it was mentioned that a first aid kit should be made available in the classroom.

3.3 Paint/Colour

It is widely recognized that color can have a strong impact on human moods and emotions. Although it is difficult to generalize the meaning of one color for all cultures because of culture differences, color can be divided into warm tones and cool tones. It is generally agreed, for instance, that warm colors, such as red, orange and yellow, convey a feeling of physical and emotion warmth. These colors can make a room feel “cozy” and warm. Conversely, cool colors, such as green, blue and violet, suggest formality and reserve. According to Pile (1995), generally accepted associations of hues are:

Table 1

Color	Generally Accepted Association
Red	Warmth, heat, excitement, stimulation, tension and danger.
Orange	Reduced warmth, heat, excitement and stimulation.
Yellow	Cheerfulness, humour, safety and hope.
Green	Calm, rest, peaceful and constructive.
Blue	Rest, repose, calm, dignity, depression and gloom.
Violet	Uncertainty.
White	Clarity, openness, brightness.

The results of our questionnaire reflected our preference for green and yellow, with the majority of students choosing green as their first choice for wall color and yellow as the dominant second choice (see question #5, appendix A). Since green and yellow sit close together on the color wheel, an analogous color scheme would best suite our purpose (see appendix B: photo of color wheel); different shades of green and yellow as opposed to a monochromatic color scheme would break up the walls to stimulate the eye.

3.4 Lighting

Lighting can have a significant impact on a learning environment. The location of lights in a classroom can either promote or distract learning objectives. Direct, bright lighting, for example, can light up an entire classroom, illuminating the entire work space, giving students the comfort of working in an environment that has an even distribution of light across space. In contrast, pod lights situated around a classroom can produce a spot-light effect, illuminating some areas more than others, casting dark shadows across important working space.

Figure 1: Pod lighting in a classroom.



Figure 2: Uniform classroom lighting.



According to energy effective lighting for classrooms daylight is a key to lighting quality in the classroom. Students with daylight in their classrooms perform 20% - 25% better than students without daylight in their classrooms.

Figure 3: Daylight lit classroom.



Figure 4: Mixed daylight and direct light.



Again, our preference for lighting was similar to the preferences expressed by students in the questionnaire; we found that most students preferred natural lighting or mixed lighting (see question #4 in appendix A). We looked at the design quality of three different types of light fixtures: prismatic plastic lenses, open cell parabolic fixtures and direct-indirect fixtures (Baker 2000). We found that prismatic plastic lens fixtures provide the most pleasant lighting quality for a classroom as they create a uniform covering with soft shadows. Parabolic lights, in contrast, cast sharp shadows on the walls, under the chairs and naturally, on people's faces.

Figure 5: Prismatic Plastic Fixtures



Figure 6: Open-cell Parabolic Fixtures



Figure 7: Direct-Indirect Fixtures



3.5 Technology

Presently professors are using anything from blackboards to overheads to LCD projectors in the lecture room. It's important to choose which type of media is to be used in the lecture room that benefits both the student and the professor; it might be a mixture of medias or just one media type. Today, LCD projectors are the most convenient tool for professors and students (see Figure 8). Professors can use their personal laptops and hook them up to the LCD projector and can display their lecture notes this way or the room can be equipped with a computer that is permanently hooked up to the projector. Another option is to have a 'multimedia trolley' that holds a computer with a CD-ROM drive and network card, presentation software such as PowerPoint, speakers, and a LCD projector. This would allow the equipment to be transportable within the building and could reduce cost; purchase one LCD projector that can be used in all lecture rooms rather than an LCD projector for each lecture room. Notes presented via PowerPoint are easy for students to read and follow and allows professors to have direct access to the internet. Projectors should be close to the screen without blocking students' line of sight and should project at 90 degrees to the screen.



Fig. 8
LCD
Projector

Many students today also take their own laptops to lectures instead of writing notes on paper. For this reason, it is important that the lecture room be equipped so that students can plug in their laptops.

Technology is constantly changing and, therefore, it is important to plan for the future. If there are new technologies that are going to be used in lecture rooms in the future it is important that the room have the appropriate wiring so that it can accept the

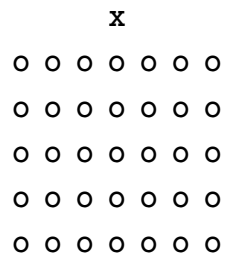
new technologies without having to reconstruct the lecture room.
(<http://www.agocg.ac.uk/wshop/lrs/lrtoc.htm>)

3.5.1 Seating Arrangements

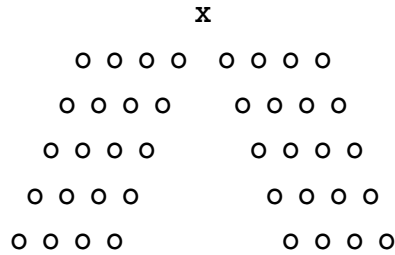
After fully completing our research we discovered that there are many types of seating arrangements that could be used in the lecture room. Each type is unique and offers its own benefits. The right seating arrangements is important in the lecture room and should allow students to have their own personal space, but at the same time allow them to interact with their fellow peers and professor. The following is a list of different seating arrangements and their advantages. Diagrams are shown to illustrate the design of each arrangement; the **x** represents the professor and the **o** represents the students. (2001, www.nwlink.com)

(1) *Traditional Seating* – Most common and typical style of seating in a lecture room.

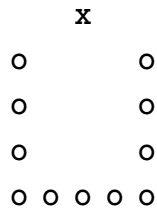
The professor stands at the front of the class and the students sit in rows directly in front of him. Communication is more one way; professor talks and students take notes. There is little space for interaction between students. This style prevents the lecturer from seeing the back of the class unless seats are sloped.



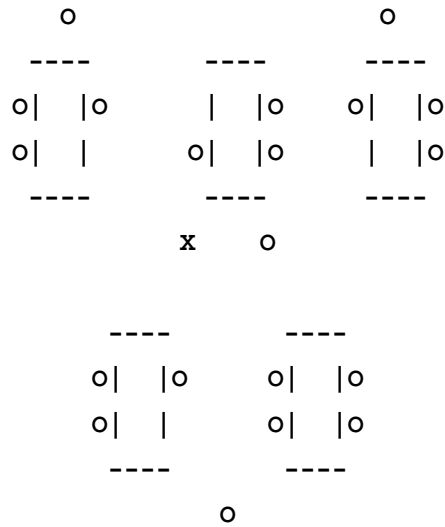
(2) *Modified Seating* – Similar to traditional seating, but seats are arranged in a fan shape. This allows more interaction between the professor and the students as the professor is able to walk up and down the aisles. This arrangement also allows for more space for the individual student and allows the professor to see all students. Allows little interaction between students.



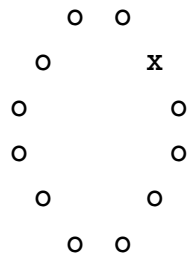
(3) *Horseshoe* – Professor is situated at the front of the classroom again, but students are arranged in a horseshoe design. Students face each other and have eye contact with another, which allows for more interaction between them and their professor. The professor and move freely and closer to students. A very good arrangement when it comes to presentations and demonstrations because all students are able to see the presenter. Also allows for large group discussions and allows for students to break up into smaller groups more easily. May not be ideal for large lectures with 100 plus students.



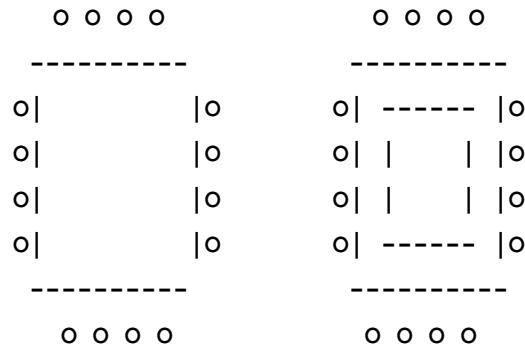
(4) *Modular* – In this arrangement students are arranged in small groups and professor moves around freely with no designated spot at the front of the room. This allows for maximum interaction between students. It is ideal for group assignments and presentations. Communication between professor and students is more difficult because professor needs to be moving constantly between groups. May be harder to control students.



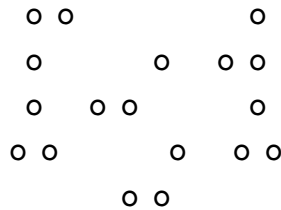
(5) *Circle* – Professor and students sit in a circle. Allows for everyone to be seen as equals. All students are revealed, there is eye contact between everyone within the circle, and communication can occur easily. This type of arrangement encourages communication and interaction, but can also lead to chaos and shouting matches. Not necessarily suitable for large lectures.



(6) *Square and Rectangle* – Similar to circle arrangement. Students sit around a square table or rectangular table. Professor is free to move around. Both arrangements allow for more communication and participation between students. There is the potential, however, in both arrangements that one side of the table become “the head of table” and allows for inequities. More suitable for seminar rooms and smaller groups.



(7) *Scatter-Plot* – Students are simply scattered throughout the room. Professor is free to move around. Communication can be limited and allows for the opportunity of groups forming. Those individuals who are less outgoing and quiet may feel left out. Not good for lecture room style where students have to take notes.



3.5.2 Seats

It is important for students to feel comfortable in the lecture room because it is where they do their work. Having the right seat that doesn't cause any harm to a student is necessary. A seat should have the right dimensions, shape, geometry, adjustments and cushioning (<http://www.openenerg.com/seating.htm>). If students were to find themselves in uncomfortable seating it could effect their learning and productivity.

Seats can either be free standing chairs (see Figure 9) that can be used at tables or they can be arranged on a permanent bar with a table system (see Figure 10) that can either be independent or form part of the seat structure. There is also the option of having the seat screwed down to the floor or to swivel with a flip up seat (see Figure 11). Another option is to have chairs with built in tables on them. Seats can be upholstered or just metal (<http://www.figueras.com>). If upholstered the material should be biodegradable or reused. For metal or wood seats recycled material should be considered before purchasing brand new seats from a manufacturer (2003-04, www.oberlin.edu). The seats must also be durable and easy to clean.



Fig. 9
This lecture room has free standing chairs pulled up at tables.



Fig. 10
This lecture room shows seats that are arranged on a permanent bar with a table system.



Fig. 11
This lecture has bolted down upholstered chairs that flip up.

3.5.3 Flooring

There numerous styles of flooring that can be used in the lecture room. It is important to have a durable, easy to clean and fairly maintenance free flooring. Also, the flooring needs to be comfortable and present no health risks to students.

A typical option is concrete and tile. Some interesting flooring that was researched includes cork, rubber and bamboo flooring. These options are more costly, but an investment that should be considered because they have a longer life and are environmentally friendly.

Cork flooring (see Figure 12) is made from Cork Oak trees that are grown in the Mediterranean Region. These trees are stripped of their bark every nine years. No more than 50% of their bark is removed at one time, enabling the trees to protect themselves. All raw materials are consumed during the manufacturing of the cork tiles. Cork floors are extremely durable, comfortable and aesthetically pleasing. They are becoming a popular flooring alternative (2004, www.expanko.com/CORK)

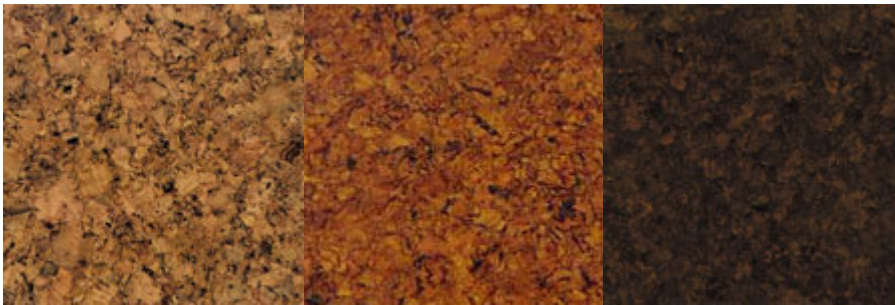


Fig. 12
Example of traditional cork flooring ranging from light (left) to dark colours.

Rubber flooring is made from a blend of recycled tires, post industrial waste rubber and virgin rubber (see Figure 13). They are excellent for high traffic areas and are highly durable and easy to maintain. They come in

multiple colours, are very resilient and can be used both inside and outside (2004, www.expanko.com/REZTEK)

Fig. 13
An example of rubber flooring in an elementary school hallway.

Bamboo flooring is sustainable, strong and very flexible. It is a great alternative to wood floors. It has been used for centuries and offers a simple, smart, easy to install and environmentally friendly alternative (www.ifloor.com)

A more recent trend is carpet flooring that is both environmentally friendly and a service-to-product material. Backings of carpets are made up of nylon, polyester, and plastics which are all nonrenewable resources that cause pollution and high energy demands. You can now purchase carpets with recyclable backings. Another option is carpet made from recycled PET polyester (i.e. soda bottles). Using carpet tiles or leasing carpet are other alternatives. Carpet tiles are useful for high traffic areas. One carpet tile can be removed when it is worn down instead of replacing the whole carpet. Carpet leasing is also appealing because the manufacture sells the service of the carpet and replaces worn out carpet and recycles it (Capek, S. 2002).

4.0 Analysis

The overall purpose of this report was to design an interactive, creative, flexible, and ergonomic learning environment. The research gathered and presented in the previous result section of the report lead to the ideal lecture room design. The design for the lecture room meets the needs of a learning environment as well as the needs of the students and professors presented in the survey.

The vision is of an open concept lecture room that holds approximately 80 to 90 students. The survey shows that the majority of students voted for an open concept room and we feel this is an appropriate choice because it allows for maximum communication between students and professors. Movable room dividers were not considered practical

in this lecture room because it is a smaller size room and the dividers might intrude on the working space of the students.

The walls would be painted using an analogous color scheme using green and yellow paint colors as opposed to a monochromatic color scheme. We decided that green and yellow walls for room 272B would best suit our effort to create a stimulating classroom that students could enjoy, as green promotes a calm and constructive atmosphere, while yellow promotes cheerfulness, safety and hope (refer to Table 1). Green and yellow were also chosen because they were the colors most favored by the students surveyed. The other colors were thought to be too harsh and obstructive or too bland for the creative and active learning environment we wanted to create.

Tables, instead of a table system, would be angled towards the front of the lecture room, directed towards the lecturer, much like a modified seating arrangement shown in the results section of the report. Tables were the majority vote of the students surveyed and it is felt that they would be more productive in this lecture space. The tables would provide ample work space for each student and would allow the room to be flexible in that the tables could be arranged into groups for group work and assignments. Chairs would be free standing, not bolted into the floor, to allow for the flexibility. They would not be upholstered, but steel chairs as they are easier to clean and move around.

The lecture room would be equipped with a mixture of media to allow for an optimal learning environment. It would be equipped with a permanent LCD projector and would have outlets for students to plug in their laptops and have access to the internet. As shown in survey results of the report greater than 50% of the students felt that internet access was not important; however, trends show that more students will be using laptops more frequently in the classroom. Having the lecture room equipped with the appropriate outlets now would save the costs of having to go in afterward and installing them. Though the LCD projector would be permanent a 'multimedia trolley' would also be used. The trolley would have a computer with a CD-ROM drive, presentation software and speakers and would allow for the equipment to be used in multiple rooms. This would save cost because only one computer, software and speakers would need to be purchased instead of one for each lecture room in the building. It would also allow for professors to bring in their own laptops to use. The lecture room

would also be equipped with a blackboard and overhead projectors. By having a mixture of media within the lecture room the professors can choose which to use based on what best suits their needs. Blackboards and overhead projectors are also a good backup if there were ever any technical problems with the LCD projector or computer.

Cork flooring would be the preferred flooring choice for this lecture room. Not only is it environmentally friendly but it is easy to maintain, highly durable, can handle high traffic areas, and is aesthetically pleasing. The survey conducted showed that the majority of students favored tile and wood flooring. It was felt that tile flooring was less appealing and could be a potential health hazard because it is extremely slippery when wet. Cork flooring is a good alternative to wood flooring because it offers the same aesthetic value plus it is environmentally friendly.

Lighting in the lecture room would be a mix of natural and direct overhead lighting. The survey showed that more students opted for natural light; however, it was felt that overhead lighting would be an asset on cloudy or stormy days when natural light would be limited. Research also showed that a mixture is more beneficial because prismatic plastic lens fixtures, a type of lighting fixture, in combination with natural lighting provide the most pleasant lighting quality for a classroom as they create a uniform covering with soft shadows

The survey that was conducted also showed that students would like to have the option of eating in the lecture room. To ensure that the space stays clean and healthy garbage bins and recycling bins would be placed in the lecture room.

The idea of adding live plants to the space is an option which would promote and increase a better quality of air, but also provide the room with a lively aesthetic appeal. The classroom is intended for environmental studies and this touch of nature would promote the “green” integration of sustainability and design.

5.0 Conclusion

Our group focused on designing a lecture room for the ERS 2 building. The lecture room is to provide an interactive, creative, flexible environment for the students and professors who use it. Our research was conducted through a survey and literature

resources, with some reference to case studies. Four main categories were looked at: technology, lighting, room layout and seats, and flooring. The following recommendations relate to these categories and are based on the research collected and studied.

6.0 Recommendations

- Cork tiles should be used for flooring; this is environmentally friendly flooring that is durable, easy to maintain, and aesthetically pleasing (questionnaire respondent preferred tile and wood over any other floor material, and this type of cover would satisfy both positions)
- Tables and free standing chairs should be used instead of a table system and fixed/bolted down chairs. This allows for flexibility; the tables and chairs can be rearranged into groups for group work and assignments
- Lighting should include both natural and direct overhead lights to maximize student awareness and take advantage of the lighting design already in classroom, including daylight, therefore reducing energy costs
- Colors should be green and yellow, the lighter color appearing in areas with a tendency to receive less light: thus the room will appear larger and brighter
- The lecture room should include mixed media: blackboard, overheads and LCD projector to allow for simple teaching utensils, when that is all that is needed
- Wiring for future equipment needs should be installed at the beginning of the construction process to accommodate future needs and possible retrofits
- Garbage bins and recycling bins should be placed strategically around the room to keep the space clean and healthy as well as promote proper waste disposal: reduce/reuse/recycle

Appendix A: Lecture Room Design for Environmental Studies Building 2

Survey Questions on Lecture Room Design

1. In a lecture room, what do you prefer to write on?
 - a) tables
 - b) chair desks
 - c) on your lap
 - d) all of the above
 - e) none of the above
 - f) doesn't matter
2. How would you like the chairs desks or tables to be set up?
 - a) in groups
 - b) straight lines
 - c) in a U shape
 - d) all of the above
 - e) none of the above
 - f) doesn't matter
3. In the lecture room do you like...
 - a) to interact with other students?
 - b) your individual space?
 - c) all of the above
 - d) none of the above
 - e) doesn't matter
4. What kinds of medium do you like professors to use when lecturing the class?
 - a) black board
 - b) power point
 - c) white boards
 - d) overheads
 - e) all of the above
 - f) none of the above
 - g) doesn't matter
5. What colour would you like to see on the walls in the lecture room?
 - a) White/beige
 - b) Yellow
 - c) Green
 - d) Purple
 - e) Blue
 - f) None of the above
 - g) Doesn't matter
6. What would you like to see on the floor?
 - a) Carpet
 - b) concrete
 - c) tile
 - d) wood
 - e) none of the above

- f) doesn't matter
- 7. Would internet access in the lecture room be important to you?
 - a) Yes
 - b) No
 - c) Doesn't matter
- 8. How would you like the room to be set up?
 - a) open concept
 - b) movable room dividers, that would break up the space and give groups within a lecture a place for discussions
 - c) none of the above
 - d) doesn't matter
- 9. What type of light do you work better under?
 - a) fluorescent
 - b) natural
 - c) mixture
 - d) none of the above
 - e) don't know
- 10. Would you like the class to be an eat free zone?
 - a) Yes
 - b) No
 - c) Doesn't matter
- 11. If you are a student with an allergy or handicap what requirements would you need in the lecture room to make it a better place for you to learn in?

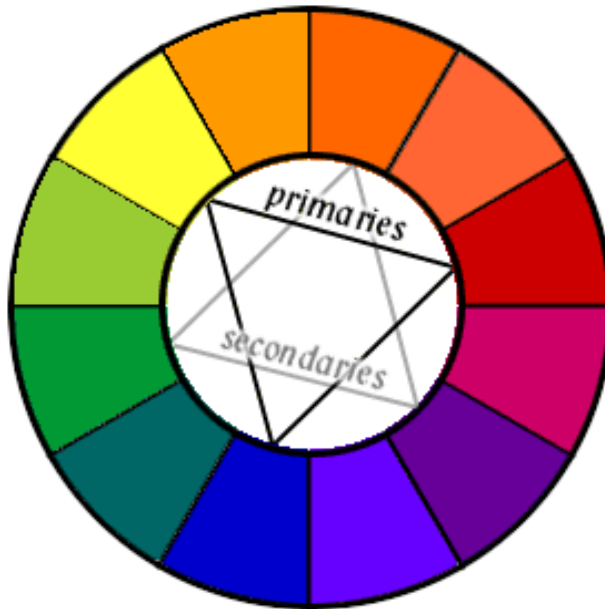
- 12. What year at the University of Waterloo are you currently in?
 - a) 1st
 - b) 2nd
 - c) 3rd
 - d) 4th

- 13. Are you an ERS student?
 - a) Yes
 - b) No

If not, what are you enrolled in? _____

Appendix B: the Color Wheel

The color wheel is used to determine appropriate color schemes in interior design. It shows analogous and monochromatic color relations as referred to in the Results: Paint/Color section.



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