

**The developing role of the university library as a student learning center:
Implications to the interior spaces within**

by

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ABSTRACT

The university library has developed into a center of learning and collaboration that can truly become the heart of campus within the university community (Hisle, 2005). Third places are “public places on neutral ground where people can gather and interact. The character of a third place is determined most of all by its regular clientele and is marked by a playful mood, which contrasts with people’s more serious involvement in other spheres” (Oldenburg, 1989). The library is neither home nor work, but a “third place” for students to study and socialize (Codispoti and Frey, 2007).

Recent trends in the design and renovation of libraries concentrate principally on the library as place, and as a social space (Bisbrouck et al., 2004). The third place role of the library has led the design of the physical environment to include a café, collaborative areas to gather and interact, and large open spaces in lieu of small study rooms (Hisle, 2005).

How do university students currently use the library? Do students primarily use the library to gather and interact, or are they using it to learn as in the suggestive traditional role of the library? How can students’ perceptions of an ideal study environment be integrated into the design of a library to better support a learning environment?

A case study of a main library at a midwestern university was used to examine these research questions. Observation of three study areas within the library was conducted, including individual study workstations, group study area, and student learning commons. An undergraduate student survey was used to engage users of the space and recognize how they use the library. Additionally, images boards and a card sort were used to identify common factors in student ideal study environments. The analysis from this mixed method

approach was used to reveal how students use the study spaces in the library and how the interior spaces of the university library can be designed to respond to student behaviors and preferences.

Student survey results revealed that students value the library and use the library as a study space. The most significant finding was that 63 percent of survey respondents stated the main reason they choose to study at the library is for quiet study space. This finding is in opposition to the literature on the library as a social space (Codispoti and Frey, 2007). While we are designing libraries to foster collaboration, we must also maintain the notion that libraries should provide patrons with a welcoming and comfortable quiet study environment that promotes prolonged use.

I. INTRODUCTION

Statement of the Problem

University libraries are at a crossroads in time. While there is a growing perception that the physical library is no longer essential to the educational experience since students increasingly rely on technology for learning and communication (Gardner and Eng, 2005), the library continues to flourish with student activity (Steelcase, 2010). The library has shifted from a reading and book storage site to a “center of interactive learning” (Steelcase 2010). The university library has developed into a center of learning and collaboration that can truly become the heart of campus within the university community (Hisle, 2005).

The library is being rethought and reorganized as the classroom expands to outside spaces (Steelcase 2010). The evolving role of the library has lead to the development of the student learning commons. The model of the student learning commons is to include a café within the library, collaborative areas to gather and interact, and large open spaces in lieu of small study rooms (Hisle, 2005). Group work is emphasized in college coursework now more than ever, and is the basis for the collaborative nature of the student learning commons. The library exemplifies all of the reasons that group work is becoming increasing important, and continues to be a symbol of learning on campus (Campbell, 2006). The interior atmosphere at the library can contribute to student success and provide students with an unparalleled study environment that accommodates student collaboration and study achievement.

Recent trends in the design and renovation of libraries concentrate principally on the library as place, and as a social space (Bisbrouck et al., 2004). The student learning commons is an expansion and implementation of the research by Oldenburg (1989) on third

places. Third places are “public places on neutral ground where people can gather and interact. The character of a third place is determined most of all by its regular clientele and is marked by a playful mood, which contrasts with people’s more serious involvement in other spheres” (Oldenburg, 1989). This conceptual connection is supported by research on the collaborative nature of the student learning commons.

The current role of the library is to satisfy a need for an environment that cultivates student collaboration and peer learning (Hisle, 2005). The traditional role of the library was to symbolically reinforce the spirit of learning by providing areas for reading and meeting (Campbell, 2006). While the current trend in library design has shifted toward the student learning commons and group study areas, it is imperative to study the effects of this shift on student attitudes and preferences for study spaces within the university library.

A case study of a main library at a midwestern university was used to examine the current usage, satisfaction, and preferences of study spaces within the library. Observation of three study areas within the library was conducted, including individual study workstations, group study area, and student learning commons. An undergraduate student survey was used to engage users of the space and recognize how they use the library. Ideal study environments were also analyzed to determine how study spaces should be designed to accommodate student’s design preferences for public study spaces. The analysis from this mixed method approach was used to reveal how students use the study spaces in the library and how the interior spaces of the university library can be designed to respond to student behaviors and preferences.

The central idea of the study was aimed at researching the student learning commons and analyzing the design implications of the trend of ‘library as place.’ The study aimed at

gathering perceptions of the student learning commons as a place to gather and interact, and a collaborative study environment. In opposition to the concept of the student learning commons is student privacy and individual study spaces within the library. As libraries have shifted to a more open space and focused more on service, the idea of student privacy and the library as a quiet study space has been set aside. Perceptions of the student learning commons and privacy were compared, as well as usage of the library by individuals and groups.

The study further examined group study space and the design implications of group study preferences related to space. It is important to ask the future users of a space for design input rather than relying on existing features that don't necessarily exemplify a perfectly functional space or on existing literature or design standards that may not represent the space entirely. This project engaged future users of the space to understand the future functional and aesthetic requirements of a group study space that appeals to students.

Purpose

The purpose of this study was to analyze current trends in the design of libraries, with a focus on how students learn in the library. The design of the twenty-first century library interior environment has changed from the traditional library. While the student learning commons is a relatively new concept and design, many libraries strive to fit within the model and have organized their library spaces and services accordingly (Hisle, 2005). The literature on the student learning commons suggests the shift in the library is based on changes in student study habits and progression in technology. However, there are relatively few studies that fully support the student learning commons as evidence-based design. This study was

developed and performed to investigate if the designs of library interior spaces are congruent with student ideal study environments, and to provide recommendations for the design of future library spaces based on the data collected.

Objectives

The objectives of this study include the following:

1. Develop an understanding of current usage behavior of the academic library.
2. Determine factors attributed to student satisfaction at the library.
3. Obtain information on ideal student learning environments with the intention to build a case for the design of interior environments within a library setting.

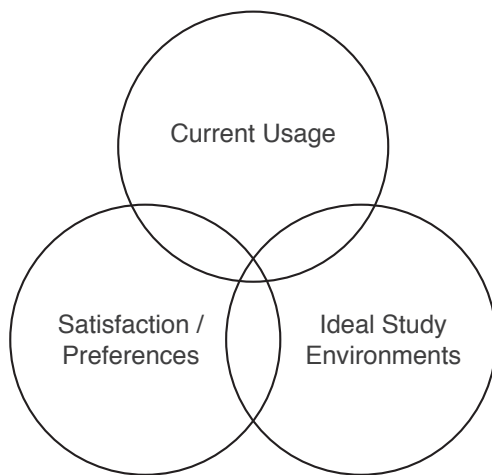


Figure 1. Research objectives

By defining how the university library is currently used and identifying features in the ideal study environment, the interior design profession will be able to design more appropriate learning spaces that appeal to students.

Research Questions

The central aim of this study focused on the current usage of library study spaces in addition to preferences and ideal study spaces within the university library setting.

Observation, interviews, survey, and image board/graffiti wall techniques were used to investigate three main research questions.

1. How do students learn while using the library? Do students primarily use the library to gather and interact, or are they using it to learn as in the suggestive traditional role of the library? Individual study spaces and group study spaces, or peer learning, were investigated to identify current usage of the university library. [CURRENT USAGE DATA]
2. Are current trends in library design, including the shift to the student learning commons, based on evidence-based design? Is the current allocation of space for study environments and technology appropriate based on student preferences? [SATISFACTION AND PREFERENCES DATA]
3. How can students' perceptions of an ideal study environment be integrated into the design of a library to better support a learning environment? [IDEAL STUDY ENVIRONMENTS DATA]

Scope/Setting

A case study of the main library at a large midwestern university served as the setting for this research. The university library is near the center of north campus, and at the intersection of two major streets that run through campus. The entry to the library opens to a grassy quadrangle that is focused on the pedestrian. Adjacent buildings include the Hub,

which offers a variety of dining options, an art museum, and classroom buildings. The location provides convenient student access and allows for the library to be a third place study environment at the heart of campus. Other third place buildings on campus, including the student union, are located on the perimeter of campus and off the main pathway that most students walk during a typical day.

Ground was broken for the university library in 1923, with completion in 1925. The first addition to the library, on the west side of the original building, was completed during 1960-1961. The multi-tier stacks and an extension to the west and north of the first addition were opened in 1969 (Day, 1980). “Continued growth of the Library holdings and the need for additional study and reader space made further expansion of the building a necessity by the mid seventies” (Day, 1980). Along with this third expansion in 1983, the existing building was remodeled to deal with issues related to building codes, climate control, and to develop a more consistent interior for the entire library (Iowa State University, Parks Library Architecture).

Overall the interior spaces of the library reflect the expansion of the library. The interiors of the original library building instill the grandness of a traditional academic library. The original building features high ceilings, relief and engraving, and ornate details. The interior spaces researched in this study are mainly within the library additions, which are a more standard study space with book stacks, open study areas, and individual workstations. Current renovation efforts have focused on remodeling interior study spaces, based on user driven research conducted by the library. The study lounge on the fourth floor received new carpet, paint, and furniture including large study tables, new task chairs on casters, as well as modular lounge furniture in 2012.

The individual workstations at the perimeter of the book stacks are currently under construction. A graduate student survey and an informal questioning of undergraduate students within the library revealed that students wanted larger workstations for room to spread out when they study. The existing workspaces will be taken down and for every two current spaces there will be one new workstation installed. The design will expand the space for users. However, because of limited space the library had to choose between more workstations that did not fit user's needs or less workstations that fit the user's needs based on research (S. Passonneau, personal communication, February 23, 2012). The library under the scope of this study continues to research how students use the library and strives to renovate spaces to make the interior space more desirable for today's students.

II. LITERATURE REVIEW

The review of literature includes a synopsis of why libraries are changing, third places and the trend of 'libraries as place,' and the development of the student learning commons within the university library. When applicable, the review includes how libraries are relevant in academia today. The final topic discussed is the design implications of private and quiet environments, in both general interior design terms and as a specific design feature in libraries. Research studies on libraries are presented throughout the literature review, and the findings are discussed in detail.

Introduction

The library is in a time of transition. The traditional role of the library has been to provide trustworthy information and to help students distinguish reliable information sources (Campbell, 2006). Information today, in any format, can be accessed anywhere and anytime on campus (Steelcase, 2009). While the role of the library remains information based, the method the information is accessed and used by students has changed drastically in the past decade. This literature review focuses on the degree to which the design of libraries has responded to shifts in learning.

"The library as place started out as a repository, and now has become more of a human space, more of a gathering space for people who need information, for people who want to learn. For curious people, for people with personal needs and professional needs, to try to find the information they need to answer their own questions. But it's definitely a social space." - Pam Baker, Reference Librarian, California State University – Monterey Bay (as

cited on the ALA American Library Association website).

Why Libraries are Changing

There are several reasons that the traditional role of the academic library is in transition. Gardner and Eng (2005) suggest that two main reasons that libraries are changing are the shift to digital technology and the changing student population.

The majority of college students are part of Generation Y, born in or after 1982 (Gardner and Eng, 2005). This generation is also referred to as the Net Generation, The Digital Generation, the Echo Boom Generation, or the Millennials. These students are academically ambitious, and the top reasons they visit the library are related to academic achievement (Gardner and Eng, 2005).

The student population in higher education has shifted from U.S. native-born to a mix of many nationalities because of the increase in number of immigrant as well as international students seeking an education in the U.S. Hence, the Generation Y student population is increasingly diverse culturally, economically, and geographically than previous generations (Black, 2009). Technology and the Internet are integral parts of their lives (Kapitzke, 2001). Generation Y students have great expectations and expect the library to adapt to their needs. Generation Y expects to control “when, where, how, and how fast they learn” (Gardner and Eng, 2005).

Gardner and Eng (2005) developed an undergraduate survey to analyze four characteristics often attributed to Generation Y. The four attributes they discussed within the context of student library use and satisfaction were:

1. They have great expectations (demand quality academic facilities and high academic achievement)
2. They expect customization
3. They are technology veterans
4. They utilize new communication modes

There is a growing perception that the physical library is no longer essential to the educational experience since students increasingly rely on technology for learning and communication (Gardner and Eng, 2005). For most students, the library has become a virtual destination (Kapitzke, 2001). The Gardner and Eng study found that “73 percent of the respondents were more likely to conduct research by using the Internet than by going to the library” (2005).

Authors have identified a handful of reasons that students choose to utilize resources other than the library to gather information. College students typically use search engines such as Google because the information is readily accessible (Campbell, 2006). Students prefer information that is simple and easy to understand, and they prefer a self-serve method. There is a lack of seamlessness in services at the library that prevents some potential patrons from using the library (Becker, 2009).

The human brain has been transformed by the digital age. Generation Y student respond faster, sift out information, and recall less than previous generations. Students have grown up with so much technical information that they have little patience for traditional lectures and teaching methods, and they have shorter attention spans and lack of depth in learning (Black, 2009).

Millennial students have a preference to learn from each other over teachers. The demand for group study spaces often exceeds library capacity (Gardner and Eng, 2005). There are also implications of peer-to-peer learning preferences on the reference desk. Student patrons almost always approach student workers over a librarian at the desk (Gardner and Eng, 2005).

Students learn outside of the classroom, with an increased emphasis on collaboration and group projects (Brown and Lippincott, 2003). On-campus spaces haven't caught up with the demands and aspirations of educators and students. The current generation is reporting low levels of out-of-classroom collaboration (Brox, 2012). It is important that the library be a space where faculty and students can cross paths and engage in non-classroom interactions that may extend and improve a student's experience at college (Hisle, 2005). College students today often do their academic work with or around their friends and classmates, with the use of technology and digital content (Lippincott, 2010).

While there is substantial research that demonstrates the trend of libraries changing due to technology and Generation Y, the most current statistics show that students indeed value the library. "A third of students indicated that the library's value has increased for them personally during the recession" (Perceptions, 2011). This current data identifies that the top role of the library is "to provide books, videos, and music," with "a place to learn" ranking second (Perceptions, 2011).

While there are many sources of information available outside the library, students continue to go to the library. Research by Steelcase (2010) showed that students go to the library because it's:

- A convenient spot between classes

- A place to socialize with others and to be motivated by them
- Where to collaborate on group work
- Close to many resources
- A safe, non-distracting place to study
- Where collections are on reserve
- The place for computing software, copying, printing, scanning
- A great atmosphere

Understanding why libraries are changing will help to identify spaces in the library that need to be researched and redesigned. The technology progression continues to change how students access information, and it is imperative that the interior environment in university libraries reflects this shift.

Student Learning Commons (or Information Commons)

Academic library renovations, additions, and new construction projects are causing library programs to “rethink how library space is used and configured” (Wells and Scepanski, 2010). The physical facilities and programming of libraries has changed to better meet the learning, teaching and research requirements of student, faculty, and staff (Wells and Scepanski, 2010).

Wells and Scepanski (2010) wrote that space planning for academic libraries has drastically changed as a result of the developing role of the new library. Previous academic libraries were designed around books, and a standard square footage calculation based on the amount of books housed within the library was used to determine the size of every space

within the library. New library design takes into consideration the users of the space, retiring the traditional square footage calculation method.

The role of the library has shifted to user education and customer service, thus it is imperative that libraries have the physical spaces to meet the needs of students (Becker, 2009). The new type of library emerged in some academic libraries in the early 1990s (Lippincott, 2010). A student learning commons, or interchangeably referred to as an information commons, “is an extension and expansion, but not a replacement, for a traditional academic library. It’s a space and a place where students can seek reference or librarian consultation services and where open access computing resources are available” (Hisle, 2005). It is a place where students may study, collaborate in groups, work with digital creation technology, use scholarly workstations, access printing service, or consult for help (Hisle, 2005). Student-learning commons typically include a coffee shop or refreshment area nearby (Wells and Scepanski, 2010).

The student learning commons was designed to serve the needs of the millennial students currently in college (Hisle, 2005). Millennial students are comfortable with multitasking and can handle noise. The student learning commons provides a new feel and energy in library buildings in a multitasking environment (Hisle, 2005). Physical spaces in the information commons were arranged to encourage collaboration and information sharing, unlike the traditional quiet library space (Lippincott, 2010). Students work together in a small group in the commons while interacting with other students via instant messaging, video chat, or other methods. In short the information commons was designed to offer an integrated digital environment and workspace, along with the technology to support it (Lippincott, 2010).

Lippincott (2006) states that the information commons has been successful in terms of getting students into the library. The student learning commons addresses the needs of students by bringing together technology, content and services in a physical space that is different from that of a traditional library. Information commons typically have computers, extensive software packages, and multimedia production and editing capabilities. The information commons also contains more areas for group work than in the traditional library (Lippincott, 2006).

Services that were once in other buildings on campus have been relocated into the library at many prominent universities. Student services such as academic advising, career services, counseling, and language learning have made their way into a number of academic libraries (Wells and Scepaniski, 2010). Educational programming that furthers the classroom learning experience by assisting faculty and graduate students with teaching and promote research has been successfully integrated into a number of libraries (Wells and Scepaniski, 2010).

Students that use the library not only seek long hours of operation, but “23 percent of college student respondents provided advice related to the physical library environment” (College students’, 2006). The students requested a separate room for completely silent study, more computers, upgraded lighting, tables for group work, and better temperature control (Perceptions, 2011). One student responded that the library should “Have more comfortable furniture for reading in the library. The bookstore has nice couches but the library just has tables and chairs” (College students’, 2006). Student behaviors were based more on the atmosphere and service than the product (College students’, 2006).

The most important finding involved in recent library development is that the interior

spaces should cater to “flexibility,” “adaptability,” “comfort,” “usability,” and “variation.” “Library users should be permitted to configure their seating in ways useful and comfortable to them” (Wells and Scepanski, 2010). A mix of desk-style furniture and soft, comfortable seating are commonly used in a student learning commons to provide seating options for students. Some information commons include booths for small groups or beanbag chairs for informal seating (Lippincott, 2006).

The role of the library should satisfy a need for an environment that cultivates student collaboration and peer learning. Literature on how students learn identifies that students are increasingly learning from each other. How can the spaces in libraries better cultivate learning? A student-learning commons provides the spaces for students to use technology and collaborate. What other spatial and design elements should be included in the design of a student-learning commons?

Library as Place

Third places are “public places on neutral ground where people can gather and interact. The character of a third place is determined most of all by its regular clientele and is marked by a playful mood, which contrasts with people’s more serious involvement in other spheres” (Oldenburg, 1989). The library is neither home nor work, but a “third place” for students to study and socialize (Codispoti and Frey, 2007).

Oldenburg argues that there has been a marked decline in gathering places near enough to people’s homes to afford the easy access and familiar faces necessary to a vital informal public life (1989). University campuses have a unique characteristic in that students live close and typically within walking distance to a great many places and establishments.

For university students, the dorm is the first place, or home space, and the classroom is the second place, or workplace. Third places for students are diverse, ranging from places on campus where students gather to coffee shops and hang outs off campus where students grab a bite to eat.

Community characteristics are at the heart of a true “third place.” Oldenburg suggests the following:

- Neutral Ground – a place where individuals can come and go as they please and where no one plays host,
- Leveling – a place where there is no distinction between class, rank, and social position
- Communication – a place where conversation is the main activity
- Accessibility & Accommodation – a place that is open long hours; where activity is unplanned, unorganized, unscheduled, unstructured; and is in close proximity to home or neighborhood
- Regulars – a place that is full of familiar faces
- Membership – a place where new comers are welcome; a non-exclusive environment
- Mood – a place where joy and acceptance reign over anxiety and alienation
- Home Away from Home – a place that provides the feeling of being in a supportive, happy home

Recent trends in the design and renovation of libraries concentrate principally on the library as place, and as a social space (Bisbrouck et al., 2004). “Placemaking is not just about the relationship of people to their place; it also creates relationships among people in

places” (Schneekloth & Shibley, 1995). The third place role of the library has led the design of the physical environment to include a café, collaborative areas to gather and interact, and large open spaces in lieu of small study rooms (Hisle, 2005).

We have argued that the practice of Placemaking is not only about the physical making, remaking, and unmaking of the material world. It is about “world making” in a much broader sense because the practice literally has the power to make worlds-families, communities, offices, churches and so on. Each act of Placemaking embodies a vision of who we are and offers a hope of what we want to be as individuals and as groups who share a place in the world (Schneekloth & Shibley, 1995).

Steelcase (2009) in their education research has found that “upon entering the library a student becomes part of a larger community.” Factors were ranked in order of importance on why students feel the library is important. Convenient hub, socialization, motivation, and collaboration were the top factors in the research by Steelcase. Other factors included resources, safe, distraction free, and tech services. Later research by Steelcase (2012) found that third place attributes attract students to the library, including:

- A convenient spot between classes
- A place to socialize with others and to be motivated by them
- Where to collaborate on group work
- Close to many resources
- A safe, non-distracting place to study
- Where collections are on reserve

- The place for computing software, copying, printing, scanning
- A great atmosphere

Quiet and Private Study Environments

To the contrary of the library as place is the notion of the library as a quiet study space. “Early in their history, libraries were endowed by colleges and universities with some of the most beautiful, uplifting, and noble spaces on campus. Usually devoted to reading or meeting, such spaces served and still serve symbolically to reinforce the spirit of learning and to imbue the knowledge-interaction experience with a powerful sense of importance” (Campbell, 2006). While current renovations in libraries are directed toward the student learning commons, it is worthwhile to examine the traditional role of the library as a place for reading and the current role of private study spaces within the university library.

Although the library is a public place, students expect a certain level of privacy when they use the library. Behavioral responses to the environment are based on the need for privacy. Privacy is the selective control over another’s access to our selves, our groups, or our environments (Kopec, 2006). This need can be satisfied at the library by providing areas free of visual and acoustic distraction, where a student feels that they are unobserved by others (Stewart-Pollack and Menconi, 2005).

Privacy is “a process by which we control access to ourselves or our group and a condition of selective distance or isolation” (Stewart-Pollack and Menconi, 2005). Privacy is a basic human need:

- Privacy is a balance in response to our changing needs to be with others and our need to be alone

- Humans seek optimum levels of interaction throughout a day and seek to control over who has access to us or our group and under what circumstances
- The human need for privacy motivates our behavior and affects our perception about other people, our surroundings, and ourselves

The university library plays a very important role as a place of privacy for a college student. In a college dorm or in a shared apartment, students live in an arrangement with perhaps less privacy than they had when living in a family home environment. Libraries serve as a more private space and an area of refuge for students seeking a private study space.

There are two major types of privacy and distractions as defined by Stewart-Pollack and Menconi (2005). Visual privacy is when users feel they are unobserved by others and able to work undistracted by sudden movements and other unexpected sights. Acoustical privacy is the ability to protect information as it is being transmitted in face-to-face conversation or via telecommunications and the freedom from unwanted acoustical intrusions such as conversations.

Visual barriers can be used to prevent visual information about a person from reaching others in the same space (Miller and Schlitt, 1985). Visual barriers such as screens and partitions can simultaneously act as both privacy and satisfy the need for control. Library carrels were designed as a way for achieving privacy in a library. A carrel is typically a small desk featuring high sides meant to visually isolate its user from any surroundings either partially or totally. Most carrels are rectangular in shape. Above the main desktop area there is often a shelf for books. Library carrels are modular in design to standalone or to be grouped together, with or without common sides or walls.

While the Steelcase (2010) research on libraries focuses on collaborative learning at the library, the research does identify that group work areas are adjacent to individual study spaces. Steelcase acknowledges that the collaborative environment in group work areas frustrate individual students seeking quiet study spaces. “A better approach is providing dedicated spaces for both individual and team work in a range of settings spread across different floors of the library that progresses from free-ranging team spaces to private study spaces” (Steelcase, 2010).

While current research and literature on the university library as an individual study space is limited as it opposes the trends in library design, there is one study that provides insight into how students are spending their time on campus. Gensler conducted a research study with the goal of mapping out the activities that constitute a typical student day. The study resulted in key findings on how campus design can respond to today’s students, and found that students prefer studying alone almost three to one. Most on-campus time is spent working alone, reinforcing the need for good focus spaces (Broz, 2012).

The findings of the Gensler (2012) study on libraries found that the preferred place to study on campus for 43 percent of students was the campus library. Furthermore, only 22 percent of students reported that study conditions at their schools’ libraries adequately supported private study. “Students want to study at the library, but because conditions are far from ideal they are more likely to head elsewhere or simply not find the space they need” (Brox, 2012).

Experts on the Gensler study explained that libraries are in high demand and short supply, which may be explained by noise levels. Only 39 percent of respondents to their study said that the spaces where they studied alone were quiet. However, of those same

students 66 percent stated that they prefer quiet when studying alone (Brox, 2012).

“For many people, having privacy means avoiding intrusions, interruptions, and distractions so that desired activities can be completed without interference from others” (Miller and Schlitt, 1985). Many times separate rooms are desired to limit distractions for focused study. At the library, however, many people must study in the same room. Common distractions can be overcome by control over the source or by blocking the source. Behavioral planning can be used to locate potential areas of conflict and interference, and spatial arrangements can be studied to separate these behaviors (Miller and Schlitt, 1985).

Summary

Understanding the reasons why libraries are changing served to identify spaces within the library that should be researched to determine if they meet the needs of current students. The technology progression continues to change how students access information, and it is imperative that the interior spaces in libraries are designed to reflect this shift. The student learning commons has sprouted from the changing student demographic and the need for technology within the library. The design of the student learning commons has followed the ‘Library as Place’ trend by including a café, collaborative areas, and computer technology such as printing services within the same space. ‘Library as Place’ has served to create a sense of place within the community.

On the other hand, the library was once a symbol of a quiet study environment. The academic library in particular has served students throughout their existence as a haven from the distractions of student life. Findings from the Gensler study in particular point to the value of quiet individual study spaces on campus.

It is evident from the review of literature that the student learning commons concept is in opposition to the traditional role of the library. This study uses multiple research methods to measure current behavior in the academic library as well as identify preferred environments for study. In a case study format this study seeks to disclose the spatial design features that students desire within study spaces in the library. There is a lack of current research that supports the student learning commons attributes as evidence-based design. Existing research has mixed results upon which new methodology could provide a renewed view of the academic library.

III. METHODOLOGY

Overview

This case study was based on a mixed methods approach with a combination of qualitative and quantitative research methods. The mixed methods methodology enabled observational research to be triangulated with quantitative survey data. Statistical data on the current usage, satisfaction, preferences, and ideal study environments can be used for funding library renovation projects. Additionally, informal methods such as observation and image boards were used to compare student actions against survey responses.

This section begins with the research questions and hypotheses that were developed to look at current usage at the library, satisfaction, preferences for student study spaces, and ideal study environments. The methods used for the study are presented, which include a description of how the research was executed including pilot studies for each section. Observation was used as the first step to identify current usage and how students are using the existing space. The next method used was an undergraduate student survey that aimed at a variety of usage, satisfaction, preference, and ideal environment questions. The group study area was further researched using image boards and graffiti walls to identify ideal environmental features of the design of this space within a library setting. The final method employed was a card sort to distinguish features of the images used in the image boards that students thought best described the image.

The analysis from this mixed methods approach was used to reveal how students use the study spaces in the library and how the interior spaces of the university library can be designed to respond to student behaviors and preferences. Research on ideal study

environments within the library environment was used to provide suggestions on improving the design of study spaces within the university library setting.

The research was conducted after completing web-based human subjects training from the National Institutes of Health (NIH) course ‘protecting human research participants,’ Appendix B. The Institutional Review Board is a committee that reviews all research at Iowa State University involving human participants, including proposals to gather data from participants for theses, dissertations, and other student projects (Iowa State University IRB). IRB approval was obtained for the observation and survey methods, Appendix C, and for the image board and graffiti wall, Appendix D. The student participant identities were kept confidential; therefore, the research was exempt from other regulations and received consent of the IRB.

Research Questions

The central aim of this study focused on the current usage of library study spaces in addition to preferences and ideal study spaces within the university library setting. Observation, interviews, survey, image board, graffiti wall, and card sort techniques were used to investigate three main research questions.

1. How do students learn while using the library? Do students primarily use the library to gather and interact, or are they using it to learn as in the suggestive traditional role of the library? Individual study spaces and group study spaces, or peer learning, were investigated to identify current usage of the university library. [CURRENT USAGE DATA]

2. Are current trends in library design, including the shift to the student learning commons, based on evidence-based design? Is the current allocation of space for study environments and technology appropriate based on student preferences?
[SATISFACTION AND PREFERENCES DATA]
3. How can students' perceptions of an ideal study environment be integrated into the design of a library to better support a learning environment? [IDEAL STUDY ENVIRONMENTS DATA]

Hypotheses

The following hypotheses were developed as a basis to answer the first two research questions.

- Hypothesis 1 (H1): The main reason students visit the library is to study, not to use the books housed within the library. [CURRENT USAGE DATA]
- Hypothesis 2 (H2): Students are learning from each other in the library (social aspect of learning). [CURRENT USAGE DATA]
- Hypothesis 3 (H3): Students prefer to have control over the learning environment in the library. [PREFERENCES DATA]
 - Six criteria were used to test this hypothesis:
 - Criterion 1 (CR1): Lighting
 - Criterion 2 (CR2): Sound levels
 - Criterion 3 (CR3): Workspace
 - Criterion 4 (CR4): Furniture
 - Criterion 5 (CR5): Privacy

- Criterion 6 (CR6): Social environment

- Hypothesis 4 (H4): Individuals prefer to study in spaces with greater amounts of privacy at the library. [PREFERENCES DATA]
- Hypothesis 5 (H5): Students prefer to study in a space where customer service is a top priority to a more private environment. (Amenities such as an information desk, computers, printing services, refreshments) [PREFERENCES DATA]

Observation

Observation was useful as an early step in the case study to reveal a basis for future research and methodology. Two observations of the study areas within the university library main branch were conducted. Each observation session was limited to two hours in length. The observation results were used to reveal how students use the study spaces at the library, the current trends in usage, and how the interior spaces of the university library can be designed to respond to student behaviors and preferences.

An initial observation of the university library was conducted on a Monday afternoon in the fall semester of 2011. The purpose of the pilot observation was to document the location and environmental characteristics of where students were studying. Field notes during this observation served to categorize the types of study spaces within the building. The categories identified include individual study carrels, quiet study tables, group study commons, group study rooms, study lounges, tiers, computer commons, multimedia production studios, stand-up computer stations, and research study rooms. The grouping of spaces into common threads served to streamline further research and aid in comparison purposes. This classification of study spaces identified three areas for further investigation.

The individual workstations on the second floor were identified as the location of individual study behavior. The study commons on the third floor was chosen for behavioral research of groups. The final location identified for further study was the computer stations and information desk in the student learning commons on the first floor. The first observation also included a photo analysis that supported written documentation of the findings.

The second observation period focused on the three areas identified for study in the first observation: individual workstations, group study commons, and student learning commons. The main goal of the observation on this Thursday morning session was to analyze why students were at the library by observing what they were working on. The group study commons observation also included whether students were studying individually or in groups as well as the size of the group (see Appendix E). Floor plans of the three areas identified for further research during the observation are shown in Figures 2 – 4 below.

The student learning commons is on the first floor in the center of the building. The student learning commons is adjacent to the café and central computer access area, which has standup computers for quick access to the e-library and online databases. The individual study workstations on the second floor are adjacent to the stacks, which act as a buffer, and off the main circulation paths. The individual workstations are along the west perimeter of the floor plan, with a few windows that penetrate the façade. The group study area is located on the third floor in an open space on the southwest corner of the plan. There are windows along the south and north walls, and group study rooms at the center of the group study area.

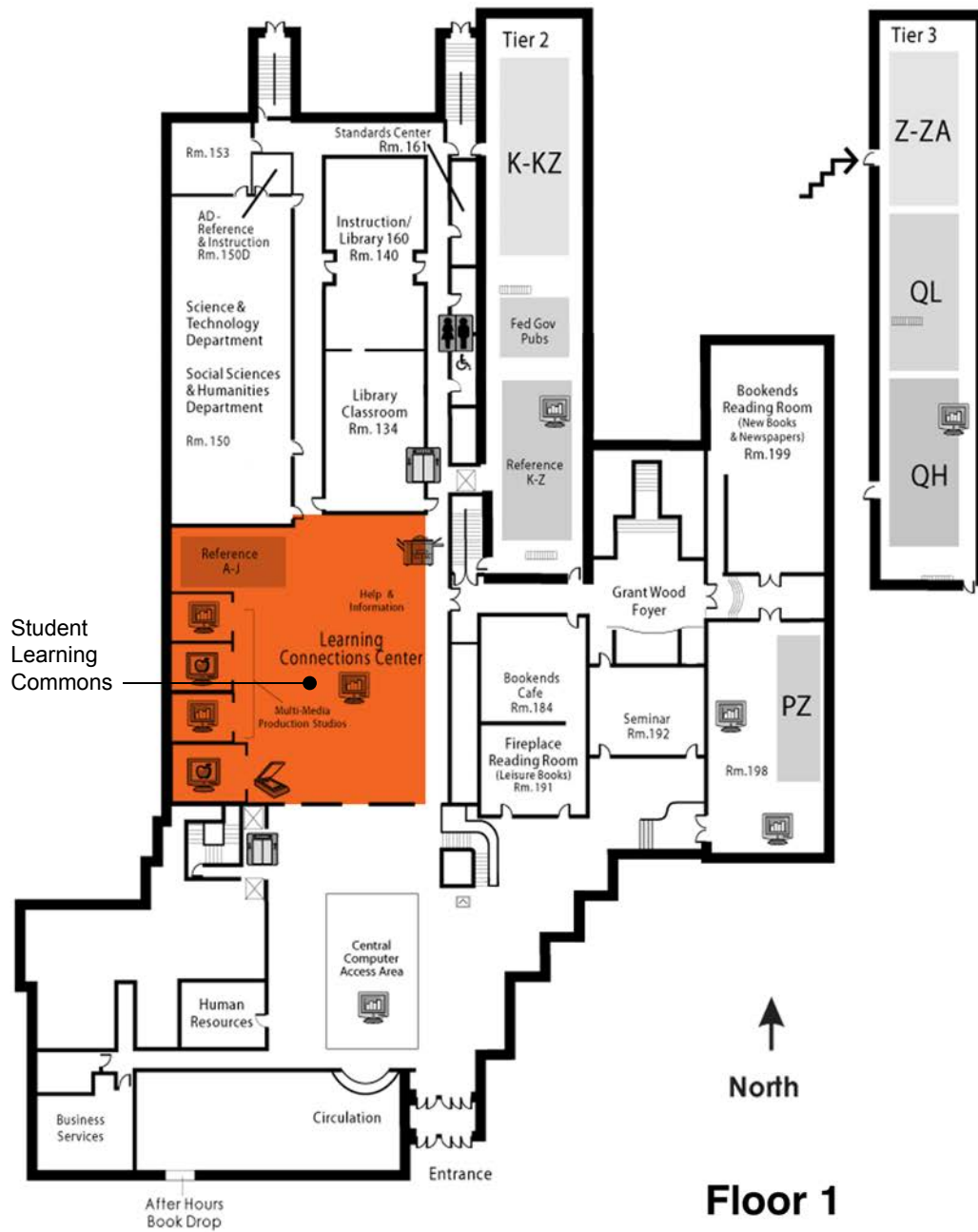


Figure 2. Floor plan of the student learning commons (Learning Connections Center)

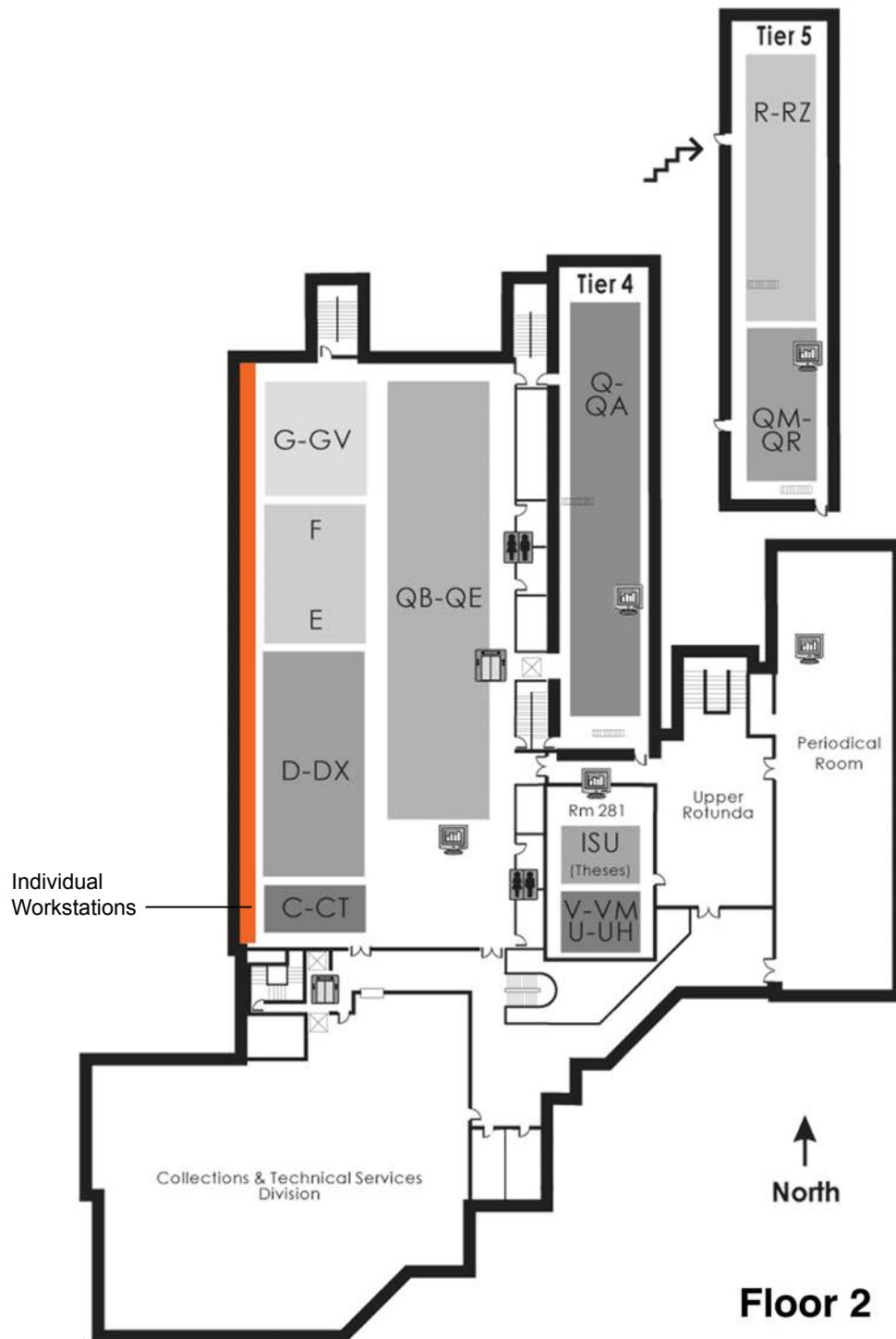


Figure 3. Floor plan of the individual study workstations

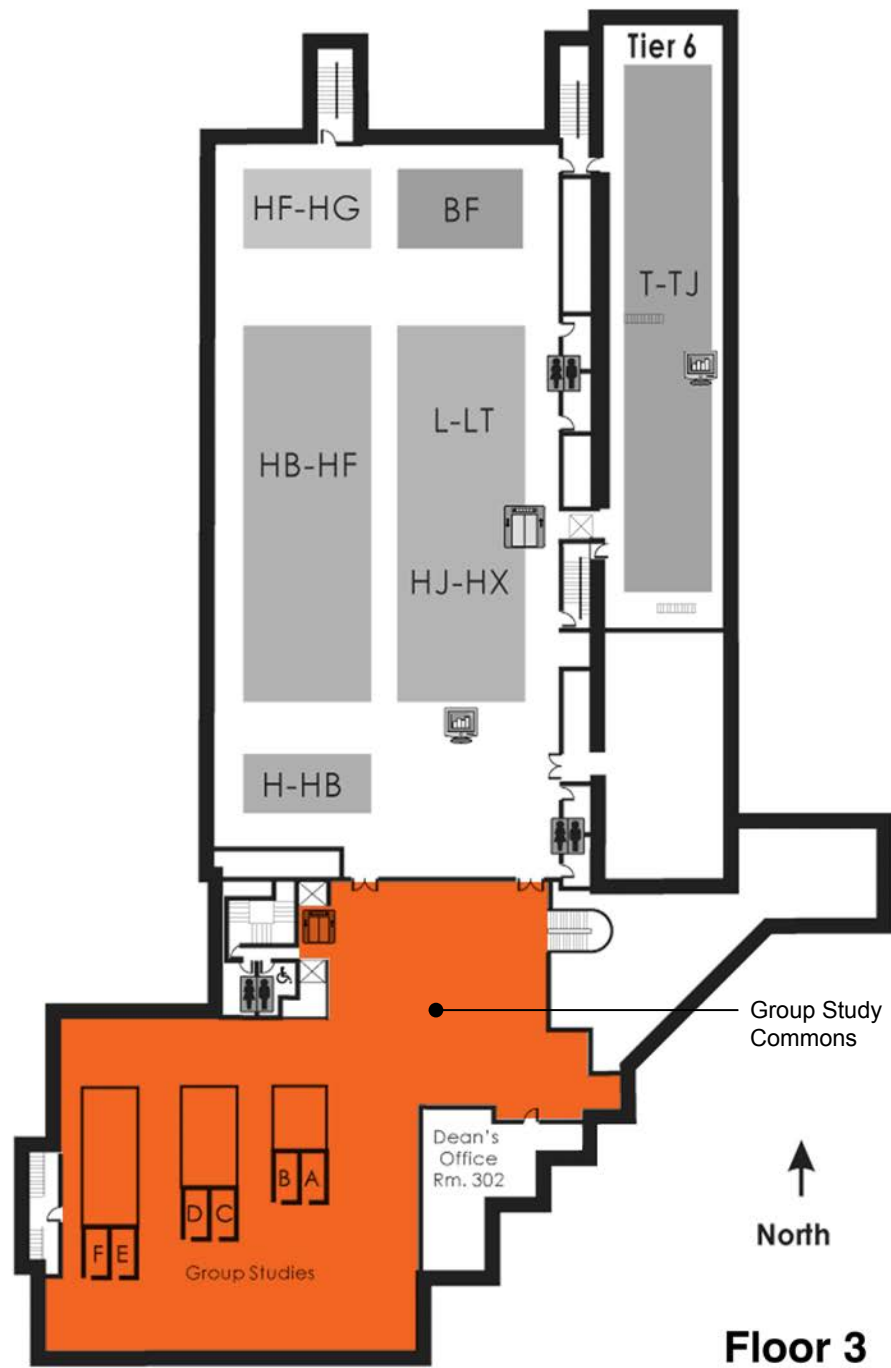


Figure 4. Floor plan of the group study area

Survey

The purpose of the survey was to gather statistical information on library usage, satisfaction, and ideal study environments from a sample of undergraduate students. The survey was developed on the website Survey Monkey. Survey Monkey was selected for ease of distribution and collecting responses. The web-based survey is a familiar method to the student demographic, and allows responses to be collected in a timely manner with the ability to accurately use software tools for data analysis.

Prior to sending out the survey, an initial pilot study was used to time students on how long the survey took to complete, and to identify questions that needed revision and clarification. Depending on how many questions were skipped due to the applied skip logic in the survey, the pilot study took approximately 5 to 15 minutes to complete. By executing the pilot survey it was possible to modify and make the proper corrections needed to achieve a more complete and accurate survey to be administered.

A random sample of 1,000 undergraduate students enrolled at the university was collected from the registrar's office. The survey reached across colleges and majors to include the entire undergraduate population. A concurrent library survey directed at international students was sent around the same time as this survey. Duplicate names were removed from this survey, leaving the final survey count to 983 students. An invitation to the study was sent via email, with a direct link to the survey included in the body of the email. Responses were collected from 156 students, a response rate of 15.9 percent. The survey was conducted at the end of the semester. Undergraduates are a difficult population to gather surveys, so the response rate was right along the lines of the expected response rate.

The Library Interior Environments Survey (Appendix F) was comprised of 34 questions. Skip logic was used to filter students that study at the library, and if they study individually or in groups. Questions were based on the research questions, but many questions were also repeated from surveys found during the literature review. A study by Gardner and Eng (2005), based on library usage and satisfaction, was used to form the usage questions on this survey. The questions on the Gardner and Eng survey that were repeated in this survey are, “Why do you visit the library?” and “How long was your visit to the library?” Several questions were based on the College Students’ Perceptions of Libraries Information Resources (2006) report, including the steps in the frequency of library use question and activities at the library. Four of the questions formed tables, in which students were to select all that apply. A 5-level Likert Scale was used on four questions, which examined the attitudes of the library numerically. The final four questions were demographic that inquired about the college in which the student was enrolled, year in school, if they were an international student, and sex. Participants were allowed to skip questions.

The student survey included descriptive statistics for use in the filtering of data. Students in the College of Engineering, Liberal Arts and Sciences, and Agriculture and Life Sciences were the largest percentage of survey respondents. The year in school was fairly evenly spread across freshman, sophomore, junior, and senior years, with the most representation from seniors / fifth year students at 31 percent, and the least representation from sophomores at 21 percent of total survey respondents. Out of survey respondents, only 4 percent were international students. International students represented approximately 20 percent of the undergraduate student population during the year of this survey (Iowa State University, Institutional Research Reports). The omission of international students on this

survey to avoid duplicates with the international student survey was a factor that affected the percent of international students respondents compared to the true population. There were slightly more female participants, representing 54 percent of respondents, compared to 46 percent of male respondents. The undergraduate student population comprises of 44 percent female students and 56 percent male students (Iowa State University, Institutional Research Reports). The survey had a higher response rate among women than the true percentage that represents the undergraduate population. Therefore, a weigh was applied to the survey data based on sex. Responses by men on the survey were weighted more heavily than responses by women on the statistical analysis. The descriptive statistics are shown in Appendix F, Library Interior Environments Survey, questions 31 through 34.

The data analysis of the survey was initially conducted in Survey Monkey, through the organization and filtering of data. The response-based filters in Survey Monkey allowed the ability to look for patterns within the results of a specific question. Survey Monkey charted results of the collected data as percentages and bar graphs, which was then downloaded to Microsoft Excel. Microsoft Excel was used to format and organize the data for use in statistical software.

JMP software was used for the statistical analysis of data, and to answer the hypotheses in the study. Contingency table analyses were used to form a chi-square ‘goodness of fit’ test for each of the data sets entered in JMP. Contingency tables categorize counts on two or more variables so that we can see whether the distribution of counts on one variable is contingent on the other (De Veaux, Velleman, and Bock, 2012). The counted data condition, independence assumption, randomization condition, and 10 percent conditions were met. With the 5-level variable of satisfaction there were concerns that the expected cell

frequency condition would not be met, as there were expected values lower than 5. The data was recoded as required for each of the chi-square tests performed to reduce the number of cells with expected values less than 5. For example, in the tests where overall satisfaction of the interior environment at the library was measured a 3-level variable was used. Very dissatisfied and dissatisfied were recoded to “1,” neutral was recoded to “2,” and satisfied and very satisfied were recoded to “3.”

The outcome of the contingency table analysis and corresponding chi-square tests are a p-value. A p-value is the probability of seeing results at least as unusual as the observed statistic, given that the null hypothesis is true (De Veaux, Velleman, and Bock, 2012). The significance level, or alpha level, used in the analysis of the data in the study was 0.05. At that level a p-value of 0.05 or lower means that it is very unlikely to observe data like this if the null hypothesis were true. To the contrary, high p-values mean that the observed statistic isn't surprising and that the results are in line with assumptions that the null hypothesis models the real world (De Veaux, Velleman, and Bock, 2012).

On data sets where the goal was to discern between the proportions of student behaviors and/or attitudes on two variables a two-proportion z-interval was run. A two-proportion z-test was also performed on these data sets where there was hypothesis-testing. The null hypothesis in each case was that there is no difference in the percentage of the student behavior or attitude. The alternative hypothesis was that the percentages are different. The assumptions and conditions for both tests are the same, and all are met. The independence assumption and randomization condition were met as the participants were selected at random by the office of the registrar. The number of students surveyed is

certainly far less than 10 percent of that population. Lastly, the success/failure condition was met as the counts for successes and failures for each group contained far more than 10.

The purpose of the questions on ideal study environments was to anticipate what students would find valuable in the spatial design of a library. The most important factors identified by students in their ideal space would be the most critical to feature in the design of library learning environments. These survey questions lead to the development of the next research method: image board and graffiti wall.

Image Board and Graffiti Wall

With the establishment of group study preferences as a significant area of this study, more research was needed to identify design preferences for this area. The survey provided scripted documentation on student's ideal study environment, but design is a visual field and images should be used to define the ideal group study environment. The group study area was identified as a large open area with a very generic layout. The open space was carpeted with indirect cove lighting. The area has windows on two walls, with views to central campus on the largest window wall to the south. The glazing allows for daylight to penetrate the space, but only at the perimeter spaces. The existing heavy, immobile furniture is organized in rows that lack a clear focal point within the space. Outlets can only be found along the perimeter of the space and relatively few of the tables are powered. Student activity in the space most often peaks in the afternoon, during which the sound levels are very high. This portion of the research sought to engage existing users of the space to understand the future functional and aesthetic requirements of a study space that appeals to students.

Group study commons typically provide users with flexibility for a wide range of users and activities. It is my hypothesis that users of this space would benefit from more control over the environmental surround, including sound level, furniture arrangement, lighting, and technology. Observation of this space has shown that there are many individuals that study in the group study area.

Image board and graffiti walls were used in conjunction to engage users of the space directly. The first of two methodologies used to identify student's perceptions of the ideal group study space at the library was an image board. An image board is "a collage of collected pictures, illustrations, or brand imagery" that can be used to visually communicate as essential description of targeted aesthetics or other design intent (Hanington and Martin, 2012). This method was used to collect preferences on the visual design features that students feel represent the ideal group study environment at the library. The images selected varied from traditional to modern, formal to informal, macro-scale to micro-scale spaces, and details of interior features including whiteboards, privacy screens, and power outlets. Twenty-four collected images were placed on a 36 inch wide by 24 inch high poster with the phrase, "Please place stickers by the two most compelling images in your ideal group study space at the library." Small, circular stickers were placed by the poster to allow for students to participate in the study at their own discretion.

Student involvement in the image boards was significant as shown in the 393 stickers placed on the boards. The results of the stickers placement on the image board were counted and figured as percentages. The images were used to visually define the meaning of a design aesthetic chosen by students that directly use the space (Hanington and Martin, 2012).

The second methodology used was graffiti walls. Graffiti walls “provide an open canvas on which participants can freely offer their written or visual comments about an environment of system, directly in the context of use” (Hanington and Martin, 2012). Large-format paper (36 inch wide by 24 inch high) with the phrase, “Please describe your ideal group study space at the library,” was used for this method. Pens were tied to the poster to encourage students to express concerns, ideas, and inspiration for the space. The informal approach of the two methods was key to making this a simple approach for students to respond and provide feedback on the design of a group study space.

The image board and graffiti walls were placed on a table within the group study area at the university library. The location selected was central in the space, and at a circulation intersection that students have to pass to enter the study spaces beyond. A poster introducing the project was placed on an easel by the table. The following disclaimer was used on the poster:

You are encouraged to participate in a research project with the objective of identifying ideal group study environments in the university library. Your participation in the project is voluntary, anonymous, and very much appreciated.

The research was in place for one consecutive week, starting and ending on a Monday morning. Throughout the installation photographs were taken to document the development of the research and to keep records of student activity.

Data gathered to answer the third research question regarding students’ ideal study environments within a library environment was used to provide suggestions on improving the

design of study spaces within university libraries in the discussion. While questions were directed toward ideal environments on the student survey, the visual clarity of these the image board and graffiti wall methods were key to providing design recommendations for library interiors.

Card Sort

To prevent bias in describing the visual images in this study, a card sort study was developed to understand the meaning of the images in the eyes of undergraduate students. Card sorting is a user-centered design method that involves labeling content that makes sense to the participant (Kaufman, 2006). This research method was used to identify trends in users' mental models, and to learn how users think about something. Card sorts are an established, inexpensive research method. The results can be highly variable depending on the participants' profiles and their unique mental model (Kaufman, 2006).

The images that were the most favorable in the image boards were printed and mounted on notecards. Students working in the group study area in which the image boards were located were asked to voluntarily participate in the study. Each student participant was asked to, "Please describe the key features that make this an ideal group study environment." The students were each given three images to select from and asked to write down their response for one image on a blank notecards. The objective for the card sort was to have participants identify key features in the images that would provide insight into features that student's recognized as being important to the success of the designs used in the image board. These key features would later be classified into meaningful terms and, if applicable, common themes identified for the selected images.

IV. RESULTS

Overview

The goals and objectives for the study were to understand current usage of the library, preferences, and ideal student study environments to provide a better study space in the design of future libraries. The research questions identified categories that were used to organize the research data: current usage, satisfaction, preferences, and ideal environments. The appropriate hypotheses are discussed within each subsection. The results were further broken down into group and individual data, for comparison purposes in the discussion. The observation results were categorized into current usage. Image boards and graffiti wall data were categorized into ideal study environments. The undergraduate student survey spans all sections: current usage, satisfaction, preferences, and ideal environments.

Current Usage

Generally students utilize the library and have gone to the university library. Students most frequently visit the library to study, as 86 percent of survey respondents stated. Other common answers of why students go to the university library were for the required freshman library class, for Internet on a personal computer, and for the café. Only 2 percent of survey respondents have never gone to the library. Figure 5 displays a graph showing the most popular choices for why students visit the library.

Why do you go to the university library?

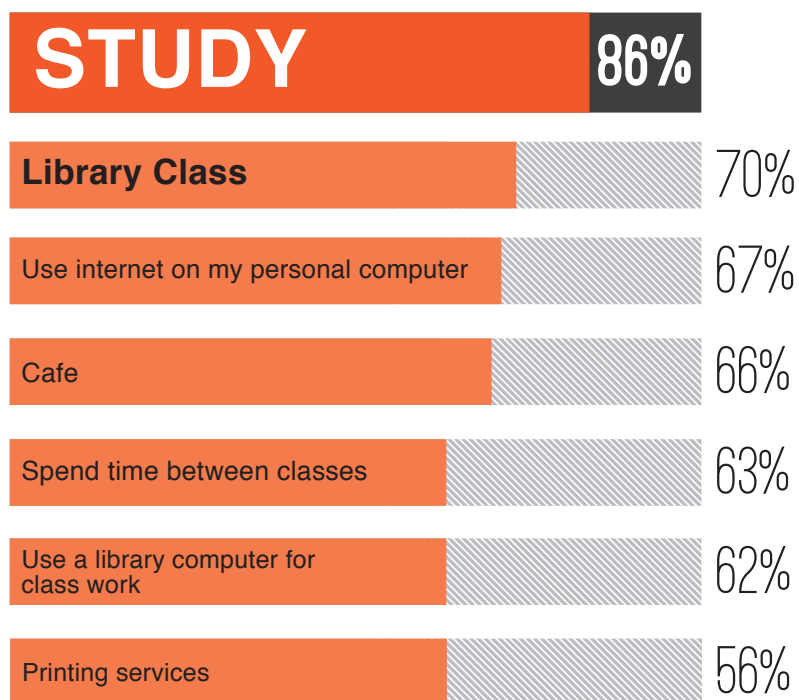


Figure 5. Why students go to the university library

Hypothesis 1

Hypothesis 1 states that the main reason students visit the library is to study, not to use the books housed within the library. A Z-test was performed on the question above, “Why do you go to the university library?” The data set of the percentage of students that study was compared with the percentage of students that checks out a print book.

H₁₀: There is no significant relation between the proportions of students that study at the library and students that go to the library to check out a print book.

H_{1a}: There is a significant relation between the proportions of students that study at the library and students that go to the library to check out a print book.

The z-test to test hypothesis 1 resulted in a p-value of 0. Therefore, I reject the null hypothesis of no difference in the proportion of students that go to the library to study and check out a print book. The data suggests that students are more likely to go to the library to study. A two-proportion z-interval was run on the proportions of students that go to the library to study compared to the students that go to the library to checkout a print book. With 95 percent confidence, the true proportion of students that study at the library is between 26.2 percent and 45.4 percent higher than the proportion of students who go to the library to check out a print book.

Questions regarding how long students spend at the library and the frequency of study were asked to better understand how students are currently using this resource. 42 percent of students spent between thirty minutes and two hours at the library during their last visit, with a total of approximately two-thirds of students spending under two hours at the library. This indicates that one-third of students spent more than two hours during their last visit, which is a significant amount of time. 42 percent of respondents visit the library weekly, followed by 21 percent monthly and 13 percent daily. Over half of the students that responded to the survey visit the library at least weekly. Students that visit the library sporadically, including several times per semester to at least once per year, total approximately one-quarter of all respondents.

When asked specifically if they study at the university library, 78 percent of student respondents stated that they do study at the library. The location was identified as the main reason that students do not study at the library, followed by interior environment and

atmosphere. Of the 78 percent of respondents that do study at the library, 63 percent responded that the main reason they study at the library is for quiet study space. This answer is followed by interior environment and atmosphere as the secondary reason for studying at the library. The total for quiet study space and interior environment was 82 percent, verifying the purpose of this study and the need for a progressive study space within the library.

The survey results regarding current usage disclosed that 91 percent of respondents study individually at the library. Analysis from the observation revealed that the study carrels along the perimeter of the stacks were a very popular space to study among individuals. The second floor was used in the observation sessions, and the carrels were steadily used during both observation times. During the afternoon study, 95 percent of the carrels were occupied, compared to 83 percent occupied on Thursday morning. A more in depth study was conducted during the second observation that looked at whether students were working or not working, using power versus not using power, and using library books versus not using library books. The results showed that the majority of students were working and using power for their personal computers. Not one of the students observed in this space during this time was using a book from the stacks even though they were studying adjacent to thousands of books. The observation results of the individual study carrels, including a photograph of a typical carrel, can be found in Figures 6 and 7 below.



Figure 6. Photograph of the individual study workstations studied during observation

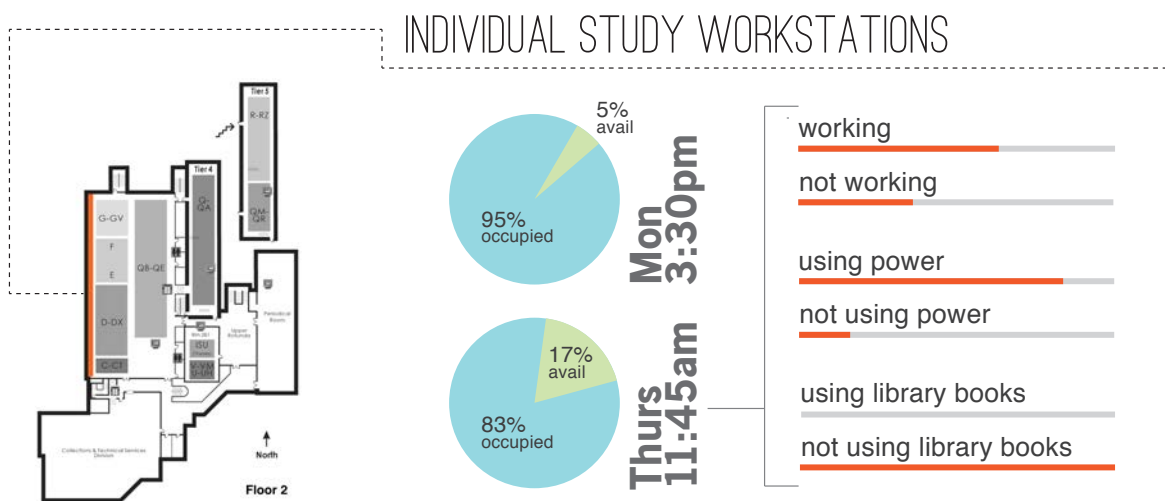


Figure 7. Observation results for the individual study workstations

The university library is a popular place for group study on campus. 75 percent of survey respondents stated that they study in groups of two or more at the library. The most common size of group according to the survey is a group of three. Nearly all group sizes are smaller than five persons, with only two percent of respondents stating that they study in larger group sizes. Figure 8 graphically depicts the group size from the survey data. When asked what students worked on during the group study sessions the most common answer was working together on a project, with 53 percent of responses (see Figure 9). 35 percent of the students responded with studying individually in close proximity to peers.

What size of group did you last meet with at the library during a group study session?

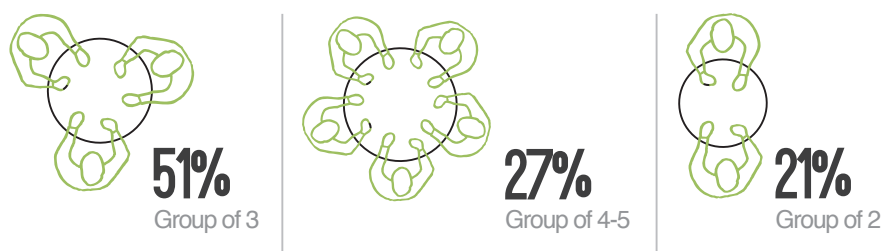


Figure 8. Group size during a group study session

When you last studied in a group at the library, what were you working on?

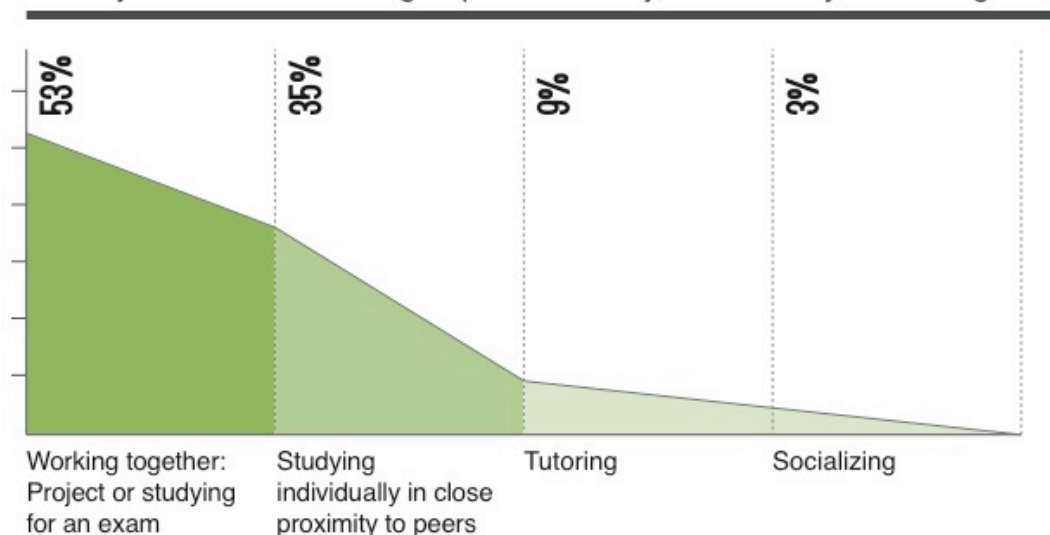


Figure 9. Tasks during a group study session

The group observation looked at a designated group study lounge in the library. The observation revealed that 30 percent of students using the space were individuals studying or working on assignments, followed by 28 percent of groups working individually and 21 percent groups working together. The total percentage of students working in groups was 49 percent. Observation revealed many students tutoring in groups of two in the general group study area (15 percent). The groups of two typically used a large table. Tutoring was also observed in the small group study rooms, with a larger group size of three to five individuals. One large group of six students was observed socializing, totaling 6 percent of those observed. See Figures 10 and 11 for a photograph of the group study area and graphic representation of the group observation results.



Figure 10. Photograph of the group study area studied during observation

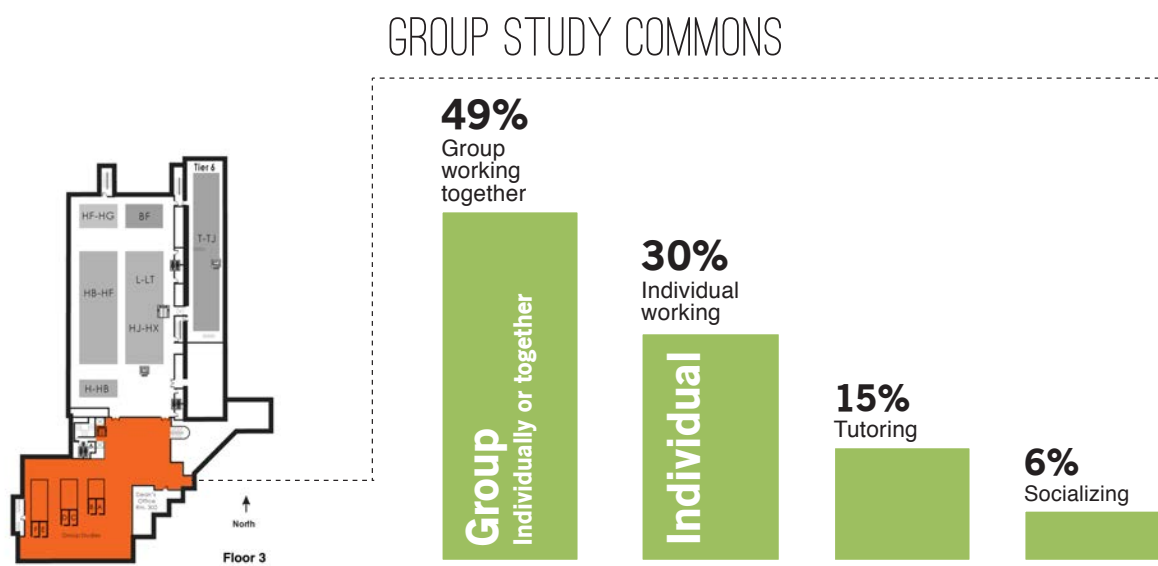


Figure 11. Observation results for the group study area

Hypothesis 2

Hypothesis 2 explores the differences in proportions of students that study individually and in a group. The hypothesis is that students are learning from each other in the library. A Z-test was performed on the current usage data from students that study individually at the library and students that study in groups (Appendix F and Appendix G).

H₂₀: There is no significant relation between the proportions of students that study individually at the library and students study in groups of two or more at the library.

H_{2a}: There is a significant relation between the proportions of students that study individually at the library and students study in groups of two or more at the library.

The two-proportion z-test resulted in a two-tailed p-value of 0.0012. The p-value of 0.0012 states that if there really were no difference in the percentages of students that study individually and in groups at the library, then the difference observed would only occur 12 times in 10,000. This is so small that I reject the null hypothesis and conclude that there is a difference between the percentages of students that study individually and in groups at the library. Students are more likely to study individually at the library. A 95 percent confidence interval showed that the true percentage of students that study individually at the library is between 6.4 percent and 25.2 percent higher than the percentage of students that study in groups of two or more. While students do learn from each other in the library, a far higher percentage of students study individually.

The 32 computer stations housed within the student learning commons (Learning Connections Center) were fully occupied during both observational studies. The activities

being conducted on these computers were difficult to document, as many of the students were multi-tasking. The study looked at one snapshot in time of each computer station. 53 percent of the students were working, 38 percent were using the computers for personal use, and 6 percent of the students were multitasking where they had both work and personal windows open on the computer. Only one student was on the library website. Figures 12 and 13 show the student learning commons observation results.



Figure 12. Photograph of the computer stations in the student learning commons

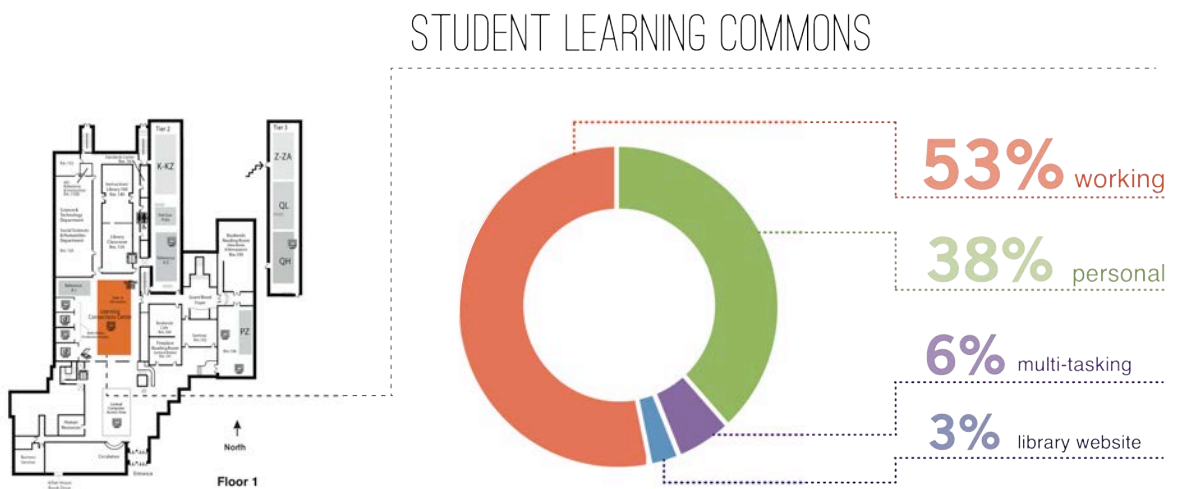


Figure 13. Observation results for the student learning commons

In addition to general library usage questions, the survey asked the question, ‘Have you changed your behavior in response to the following environmental factors at the university library? (Select all that apply).’ At 85 percent responding yes, the most popular answer for the reason that students changed their behavior was moved because of access to power. Students also moved because of noise (65 percent), selected a space because of cleanliness (62 percent), and rearranged furniture to adapt to needs (55 percent). Fewer than 50 percent of student participants selected a space because of the décor, moved because someone sat too close, moved because of inadequate artificial light, or moved from the glare or temperature of daylight.

Have you changed your behavior in response to the following environmental factors at the library?

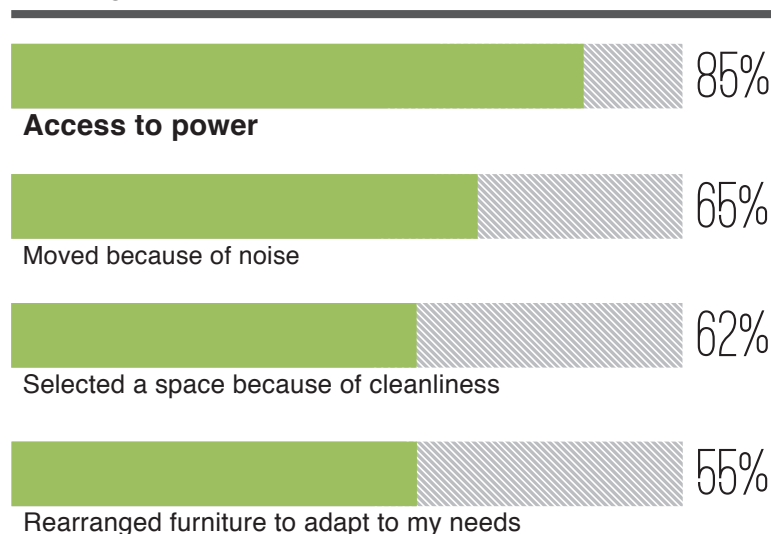


Figure 14. Changed behavior in response to environmental factors at the library

Satisfaction

Student survey respondents are satisfied with the overall interior environment at the library. 69 percent of respondents were either satisfied or very satisfied with the overall interior environment, with another 24 percent of students neutral. Only 6 percent of respondents were dissatisfied or very dissatisfied.

A contingency table analysis was performed on the descriptive stats and the satisfaction of the overall interior environment at the library. There was a significant relationship between the student's college and overall satisfaction with the interior environment, as shown in Table 1. The students most satisfied with the library interiors were in the College of Human Services and College of Liberal Arts and Sciences. Students in the College of Design were the least satisfied with the interior environment at the library, and therefore were the highest percentage of respondents dissatisfied with the interiors. The

Contingency Table

N	DF	-LogLike	RSquare (U)
143	10	11.122457	0.1009

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	22.245	0.0139*
Pearson	19.520	0.0341*

A contingency table analysis was performed on the question ‘Why do you go to the university library?’ with the dependent variable ‘How satisfied are you with the overall interior environment at the library?’ The responses from reasons students visit the library were recoded to yes “1” and no “0”. The satisfaction levels for overall satisfaction with the interior environment at the library were recoded to dissatisfied “1,” neutral “2,” and satisfied “3.”

The results of the contingency table analysis found that there was a significant relationship between satisfaction with the overall interior environment and studying at the library. The contingency table below and corresponding Chi-square tests show a P-value below 0.05, indicating that the students that go to the library to study have a significantly higher level of satisfaction with the interiors than the students that do not go to the library to study.

Table 2. Contingency table of study as a reason to go to the library and overall satisfaction of the interior environment at the library

Contingency Table

Count Total % Row %	1 Overall Dissatisfied	2 Overall Neutral	3 Overall Satisfied	
0 Study No	4 2.91 21.83	5 3.29 24.65	11 7.13 53.52	21 13.33
1 Study Yes	4 2.91 3.36	41 26.43 30.49	88 57.33 66.15	133 86.67
	9 5.82	46 29.71	99 64.47	154

N	DF	-LogLike	RSquare (U)
154	2	3.7978312	0.0305

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	7.596	0.0224*
Pearson	11.075	0.0039*

The contingency table analysis also showed a significant relationship between overall satisfaction with the interior environment and students that go to the library to spend time between classes (Table 3). The results of the contingency table analysis showed no association between satisfaction with the overall library interior environment and students that go to the library to check out a print book.

Table 3. Contingency table of spend time between classes as a reason to go to the library and overall satisfaction of the interior environment at the library

Contingency Table

Count	1	2	3	
Total %	Overall	Overall	Overall	
Row %	Dissatisfied	Neutral	Satisfied	
0	6	23	30	59
Spend time between	3.70	14.87	19.54	38.11
classes	9.72	39.02	51.26	
No				
1	3	23	69	95
Spend time between	2.12	14.84	44.93	61.89
classes	3.42	23.98	72.60	
Yes				
	9	46	99	154
	5.82	29.71	64.47	

N **DF** **-LogLike** **RSquare (U)**
154 2 3.8562395 0.0310

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	7.712	0.0211*
Pearson	7.804	0.0202*

A contingency table analysis was performed on the frequency data (how often the student studies at the library) and satisfaction with the overall library environment at the library. The frequency data was recoded to a 3-level variable: rare use (do not go to the library or visit once per year) “1,” low frequency (monthly and several times per semester) “2,” and high frequency (daily and weekly) “3.” The same 3-level variable was used for satisfaction.

The results of the contingency table analysis (Table 4) found that there is a significant relationship between how often the student visits the library and satisfaction with the overall interior environment at the library. The corresponding Chi-square test shows a P-value below 0.05, indicating that high frequency users have a higher level of satisfaction with the interior environment than low or rare frequency users.

Table 4. Contingency table of frequency of visits to the library and overall satisfaction of the interior environment at the library

Contingency Table

Count Total % Row %	1 Overall Dissatisfied	2 Overall Neutral	3 Overall Satisfied	
1 Rare use	6 3.70 14.78	15 10.00 39.90	17 11.36 45.32	39 25.06
2 Low frequency	1 0.53 1.65	13 8.67 27.17	35 22.71 71.18	49 31.91
3 High frequency	2 1.59 3.69	17 11.05 25.67	47 30.40 70.64	66 43.03
	9 5.82	46 29.71	99 64.47	154

N	DF	-LogLike	RSquare (U)
154	4	5.6147745	0.0451
Test	ChiSquare	Prob>ChiSq	
Likelihood Ratio	11.230	0.0241*	
Pearson	12.053	0.0170*	

As the library continues to plan remodeling projects to the interior spaces within the university library, research is needed to support these efforts. Students were asked what space they would most like to see renovated and how the space should be designed to make the environment more appealing to you. The space that students would most like to see renovated was the study workstations along the perimeter of the stacks, by 26 percent of respondents. The students wrote that they would like more outlets for personal computers, better lighting, and more comfortable chairs. One student commented “additional sound insulation or methods to make things quieter would help.” The study carrels throughout the stacks were selected by 22 percent of student respondents as the space they would most likely to see renovated. 18 percent of the students surveyed would like the group study area to be renovated, with more outlets and new furniture as the top suggestions. Several of the students felt the space was too open. A student wrote “more rooms for groups to work, or nooks for group to work.” Another student suggested “moveable screens to section-off parts of the area if needed.”

Students were asked if they are satisfied with the current level of privacy while studying individually at the university library. 69 percent of students were either satisfied or very satisfied with the current level of privacy in these environments. Another 25 percent of students were neutral to the current level of privacy. Only 6 percent of student respondents

were either dissatisfied or very dissatisfied with the current level of privacy in the individual study spaces.

A contingency table analysis was run on students' preferred space to study individually at the library and how satisfied the student is with the current level of privacy while studying individually. No statistically significant relationship was identified with the students' preferred space to study and satisfaction with privacy levels. However, students were least satisfied with the privacy in the study carrels throughout the book stacks and at the quiet study tables. Students cited the most satisfaction with privacy at the workstations at the perimeter of the stacks and in the computer labs.

Furthermore, the level of control over environmental factors may influence the choice of study space. On scales from very dissatisfied, dissatisfied, neutral, satisfied, or very satisfied, students rated lighting, sound levels, workspace, furniture, privacy, and social environment (Appendix F, Question 22). Students are very satisfied with the workspace provided in the library interior environments. While the overall diagram shows that students are either satisfied or neutral, the most significant data are in the analysis of the very dissatisfied or dissatisfied responses. Students are the most dissatisfied with sound levels, lighting, and furniture. Sound levels are in dissatisfaction levels for 24 percent of respondents.

Hypothesis 3

Hypothesis 3 states that students prefer to have control over the learning environment in the library. A contingency table analysis was performed on the question 'How satisfied are you with the level of control you have over the following factors in the library?' with the

dependent variable ‘How satisfied are you with the overall library environment at the library?’ The satisfaction levels for both sets of data were recoded to dissatisfied “1,” neutral “2,” and satisfied “3.”

Six criteria were used to test this hypothesis:

- Criterion 1 (CR1): Lighting
- Criterion 2 (CR2): Sound levels
- Criterion 3 (CR3): Workspace
- Criterion 4 (CR4): Furniture
- Criterion 5 (CR5): Privacy
- Criterion 6 (CR6): Social environment

H₃₀: There is no significant relation between the satisfaction with the level of control over the six criteria and overall library satisfaction.

H_{3a}: There is a significant relation between the satisfaction with the level of control over the six criteria and overall library satisfaction.

The results of the contingency table analysis found that there is a significant relationship between the level of control with the criteria workspace, furniture, privacy and social environment and overall satisfaction with the interior environment at the library. There was no statistical relationship between level of control of lighting and sound levels and the overall satisfaction with the interior environment at the library. The contingency tables of the significant criterion are shown in detail below in Tables 5 – 8.

Table 5. Contingency table of satisfaction with the level of control over workspace and overall satisfaction of the interior environment at the library

Contingency Table - Workspace

Count	1	2	3	
Total %	Overall	Overall	Overall	
Row %	Dissatisfied	Neutral	Satisfied	
1	2	0	0	2
Workspace	1.79	0.00	0.00	1.79
Dissatisfied	100.00	0.00	0.00	
2	0	12	15	28
Workspace	0.00	10.92	13.63	24.54
Neutral	0.00	44.47	55.53	
3	1	14	68	84
Workspace	1.08	12.71	59.88	73.66
Satisfied	1.46	17.25	81.29	
	3	27	83	113
	2.87	23.62	73.51	

N	DF	-LogLike	RSquare (U)
113	4	12.199581	0.1607

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	24.399	<.0001*
Pearson	78.688	<.0001*

Table 6. Contingency table of satisfaction with the level of control over furniture and overall satisfaction of the interior environment at the library

Contingency Table - Furniture

Count	1	2	3	
Total %	Overall	Overall	Overall	
Row %	Dissatisfied	Neutral	Satisfied	
1	2	4	9	15
Furniture	1.79	3.59	7.53	12.91
Dissatisfied	13.89	27.77	58.34	
2	0	14	25	39
Furniture	0.00	12.35	21.88	34.22
Neutral	0.00	36.07	63.93	
3	1	9	50	60
Furniture	1.08	7.69	44.09	52.86
Satisfied	2.04	14.55	83.41	
	3	27	83	113
	2.87	23.62	73.51	

N	DF	-LogLike	RSquare (U)
113	4	6.0308308	0.0794

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	12.062	0.0169*
Pearson	13.941	0.0075*

Table 7. Contingency table of satisfaction with the level of control over privacy and overall satisfaction of the interior environment at the library

Contingency Table - Privacy

Count	1	2	3	
Total %	Overall	Overall	Overall	
Row %	Dissatisfied	Neutral	Satisfied	
1	2	1	5	8
Privacy	1.79	0.72	4.30	6.81
Dissatisfied	26.33	10.51	63.16	
2	1	13	21	35
Privacy	1.08	11.28	18.66	31.02
Neutral	3.47	36.36	60.17	
3	0	13	57	71
Privacy	0.00	11.63	50.54	62.17
Satisfied	0.00	18.71	81.29	
	3	27	83	113
	2.87	23.62	73.51	

N	DF	-LogLike	RSquare (U)
113	4	7.3164860	0.0964

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	14.633	0.0055*
Pearson	22.129	0.0002*

Table 8. Contingency table of satisfaction with the level of control over the social environment and overall satisfaction of the interior environment at the library

Contingency Table – Social Environment

Count Total % Row %	1 Overall Dissatisfied	2 Overall Neutral	3 Overall Satisfied	
1 Social Environment Dissatisfied	1 0.72 100.00	0 0.00 0.00	0 0.00 0.00	1 0.72
2 Social Environment Neutral	0 0.00 0.00	12 10.91 32.89	25 22.25 67.11	38 33.16
3 Social Environment Satisfied	2 2.16 3.26	14 12.72 19.23	58 51.26 77.51	75 66.13
	3 2.87	27 23.62	83 73.51	113

N **DF** **-LogLike** **RSquare (U)**
113 4 5.1061866 0.0673

Test **ChiSquare** **Prob>ChiSq**
Likelihood Ratio 10.212 0.0370*
Pearson 30.942 <.0001*

Preferences

Survey questions were used to analyze the preferred study spaces within the university library. Students were asked, “Where is your favorite place to study in the library?” Individual study carrels were selected as the favorite place to study in the university library, followed closely by group study space and quiet study spaces such as the Bookends reading room or Periodical room. The total response for these three spaces totaled 72 percent. Study spaces with technology such as computer labs and the student learning commons (Learning Connections Center) were the favorite place to study for only 7

Where is your favorite place to study at the library?

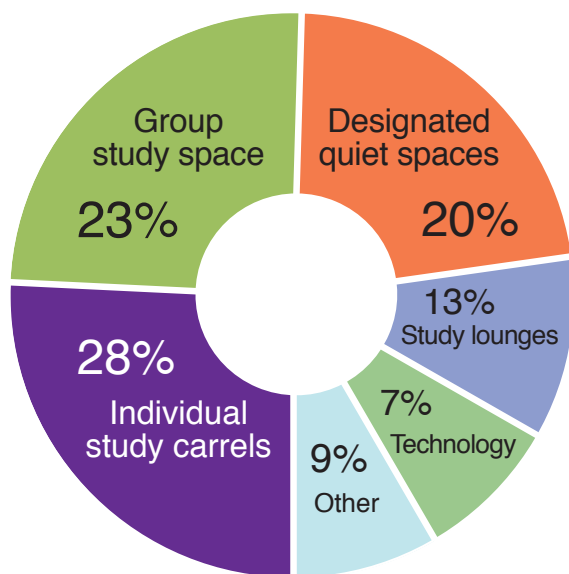


Figure 15. Where is your favorite place to study at the library?

percent of students. The student learning commons not only houses computers but also has printers and scanners for the students to use. The customer service desk is located within the student learning commons.

The students were asked to identify the physical aspects of their favorite study space that they liked the most and the least. In general, students liked the sound level of their preferred study location. Other physical aspects of the space that the students like the most included location and privacy. Figure 16 depicts the physical aspects students like the most in their favorite study space. The majority of student respondents did not find physical aspects of the space that they disliked, and felt that the space works well. Figure 17 shows that temperature and lighting were the physical aspects that the students liked the least,

although the percentage are relatively low compared to the students that disliked nothing about the space.

What physical aspects of this space do you like the MOST?

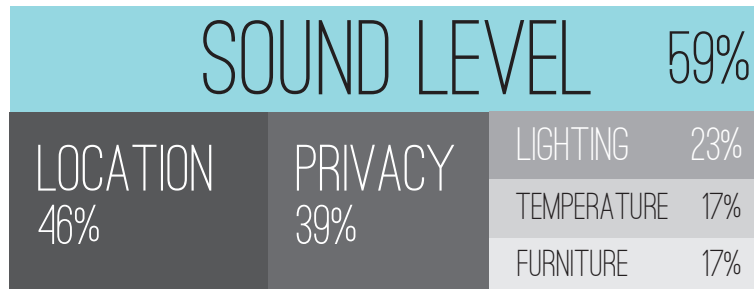


Figure 16. Physical aspects of the space students like the most

What physical aspects of this space do you like the LEAST?

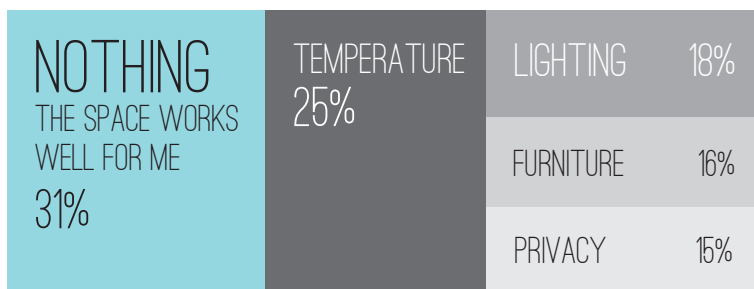


Figure 17. Physical aspects of the space students like the least

Through the use of data filters the physical aspects of space that the students liked and disliked were linked to the space they identified as their favorite. The survey respondents that selected the individual study workstations as their favorite place to study in the library stated privacy as the physical aspect of this space that they liked the most. Sound

levels and location were other physical aspects of the space that they liked. Students wrote in responses on the survey that they like the accessible outlets in this space. Lighting and furniture were the physical aspects of the space that they liked the least.

The group study space was selected as a favorite place to study in the university library by 23 percent of respondents. The location, sound levels, and it's where my friends are were the physical aspects of the space that students like the most. The space worked well for most students, with a mention of a lack of outlets.

Students that selected the quiet study spaces identified the sound level as the physical aspect of the space they like the most, followed by lighting and location. The aspects they liked the least were the temperature of the space and that there are no plug-ins.

Within the individual survey data the preferred space to study at the university library was the quiet study tables at 29 percent. This was followed by study workstations at the perimeter of the stacks (22 percent) and the study carrels throughout the book stacks (19 percent). 79 percent of student respondents indicated that there are enough of their preferred individual study spaces available at the times they need it. However, the observation analysis of the individual study workstations on the second floor showed that they were nearly fully occupied during the observed times.

Hypothesis 4

Hypothesis 4 states that individuals prefer to study in spaces with greater amounts of privacy at the library. A contingency table analysis was performed on the question 'How satisfied are you with the current level of privacy while studying individually at the library?' with the dependent variable 'How satisfied are you with the overall library environment at

the library?’ The satisfaction levels for both sets of data were recoded to dissatisfied “1,” neutral “2,” and satisfied “3.”

H4₀: There is no significant relation between the satisfaction with the level of privacy while studying individually at the library and overall library satisfaction.

H4_a: There is a significant relation between the satisfaction with the level of privacy while studying individually at the library and overall library satisfaction.

The results of the contingency table analysis found that there is a significant relationship between satisfaction with the level of privacy while studying individually at the library and satisfaction with the overall interior environment. The contingency table below (Table 9) and corresponding Chi-square tests show a P-value below 0.0002. Students that are satisfied with the level of privacy while studying individually at the library are more satisfied with the overall interior environment at the library.

Table 9. Contingency table of student’s satisfaction with the level of privacy and overall satisfaction of the interior environment at the library

Contingency Table

Count Total % Row %	1 Overall Dissatisfied	2 Overall Neutral	3 Overall Satisfied	
1 Privacy Dissatisfied	2 1.95 35.74	2 1.55 28.52	2 1.95 35.74	6 5.45
2 Privacy Neutral	0 0.00 0.00	13 12.38 51.46	12 11.68 48.54	25 24.07
3 Privacy Satisfied	1 1.17 1.66	11 10.51 14.92	61 58.80 83.42	74 70.48

	3	26	76	104
	3.12	24.45	72.43	

N	DF	-LogLike	RSquare (U)
104	4	10.999664	0.1534

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	21.999	0.0002*
Pearson	35.263	<.0001*

The preferred group study space at the university library was the group study area on the third floor, as stated by 56 percent of the students that study as a group within the library. The group study rooms, with 27 percent of responses, were the only other location of preferred study space of any merit. Only one person preferred the group study area on the fourth floor. 80 percent of student respondents state that there were enough of their preferred group study spaces available at the times that they are needed. Of the students that responded that there were not enough of their preferred group study spaces available, group study rooms were referred to most often at 47 percent. Students also stated that the group study area was not available at the times they study.

The students that study in a group environment were asked to “please describe any missing features in the group study areas at the library that would help provide you with a better study environment.” A content analysis revealed that over half of the comments concerned the need for more outlets. Other comments were new tables with power built-in, more private study rooms, partitions, marker boards, and vending.

Movable furniture was broken out as a feature to ask preferences about since it is generally adaptable to many needs. However, movable furniture is under utilized as multifunctional pieces of the environment if designed in a way that discourages its

movability or hides its multifunctionality. Students were asked if they prefer to study in an environment with movable furniture. More students answered that they would prefer moveable furniture, with a ratio of six to one. 55 percent of students stated that they are probably would or definitely would rearrange moveable furniture to meet their study needs.

Hypothesis 5

Hypothesis 5 states that students prefer to study in a space where customer service is a top priority, which amenities such as an information desk, computers, printing services, and refreshments, (definition of a student learning commons) to a more private environment.

H₅₀: There is no significant relation between the proportions of students that prefer to study in a student learning commons and students that prefer a more private environment.

H_{5a}: There is a significant relation between the proportions of students that prefer to study in a student learning commons and students that prefer a more private environment.

Students were directly asked on the survey, “Do you prefer to study in an area that has convenient access to an information desk, computers and printers, services, and refreshments or in a more private environment?” The private environment was chosen by 61 percent of respondents. The z-test for hypothesis 5 resulted in a two-tailed p-value of 0.001. With a p-value this small I reject the null hypothesis of no difference and conclude that there is a difference in the percentage of students that prefer to study in a student learning commons and a more private environment. A two-proportion z-interval shows that the true

proportion of students that prefer a more private environment is between 9.2 percent and 34.4 percent higher than students that prefer a student learning commons, with 95 percent confidence. The data revealed that students are more likely to prefer a more private study environment.

A contingency table analysis looked at the reasons why students visit the library and whether they prefer to study in a learning commons or more private environment. The students that use a print book in the library prefer to study in a more private environment, which is presented in the contingency table below.

Table 10. Contingency table of use a print book as a reason to go to the library and preference of a student learning commons or private environment

Contingency Table

Count	0	1	
Total %	Private Environment	Student Learning Commons	
Row %			
0	28	28	55
Use a print book	24.76	24.77	49.54
No	49.99	50.01	
1	40	16	56
Use a print book	36.08	14.38	50.46
Yes	71.51	28.49	
	68	44	112
	60.85	39.15	

N	DF	-LogLike	RSquare (U)
112	1	2.7373584	0.0366

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	5.475	0.0193*
Pearson	5.424	0.0199*

Ideal Study Environment

On the undergraduate student survey students were asked questions about their ideal study environment. One question on the survey was, ‘Imagine your ideal study environment. How important are the following factors in your ideal study environment?’ (See Appendix F, Question 23). Recorded as either important or very important by 95 percent of students was a quiet study environment. Access to power was important or very important by 94 percent, followed by comfortable furniture by 92 percent of respondents. Also important or very important were privacy (83 percent), tables for group work (83 percent), and control over task lighting (74 percent). A social space was listed as unimportant or very unimportant by 57 percent of respondents.

Selective phrases that describe possible individual study environments were included in the survey. An ideal individual study environment was selected by 33 percent of students as a ‘Workspace: At a table where I can spread out – with access to power. I don’t mind studying next to other people as long as they are quiet.’ This response identified power and a large workspace as the most important features in an individual study space at the university library. The second most popular selection, with 27 percent, was ‘Cozy: A cozy nook that is off the main circulation path – quiet and peaceful. A place where you can get lost in a book, with comfortable furniture.’ The cozy nook is a place where you read a book for enjoyment, whether a textbook or a novel, in comfort. The notion of a cozy nook suggests that these areas would be somewhat hidden, private and quiet, with furniture that supports the “cozy” implication. With 18 percent, the third choice for an ideal individual study space was ‘Quiet: In a very quiet, private, workspace where I have control over the environment, including the sound and light levels.’ The features identified in this phrase were control and the ambient

environment of sound and light levels. The selections are graphically shown in Figure 18 and Appendix F, Library Interior Environments Survey, question 26.

What phrase best describes your ideal INDIVIDUAL study environment?



Figure 18. Ideal individual study environment

The least popular selection for the ideal individual study environment was ‘Café: A study space where I am surrounded by an active environment. I enjoy people watching while I study, and convenient access to coffee or snacks.’ The premise of this phrase was the idea that the library has become a third place for students, with access to a lively environment for socialization and access to food and drink. Only one person out of 143 responses to this question identified this environment as their ideal individual study environment. Another unpopular choice for individual study, with only one selection, was ‘Amenities and services: In a study area that has convenient access to computers and printers, and help available if I

need it.’ Ideal individual study environments were also not associated with ‘Social: A space where I can talk with my friends while I study.’

The ideal group study environment choices were more closely clustered, indicating that ideal group study environments vary more widely than ideal individual study environment. The phrase that best describes the idea group study environment for 28 percent of students was ‘Group control: A quiet group study space where the group can have control over the environment, including the sound and light levels.’ The second choice, selected by 26 percent of respondents, was ‘Social: A space where I can talk with my friends while I study. I prefer tables or a booth type space for social interaction.’ The third choice was ‘Hybrid environment: A quiet group study space that is adjacent to an individual study space. I want to be able to work individually and in a group in the same quiet environment.’ The least popular choices were the ‘Amenities and Services’ and ‘Café’, with the same descriptions as listed in the above paragraph. The top three selections for an ideal group study environment by student survey respondents are shown in Figure 19 below, and in Appendix F, question 27.

What phrase best describes your ideal GROUP study environment?



Figure 19. Ideal group study environment

Data collected from the image board study was used to decipher features that students perceive as important in an ideal study environment. The completed image board can be found in Appendix H. Students selected private niches for study (Figure 20) and booth type spaces (Figure 21) as their ideal group study space, representing 22 percent and 21 percent of the total counts, respectively. In total, students selected this private alcove space 43 percent of the time.

Students were asked to describe the features in these study spaces that make this an ideal group study space at the library. Students felt that the image in Figure 20 would limit distractions extremely well. One student wrote, “While the space is open enough that you don’t feel isolated, it is still separate from the rest so you don’t worry about interrupting others.” Another student described that she felt like she was in her ‘own little world’ when

she studied for tests in the cubicles in the existing library. She felt like these would amplify that feeling as well as limit noise pollution. Another student wrote, “The privacy would be really nice! Includes both individual work area and group. Looks clean!” A student described the image in Figure 21 as “not a boring spot to study; there’s good atmosphere. You are closed in by the booth so you can focus.” There are large tables so there is ample room for group work and to spread-out textbooks. A student noted the outlets for charging computers, bright lighting, and comfortable seating.



Figure 20. Image board – photograph of niches

The third most selected image(s) were two photographs showing a writable table surface as well as whiteboards on a movable cart. These images represented 8 percent of the stickers (Figure 22). Students thought that having writable surfaces within a study environment would increase the usability and efficiency of the space. One student wrote, “I

like that you can write on the tables. That would make group work easy because you could draw out what you are thinking and you could share ideas with your group mates.”



Figure 21. Image board – photograph of booth



Figure 22. Image board – photographs of writable surfaces

The fourth image selected with 8 percent of the stickers was a large open study lounge with a variety of seating options (Figure 23). The ‘ultramodern’ space had a monochromatic color scheme that gave students the impression that this was a calm and positive atmosphere. Students repeatedly described the space as compelling for the variety within the design, including seating and options for individual and group study. Students identified that daylight contributed to the effectiveness of the space, and commented on the high windows and natural light within the space. One student pointed out the two different environments created by the contrast between the high and low ceilings. The student thought that noise would be reduced in the inside space. Another student focused on the adaptable floor space and could see the effectiveness of using the space as an individual and group space.



Figure 23. Image board – photograph of study lounge

Images that emphasize seating were selected by students 7 percent and 6 percent of the time. The first was a more typical study environment with tables and chairs (Figure 24). One student wrote, “I like that there are tables and chairs that you can sit in with the intent to get work done. It also gives options for different types of seating.” The windows were noted for the sunlight and view outside. The second image was an informal lounge with beanbag seating (Figure 25). One student felt that students were not always comfortable in chairs, and being comfortable makes studying easier.



Figure 24. Image board –
photograph of tables and chairs



Figure 25. Image board –
photography of beanbag chairs

With 5 percent of the stickers was a table with a power source in the center. The last image with a significant number of votes was a more formal lounge with a long sofa, center coffee table, and chair. Bold color was used in this image, and the space was described as “modern and cozy.” These images are shown in Appendix I.

There were an additional 5 images that received 2 to 3 percent of the votes each, accounting for 12 percent of the total counts. There were key features in these images that complement and support the images that received more votes. One student liked “chairs that make you sit upright. I feel like I am able to concentrate more than if I was sitting in a chair or couch that I could lounge in. Also, the table provides room to spread out my things.” Leather chairs were viewed as traditional, with the textures and colors of fabric comforting and stress reducing. In an image that featured a room divider with limited views through, a student stated that it is a “good division of space; still feels open but not overcrowding. Cool modern art form too.” The final two images were chairs with tall sides and back. A group of students described the chairs as enclosed, space effective, but an idea that doesn’t necessarily limit distractions. The students correlated the chairs with a scene in *Men in Black* and a smaller version of the image in Figure 20. The students discussed options for where these would be located, such as all together in a room or in a row. Appendix I includes these images at the bottom of the page.

The information gathered on the graffiti walls was slow to start, but proved to be an invaluable research method as the “graffiti” sprouted. After omitting information that was not pertinent to this study a content analysis of the phrases written and images drawn was completed to quantify the data collected. A photograph of the final graffiti wall is shown in Figure 26. The most comments were concerning a lack of power and outlets in the group study space. Students emphasized this concern by adding arrows, stars, and restating this problem, totaling 43 percent of the graffiti wall comments. Visual and written comments on outlets are shown in Appendix J. In addition to outlets, comments totaling 15 percent of the total graffiti were regarding furniture. The students noted that they would like to see

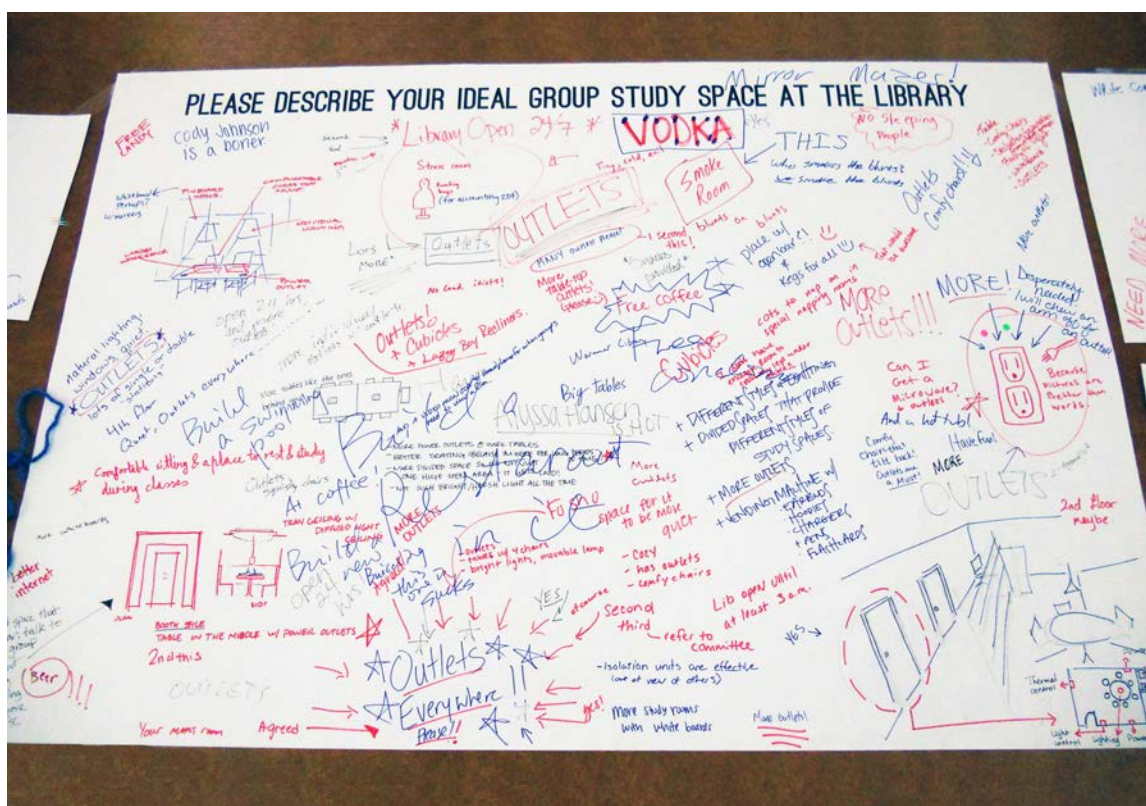


Figure 26. Photograph of final graffiti wall

Some of the comments on the graffiti walls were an expansion on ideas presented in the image boards. Drawings depicting some of the imagery shown in the image boards were noted on the graffiti walls with key items highlighted, noted, and drawn in greater detail. One such drawing was a screen at the end of a table where groups could plug a computer into a mounted monitor so the whole group could see the screen. A second drawing expanded on the booth type space with diffuse lighting, task lighting, and power.

V. DISCUSSION

Overview

This study was performed to obtain current perceptions of the student learning commons model to undergraduate students, and to provide recommendations for the design of future library interior spaces. The study looked at current usage and satisfaction to determine what students value in the current design of the university library. Ideal study environments were examined to broaden the thinking of study space at the university library. The idea of the ideal study environment would then be fused with future design recommendations. The research provided ideation generation and insight into the preferences of student group study space and individual study environments. The design outcomes of this research are to better the student learning spaces in the library through spatial definition, installation of outlets, increased private and quiet study environments, workspace, and control for users of the space.

Major Themes Identified

Privacy Over the Student Learning Commons Model

The main hypothesis of the study was that students prefer to study in an area that fits the definition of the student learning commons to a more private environment. It was my hypothesis that students use the library as a third place environment. Students use the library as a place for meeting outside of their dorm or apartment, the first place, or the classroom, the second place. The library as a third place stems from the current trend in libraries as place, placemaking in the built environment, and the inclusion of café functions into the

library setting. The literature review revealed the need to test this hypothesis, and the purpose of the study was reinforced many times throughout the analysis of the research data.

The implications of the student learning commons have been that students have given up privacy while they study at the library in exchange for services and amenities. Many libraries have turned floors once filled with stacks to a learning commons with an open floor plan (Hisle, 2005). While the computer stations and printing services are widely used by students there appears to be an even greater need for private areas. The results of this central hypothesis show that there is clearly a difference in the percentages of students that prefer to study at the library in a private environment with the percentage of students that prefer the student learning commons concept. The percentage of students that prefer the private environment is higher.

The image board and graffiti wall methods expanded on this idea. The students' consensus with the results of the image board suggests that even the group study space within the library should be designed to allow for privacy. The niche or booth imagery selected by the students feature an alcove design that provide a more intimate and private gathering area for group work. Intimate spaces allow for a more quiet and controlled work environment. Spatial definition is an important aspect of these spaces that control acoustics, create a collaborative environment, and provide the opportunity for task lighting for the group. These spaces should be supported with a variety of other seating options including tables and padded chairs, informal lounge spaces that allow students to relax in a comfortable chair, as well a bold color scheme that supports a relaxing atmosphere.

Library furniture can be oriented in a manner as to make it difficult for people to observe another student's behavior. Back-to-back seating allows a person to engage in

solitary behavior while face-to-face seating promotes conversation (Miller and Schlitt, 1985). Individual study carrels in a library are often placed on the perimeter of a room to send a message that the workstations are to be used by an individual for private study.

Room configurations can block lines of sight, thereby producing some degree of visual protection for individuals desiring privacy. L-shaped rooms create natural pockets of low visual exposure. Rooms can be structured with built-ins, diagonals, and walls to increase the level of privacy in a room (Miller and Schlitt, 1985). A privacy alcove can be created within a library to create a cozy nook of isolation for students that desire to study alone.

Individuals Use the Library

One of the most significant findings revealed through multiple methods in the study was that more students study individually at the library than in a group. This outcome supports the findings by Gensler (Broz, 2012). The implications of this are that a higher percentage of students that study individually at the library compared to students that study in groups of two or more. While students do study in groups there is an undeniably higher need to support the individual at the library. The student learning commons model places a much greater focus on the group and fails to support the student that seeks an environment conducive to individual study.

Students that study individually at the library prefer a quiet study environment that is off the main circulation path. The carrels most widely used and preferred for individual study are along the perimeter of the building footprint and have the book stacks acting as a buffer from circulation and other students. The carrels that are grouped together in a more prominent area are not as widely used. The reasons associated with the lower rate of use

appear be access to power and privacy. This finding was triangulated through observation and the survey data.

It is the microscale spaces in libraries that students studying individually value. As interior designers, we have the opportunity to increase student study productivity by creating tailored study spaces that focus on the individual. Privacy, both visually and acoustically, should be a key factor to design for in individual study areas.

Need for Power

In a university college students strive to keep up with the latest in technology. These technologies require power, whether it is a personal laptop, iPad, or smart phone. Students expect power sources to be integrated into the design of study spaces. The results of the graffiti wall undeniably showed that there are not enough outlets in the current study spaces within the library. Students highlighted, circled, and starred the outlet sketches and written recommendations. The existing conditions in the group study area in the library under review certainly limit the addition of outlets, as it is an open area with standard unpowered tables. This is not an uncommon problem among older buildings that were designed before the need for power to individuals was a concern. However, methods of integrating power into an existing space should be considered since there is so much evidence that there is a lack of available power for students. Methods such as core drilling the concrete slab and installing floor outlets, designing flexible power reels from above, or strategically locating powered tables within the open floor plan would allow more students to power their personal electronic devices.

Control

In an ever-changing world where information is readily available, the library serves as a place to organize information and a public resource to retrieve that information.

However, research has shown that the behaviors of library users are more based on the atmosphere and service than the product (College students', 2006). Ambient environmental factors are key to a comfortable space for students.

Control of the ambient environment is a basic human need and a desire a person has at all times. The control of lighting, sound levels, and temperature in a public space such as the library presents challenges with diversity of users. Presenting users of public space with the perception of control will enhance a users emotional response to the environment. In this study control over group spaces was a larger factor than control of individual spaces. In the undergraduate survey group control was the highest priority for students in their ideal group study environment.

The ability to manipulate and produce various effects in the visual environment is a way for a user to control the environment. The use of dimmers allows users to have control over the precise amount of light needed for various activities. Devices such as track lights allow for control over the position of a light source. Finally, the placement of control devices can provide a variety of optional responses. Task lighting placed at the individual's work surface is typically a good way for users to have control over light levels. Another way is for lighting to be integrated into furniture and adjustable by the user (Stewart-Pollack and Menconi, 2005).

Lighting is a component of visual privacy because lighting provides us with visual cues about the level intimacy in a room. Low levels of illumination contribute to feelings of

intimacy and privacy, and that type of visual cue will encourage the appropriate type of behavior in a private space for passersby. High levels of illumination signal open public spaces (Stewart-Pollack and Menconi, 2005). Dim lighting also limits how much you can see what others are doing. When paired with focused task lighting this can be a viable alternative to provide sufficient light for activities and as well as protect visual privacy.

Quiet environment

Student survey results revealed that students value the library, and use the library predominantly as a quiet study space. Another significant finding was that 63 percent of survey respondents stated the main reason they choose to study at the library is for quiet study space. This finding is in opposition to the literature on the library as a social space (Codispoti and Frey, 2007). While we are designing libraries to foster collaboration, we must also maintain the notion that libraries should provide patrons with a welcoming and comfortable quiet study environment that promotes prolonged use.

The conclusions of the study revealed that in the design of libraries more emphasis needs to be placed on the sound level of spaces. Sound deadening materials should be used in study areas, in spaces designed for individual study as well as in group study spaces.

In the design of an acoustically comfortable interior environment the first step is to interrupt the paths of sound (Stewart-Pollack and Menconi, 2005). The ceiling is the largest sized sound-reflective element, therefore should be designed with high absorption so that the sound reaching the ceiling is trapped before it bounces back. Soft, porous materials such as carpeting, fabric wall hangings on canvas stretchers, window panels with fabric inserts, and fully upholstered seating can also help deaden sound within a space (Stewart-Pollack and

Menconi, 2005). Sound absorption is extremely important in a library where students are completing concentration heavy tasks such as reading and writing.

“Sound masking is the addition of background noise at a decibel level higher than that of the ambient sounds” (Stewart-Pollack and Menconi, 2005). Noise and conversation can be rendered unintelligible to others through masking. By creating a background sound artificially, other sounds and conversations become harder to hear.

Furniture Selection

The underlying theme in students’ response to the furniture in the library was that is should be comfortable and that horizontal workspace should be large enough to spread out. Ideal study environments for students typically included variety, with some students stating that they prefer to study upright at a table and others stating they prefer to study in a lounge chair. Students had a preference for movable furniture, with students responding that they prefer to study in an environment with movable furniture six to one. Flexibility was stated as a positive factor during the card sort.

Conclusions

The trend of library design needs to be re-evaluated as new library renovations seek to fit into the student learning commons model. While the student learning commons in this case study was being used throughout the observed times, survey results showed that it was not the most widely used space nor the study space most desired by students. Without gathering the appropriate research on how students use the space, current efforts in library design are not being focused on the spaces that would have the most impact on students. A

statistically significant higher percentage of students seek individual study spaces within the library. The interiors spaces within libraries are also not being designed in a way that promotes students' ideal study environment.

Interior design for public spaces should be grounded on evidence-based design that has been proven to fit with the largest percent of the user population. While designing a public space the designer should take a larger population into account by providing flexibility within the space. However, research has shown that efforts to satisfy the needs of all users have gone too far in the direction of open space planning. The results clearly show that while student's attitudes and behaviors are diverse, they clearly seek power, large workspace, privacy, and a quiet work environment in the library.

When the design of public facilities is planned, the architecture, entry sequence, and main interior lobby spaces are often where monetary funds are allocated. The design of the intimate spaces within the building are often designed separately from the building, and typically on a much smaller budget and in spaces that have already been defined. The research conducted reveals a need to design functional intimate spaces that work well on a personal and human level. The study spaces within a library should do several things. On a functional level the space must be quiet, allow for students to plug in their personal laptop, and a certain level of control over other environmental aspects such as lighting and furniture arrangement. Concurrently, the design of spaces must feel welcoming to an individual. The spaces should have an adequate level of visual stimulation, but yet be quiet enough to study. The booth or study nook has shown to be an appealing image and potential design feature among users in the group study area at the university library.

The findings of why students do not visit the library may reveal an even greater importance in the interior design of a library-learning environment. Students that do not study the library stated that the interior environment and atmosphere was the main reason that one-third of survey respondents do not visit the library.

Limitations of the Study

- This study represented only one University, with survey results limited to one undergraduate student body. Generalizations based on one student body are limited.
- The survey response rate was lower than a typical survey but along the response rate expected for an undergraduate survey. Repeating the study with a new sample during a different time within the semester could produce a higher, more desirable response rate.
- Students that are in the first years of their undergraduate study may have limited exposure to interior design and study spaces. These students may not be able to articulate an ideal study environment. Therefore, student contribution to the graffiti wall method may have been influenced by the adjacent image board or other students instead of the student's personal knowledge of an ideal study space.
- While data was triangulated as much as possible there could be a disparity between how students actually use the space and how they responded to the survey. The survey data was used in the hypotheses testing.
- The images selected for the image board were based on including a variety of overall study spaces with identifiable spatial qualities alongside details of interior features.

While there were a variety of images it may have simplified the card sort method to keep the image within the same scale, i.e., all detail images of interior features.

- Writable space on the graffiti wall was hard to find by the end of the week during the installation. While this indicates that students responded favorably to the research method it may have deterred students from adding comments.

Recommendations for Future Research

The following are recommendations for future research, based on the results of this study.

- Repeat the study at other universities, including universities from other regions. Case studies from the south, in addition to the west and east coasts would provide a wide range of data. The findings from other universities could then be compared to discover if library trends are nation-wide or regionally focused.
- Conduct focus group research that concentrations on design workshops of the ideal library study space. A design charrette would allow students to design their ideal library space by drafting annotated furniture floor plans, based on a study by Gibbons and Foster (2007).
- Re-evaluate the space allocations of individual study space and student learning commons for the planning phase in the design of future libraries. Conduct a study that focuses on the current space allocations vs. findings of studies on student behaviors, attitudes and ideal study environment.
- Research is needed on the impact of funding secluded, private study environments that are adjacent to group study spaces. Prototypes would be a way to evaluate

student perceptions of the new study space and a way to analyze the success of the design.

- Explore the psychological and behavioral effects of small-scale spaces in public buildings.
- Research the meaning of privacy in the library. Design and perform a research study that compares desired levels of visual and acoustical privacy in the university library.
- Conduct research to compare adjacencies of the traditional library with new library design (student learning commons). Is there a difference in satisfaction based on adjacencies?

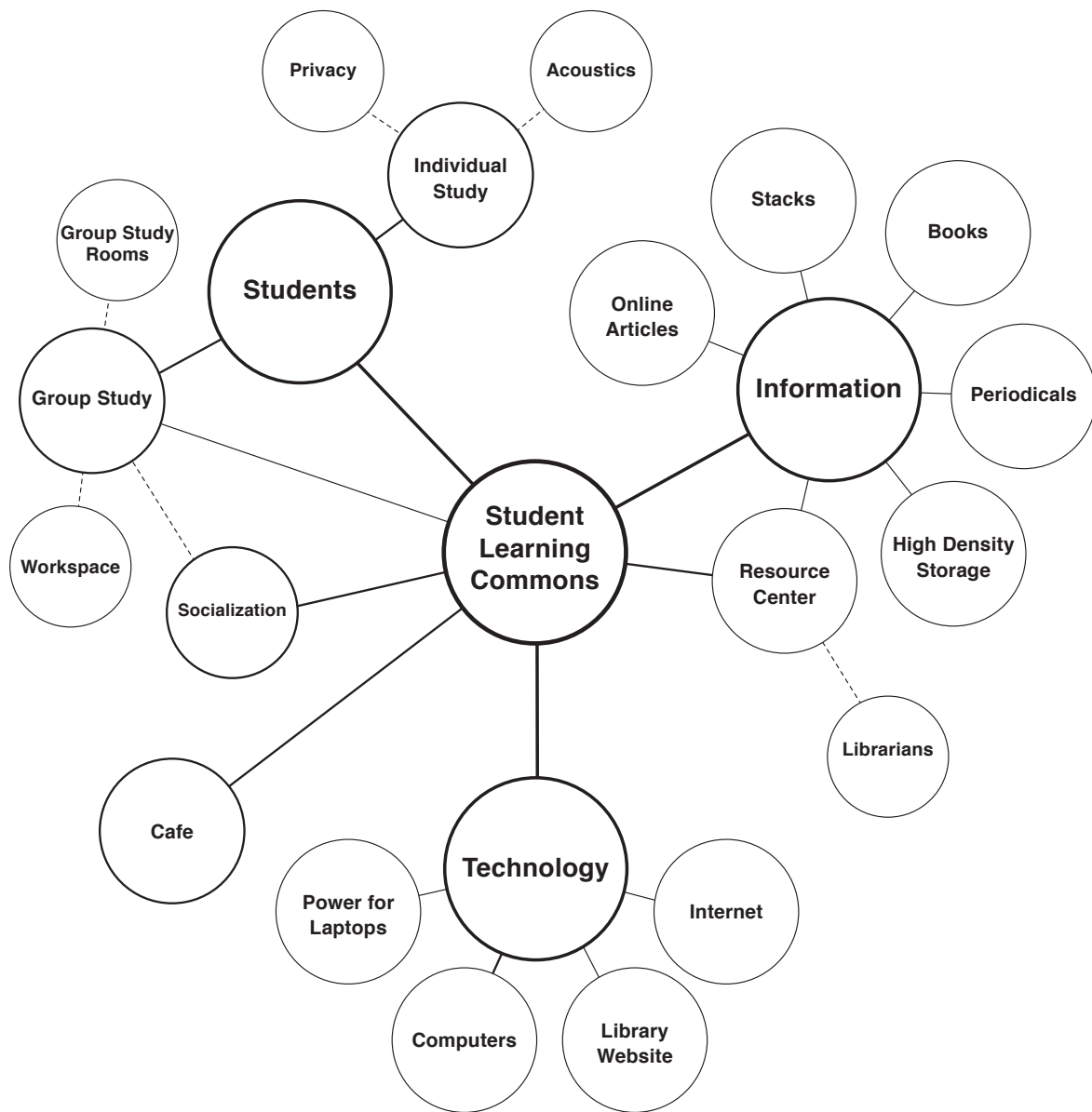
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APPENDIX A: CONCEPT MAP OF THE STUDENT LEARNING COMMONS

APPENDIX B: HUMAN SUBJECTS TRAINING APPROVAL

APPENDIX C: IRB SURVEY APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 4/12/2012

To: Nicole Peterson
1207 NE 5th Lane, #9, Ankeny, IA 50021

CC: Dr. Lori Brunner Stone
158 Design

From: Office for Responsible Research

Title: The developing role of the university library as a student learning center: Implications to the interior spaces within

IRB ID: 12-197

Study Review Date: 4/11/2012

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
 - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
 - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.
- (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified directly or through identifiers linked to the subjects.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX D: IRB IMAGE BOARD AND GRAFFITI WALL APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 10/16/2012

To: Nicole Peterson
1207 NE 5th Lane, #9, Ankeny, IA 50021

CC: Dr. Lori Brunner Stone
158 Design
Dr. Sarah Passonneau
302 Iowa State University Library

From: Office for Responsible Research

Title: Identifying Student Perceptions of the Library Environment

IRB ID: 12-509

Study Review Date: 10/12/2012

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
 - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
 - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

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Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

Please be aware that **approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that**

permission from these other entities will be granted.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX E: LIBRARY OBSERVATION NOTES**Group study lounge on the third floor**

Dynamic of study	
Individual – working	28
Group – working individually	26
Group – working together	20
Group – socializing	6
Group – tutoring	14
Total number of students	94

Total of 85 tables
 Total of 26 carrels
 Total of 27 seats along the window

Group size	
Group of 2	13
Group of 3	4
Group of 4	2
Group of 5	0
Group of 6+	1
Total	20

Power	18
No power	26

Individual study on the second floor

Occupied stations	33
Unoccupied stations	7
Total	40

Power	28
No power	5
Total	33

Working	21
Not working	12
Total	33

Using library books	0
Not using books	33
Total	33

Computer stations in the student learning commons on the first floor

Using library website	1
Checking email	0
Working	17
Personal use	12
Multi-tasking	2
Total	32

Group (of 2 students)	3
Individual	29
Total	32

This information was taken the first time I walked through the space. I walked around once more before leaving the space and noticed that many students had changed what they were doing and working on. The students multi-tasking had multiple windows open on the screen. The computer stations were fully occupied every time I walked by. One station did open up while I was there but it was quickly filled within minutes.






APPENDIX F: LIBRARY INTERIOR ENVIRONMENTS SURVEY

Library Interior Environments Survey










1. Why do you go to the ISU Library? Select all that apply.			
	Yes	No	Response Count
Check out a print book	51.7% (78)	48.3% (73)	151
Use a print book in the library	48.3% (72)	51.7% (77)	149
Use the e-Library (including online databases for collections of journals)	48.3% (73)	51.7% (78)	151
Library 160	69.5% (105)	30.5% (46)	151
Use a library computer for class work	61.7% (92)	38.3% (57)	149
Use a library computer for personal use	43.4% (63)	56.6% (82)	145
Use the internet on my personal computer	66.9% (101)	33.1% (50)	151
Study	86.4% (133)	13.6% (21)	154
Spend time between classes	63.1% (94)	36.9% (55)	149
Cafe	66.2% (102)	33.8% (52)	154
Printing services	56.1% (83)	43.9% (65)	148
Assistance with research	19.0% (28)	81.0% (119)	147
Never have gone to the ISU Library	2.2% (3)	97.8% (132)	135
answered question			156
skipped question			0

2. How much time did you spend at the ISU Library during your last visit?







		Response Percent	Response Count
5-30 minutes		24.4%	38
30 minutes - 2 hours		42.3%	66
2-4 hours		24.4%	38
Longer than 4 hours		7.7%	12
Never have gone to the ISU Library		1.3%	2
answered question			156
skipped question			0

3. Do you study at the ISU Library?






		Response Percent	Response Count
Yes		78.2%	122
No		21.8%	34
answered question			156
skipped question			0








4. What is the main reason you do not study at the ISU Library?			
		Response Percent	Response Count
Location		41.7%	10
Customer service		0.0%	0
Technology		0.0%	0
Interior environment and atmosphere		33.3%	8
Does not have the resources I need		8.3%	2
I use library online resources at other locations		8.3%	2
Does not have the food and refreshments I want		0.0%	0
Not enough quiet study space		8.3%	2
Other (please specify)			12
answered question			24
skipped question			132

5. What is the main reason you choose to study at the ISU Library?









		Response Percent	Response Count
Location		10.4%	12
Customer service		0.0%	0
Technology (i.e. computers, printers, etc.)		4.3%	5
Interior environment and atmosphere		19.1%	22
Books		1.7%	2
Online resources		1.7%	2
Cafe		0.0%	0
Quiet study space		62.6%	72
Other (please specify)			8
		answered question	115
		skipped question	41

6. How often do you study at the ISU Library?










		Response Percent	Response Count
Daily		12.5%	15
Weekly		41.7%	50
Monthly		20.8%	25
Several times per semester		21.7%	26
At least once per year		3.3%	4
		answered question	120
		skipped question	36

7. Where is your favorite place to study in the ISU Library? (Select one answer.)			
		Response Percent	Response Count
Group study space		23.3%	28
Individual study carrels		28.3%	34
Study lounges		12.5%	15
Study spaces with up-to-date technology (including computer labs and Learning Connections Center)		6.7%	8
Quiet study spaces such as Bookends reading room or Periodical room		20.0%	24
Research study rooms		1.7%	2
Other (please specify)		7.5%	9
answered question			120
skipped question			36



8. What physical aspects of this space do you like the MOST? (The space you identified in question #6.)

		Response Percent	Response Count
Location		45.8%	55
Sound level		59.2%	71
Lighting		22.5%	27
Temperature		16.7%	20
Privacy		39.2%	47
Furniture		16.7%	20
It's where my friends are		13.3%	16
Other (please specify)		7.5%	9
answered question			120
skipped question			36









9. What physical aspects of this space do you like the LEAST? (The space you identified in question #7.)

		Response Percent	Response Count
Location		10.2%	12
Sound level		13.6%	16
Lighting		17.8%	21
Temperature		24.6%	29
Privacy		15.3%	18
Furniture		16.1%	19
My friends aren't there		5.1%	6
Nothing - the space works well for me		31.4%	37
Other (please specify)		5.1%	6
answered question			118
skipped question			38



10. Do you study individually at the ISU Library?

		Response Percent	Response Count
Yes		90.8%	109
No		9.2%	11
answered question			120
skipped question			36






**11. Which of the following is your preferred space to study individually at the ISU Library?
(Select one answer.)**

		Response Percent	Response Count
Study workstations at the perimeter of floors 2-4		21.9%	23
Study carrels throughout the book stacks		19.0%	20
Quiet study tables		28.6%	30
Lounge		5.7%	6
Group study area		6.7%	7
Computer lab		7.6%	8
Research study rooms		1.0%	1
Other (please specify)		9.5%	10
answered question			105
skipped question			51



**12. Does the ISU Library have enough of your preferred individual study space available at
the times you need?**

		Response Percent	Response Count
Yes		79.0%	83
No		21.0%	22
answered question			105
skipped question			51





13. How satisfied are you with the current level of privacy while studying individually at the ISU Library?

		Response Percent	Response Count
Very dissatisfied		1.0%	1
Dissatisfied		4.8%	5
Neutral		24.8%	26
Satisfied		51.4%	54
Very satisfied		18.1%	19
answered question			105
skipped question			51






14. Do you study in groups (of two or more) at the ISU Library?

		Response Percent	Response Count
Yes		75.0%	87
No		25.0%	29
answered question			116
skipped question			40







15. What size of group did you last meet with at the ISU Library during a group study session?

		Response Percent	Response Count
Group of 2		20.7%	18
Group of 3		50.6%	44
Group of 4-5		26.4%	23
Group of 6-7		2.3%	2
Group of 8+		0.0%	0
answered question			87
skipped question			69



16. When you last studied in a group at the ISU Library, what were you working on?

		Response Percent	Response Count
Working together on a project		47.1%	41
Studying individually in close proximity to peers		34.5%	30
Socializing		3.4%	3
Tutoring		9.2%	8
Other (please specify)		5.7%	5
answered question			87
skipped question			69

17. Which of the following is your preferred group study space at the ISU Library? (Select one answer.)

		Response Percent	Response Count
Group study area on level 3		56.0%	47
Group study area on level 4		1.2%	1
Group study rooms		27.4%	23
Lounge		2.4%	2
Learning Connections Center		0.0%	0
Computer lab		2.4%	2
Quiet study tables		10.7%	9
Other (please specify)			3
answered question			84
skipped question			72



18. Does the ISU Library have enough of your preferred group study space available at the times you need?

		Response Percent	Response Count
Yes		80.5%	70
No		19.5%	17
answered question			87
skipped question			69

19. Please describe any missing features in the group study areas at the ISU Library that would help provide you with a better study environment.

	Response Count
	28
answered question	28
skipped question	128

20. Do you prefer to study in an area that has convenient access to an information desk, computers and printers, services, and refreshments or in a more private environment?

		Response Percent	Response Count
Prefer an area with access to multiple services nearby		39.1%	45
Prefer a more private environment		60.9%	70
	answered question		115
	skipped question		41

21. Have you changed your behavior in response to the following environmental factors at the ISU Library? (Select all that apply.)

	Yes	No	Response Count
Rearranged furniture to adapt to my needs	54.9% (62)	45.1% (51)	113
Moved because of noise	64.9% (74)	35.1% (40)	114
Moved because of daylight (light, glare, or temperature)	39.8% (45)	60.2% (68)	113
Moved because of inadequate artificial light	26.1% (29)	73.9% (82)	111
Moved because I needed access to power	85.0% (96)	15.0% (17)	113
Moved because someone sat too close to me	25.0% (28)	75.0% (84)	112
Selected a space because of the decor	21.1% (23)	78.9% (86)	109
Selected a space because of cleanliness	62.2% (69)	37.8% (42)	111
		Other (please specify)	3
			answered question 114
			skipped question 42




22. How satisfied are you with the LEVEL OF CONTROL you have over the following factors in the ISU Library?






	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied	Response Count
Lighting	1.8% (2)	8.8% (10)	44.7% (51)	35.1% (40)	9.6% (11)	114
Sound levels	5.3% (6)	18.4% (21)	36.8% (42)	35.1% (40)	4.4% (5)	114
Workspace	0.0% (0)	1.8% (2)	24.6% (28)	65.8% (75)	7.9% (9)	114
Furniture	0.9% (1)	11.4% (13)	34.2% (39)	47.4% (54)	6.1% (7)	114
Privacy	0.9% (1)	6.1% (7)	28.9% (33)	54.4% (62)	9.6% (11)	114
Social environment	0.0% (0)	0.9% (1)	32.5% (37)	59.6% (68)	7.0% (8)	114
answered question						114
skipped question						42









23. Imagine your ideal study environment. How important are the following factors in your ideal study environment?

	Very unimportant	Unimportant	Important	Very important	N/A	Response Count
Control over task lighting	2.1% (3)	22.1% (32)	54.5% (79)	19.3% (28)	2.1% (3)	145
Quiet study environment	0.7% (1)	3.4% (5)	31.7% (46)	63.4% (92)	0.7% (1)	145
Privacy	2.8% (4)	13.2% (19)	46.5% (67)	36.8% (53)	0.7% (1)	144
Access to power	0.0% (0)	4.9% (7)	24.3% (35)	69.4% (100)	1.4% (2)	144
Access to computers	4.8% (7)	28.3% (41)	29.7% (43)	35.2% (51)	2.1% (3)	145
Comfortable furniture	0.0% (0)	8.3% (12)	50.3% (73)	41.4% (60)	0.0% (0)	145
Tables for group work	0.7% (1)	16.6% (24)	48.3% (70)	34.5% (50)	0.0% (0)	145
A variety of seating options	4.9% (7)	21.7% (31)	43.4% (62)	30.1% (43)	0.0% (0)	143
A social space	13.2% (19)	43.8% (63)	31.9% (46)	9.7% (14)	1.4% (2)	144
answered question						145
skipped question						11

24. Moveable tables and chairs allow you to redefine your study environment. Do you prefer to study in an environment with moveable furniture?







		Response Percent	Response Count
Yes		66.2%	96
No		10.3%	15
I don't know		23.4%	34
answered question			145
skipped question			11

25. How likely are you to rearrange moveable furniture to meet your study needs?			
		Response Percent	Response Count
Definitely won't		2.1%	3
Probably won't		28.3%	41
Probably will		40.7%	59
Definitely will		13.8%	20
Unsure		15.2%	22
answered question			145
skipped question			11

26. What phrase best describes your ideal INDIVIDUAL study environment?			Response Percent	Response Count
Cozy: A cozy nook that is off the main circulation path - quiet and peaceful. A place where you can get lost in a book, with comfortable furniture.			26.6%	38
Workspace: At a table where I can spread out - with access to power. I don't mind studying next to other people as long as they are quiet.			32.9%	47
Quiet: In a very quiet, private, workspace where I have control over the environment, including the sound and light levels.			17.5%	25
Social: A space where I can talk with my friends while I study. I prefer tables or a booth type space for social interaction.			4.2%	6
Hybrid environment: A very quiet individual study space where I can spread out my work, but is adjacent to a quiet group study space. I want to be able to turn around and talk to my friends.			14.0%	20
Lounge: Where the furniture is comfortable and moveable to meet my needs. I am not concerned with a little background conversation.			3.5%	5
Cafe: A study space where I am surrounded by an active environment. I enjoy people watching while I study, and convenient access to coffee or snacks.			0.7%	1
Amenities and services: In a study area that has convenient access to computers and printers, and help available if I need it.			0.7%	1

answered question	143
skipped question	13

27. What phrase best describes your ideal GROUP study environment?

		Response Percent	Response Count
Group control: A quiet group study space where the group can have control over the environment, including the sound and light levels. 		27.6%	40
Social: A space where I can talk with my friends while I study. I prefer tables or a booth type space for social interaction. 		25.5%	37
Hybrid environment: A quiet group study space that is adjacent to an individual study space. I want to be able to work individually and in a group in the same quiet environment. 		22.1%	32
Lounge: Where the furniture is comfortable and moveable to meet my needs. I am not concerned with a little background conversation. 		13.1%	19
Cafe: A study space where I am surrounded by an active environment. I enjoy people watching while I study, and convenient access to coffee or snacks. 		6.2%	9
Amenities and services: In a study area that has convenient access to computers and printers, and help available if I need it. 		5.5%	8
answered question			145
skipped question			11

28. How satisfied are you with the overall interior environment at the ISU Library?

		Response Percent	Response Count
Very dissatisfied		2.1%	3
Dissatisfied		3.5%	5
Neutral		24.3%	35
Satisfied		52.1%	75
Very satisfied		16.7%	24
Never have gone to the ISU Library		1.4%	2
answered question			144
skipped question			12







29. What space at the ISU Library would you most like to see renovated?

		Response Percent	Response Count
Study lounges		11.0%	15
Fireplace reading room		7.4%	10
Learning Connections Center		2.9%	4
Study workstations along the perimeter of levels 2-4		25.7%	35
Study carrels throughout the stacks		22.1%	30
Group study area on level 3		18.4%	25
Other (please specify)		12.5%	17
answered question			136
skipped question			20






**30. How should this space be designed to make the environment more appealing to you?
Please provide details.**

	Response Count
	76
answered question	76
skipped question	80



31. What is your college?

	Response Percent	Response Count
Agriculture and Life Sciences 	17.9%	26
Business 	9.0%	13
Design 	6.2%	9
Engineering 	25.5%	37
Human Services 	17.2%	25
Liberal Arts and Sciences 	24.1%	35
Veterinary Medicine	0.0%	0
Undecided	0.0%	0
answered question		145
skipped question		11



32. What is your year?

		Response Percent	Response Count
Freshman		24.8%	36
Sophomore		20.7%	30
Junior		22.8%	33
Senior / 5th year student		31.0%	45
Graduate / PhD		0.7%	1
answered question			145
skipped question			11

33. Are you an international student?

		Response Percent	Response Count
Yes		3.5%	5
No		96.5%	139
answered question			144
skipped question			12

34. Are you male or female?

		Response Percent	Response Count
Male		45.8%	66
Female		54.2%	78
answered question			144
skipped question			12

35. To be entered in the drawing for a \$20 ISU Dining Card, please enter your email address. Your email address will be kept confidential and will not be linked to any data. The winner of the gift card will be contacted via email.

**Response
Count**

115

answered question 115

skipped question 41

APPENDIX G: HYPOTHESIS TESTS – SURVEY QUESTIONS

Hypothesis 1

- Hypothesis 1 (H1): The main reason students visit the library is to study, not to use the books housed within the library. [CURRENT USAGE DATA]
 - For current usage data a two-proportion z-test and z-interval were run on Q1 (Reasons to visit the library: study and check out a print book)
 - To compare the satisfaction as a variable dependent on the reasons students visit the library a contingency table analysis was performed on Q1 (Reasons to visit the library) and Q28 (Satisfaction with the overall interior environment at the library)

Hypothesis 2

- Hypothesis 2 (H2): Students are learning from each other in the library (social aspect of learning). [CURRENT USAGE DATA]
 - Two proportion z-test and z-interval of Q10 (Do you study individually at the library?) and Q14 (Do you study in groups?)

Hypothesis 3

- Hypothesis 3 (H3): Students prefer to have control over the learning environment in the library. [PREFERENCES DATA]
 - Criterion 1 (CR1): Lighting
 - Criterion 2 (CR2): Sound levels

- Criterion 3 (CR3): Workspace
- Criterion 4 (CR4): Furniture
- Criterion 5 (CR5): Privacy
- Criterion 6 (CR6): Social environment

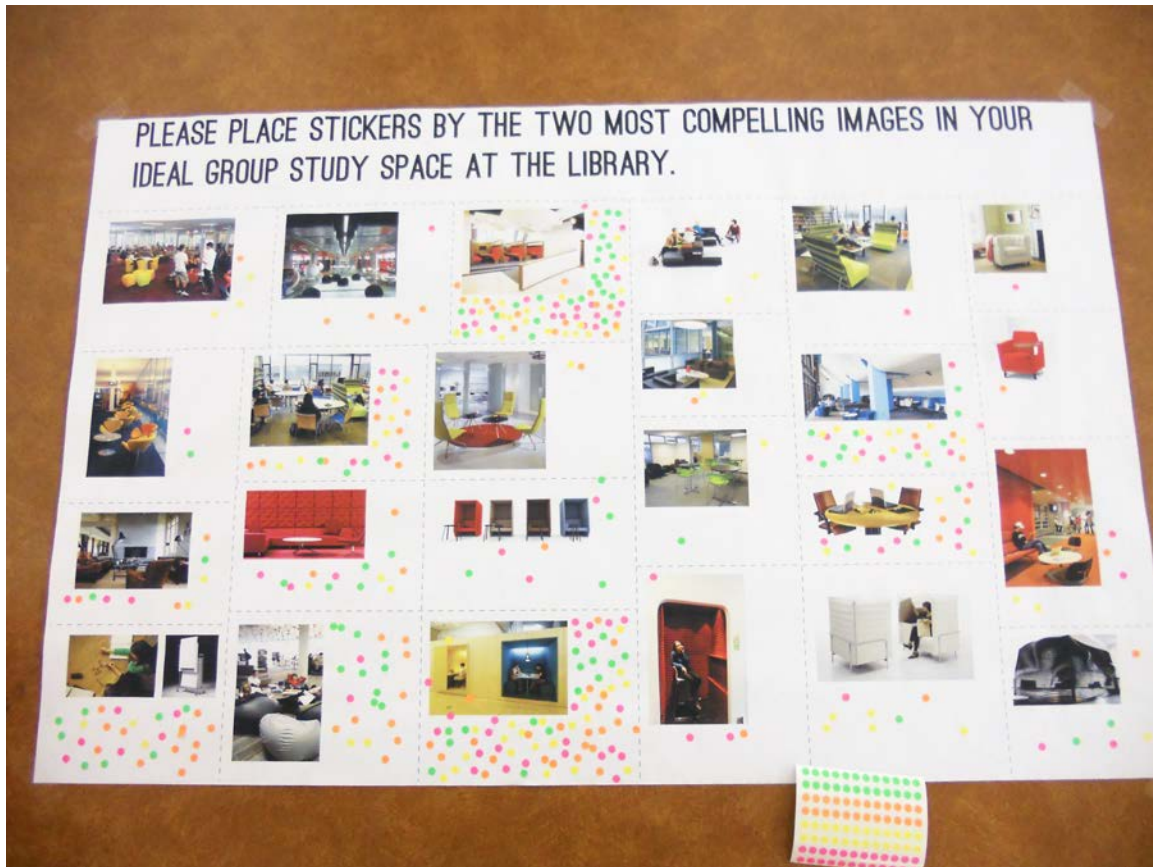
- Contingency table analysis of Q22 (Satisfaction with level of control over these factors) and Q28 (Overall satisfaction)

Hypothesis 4

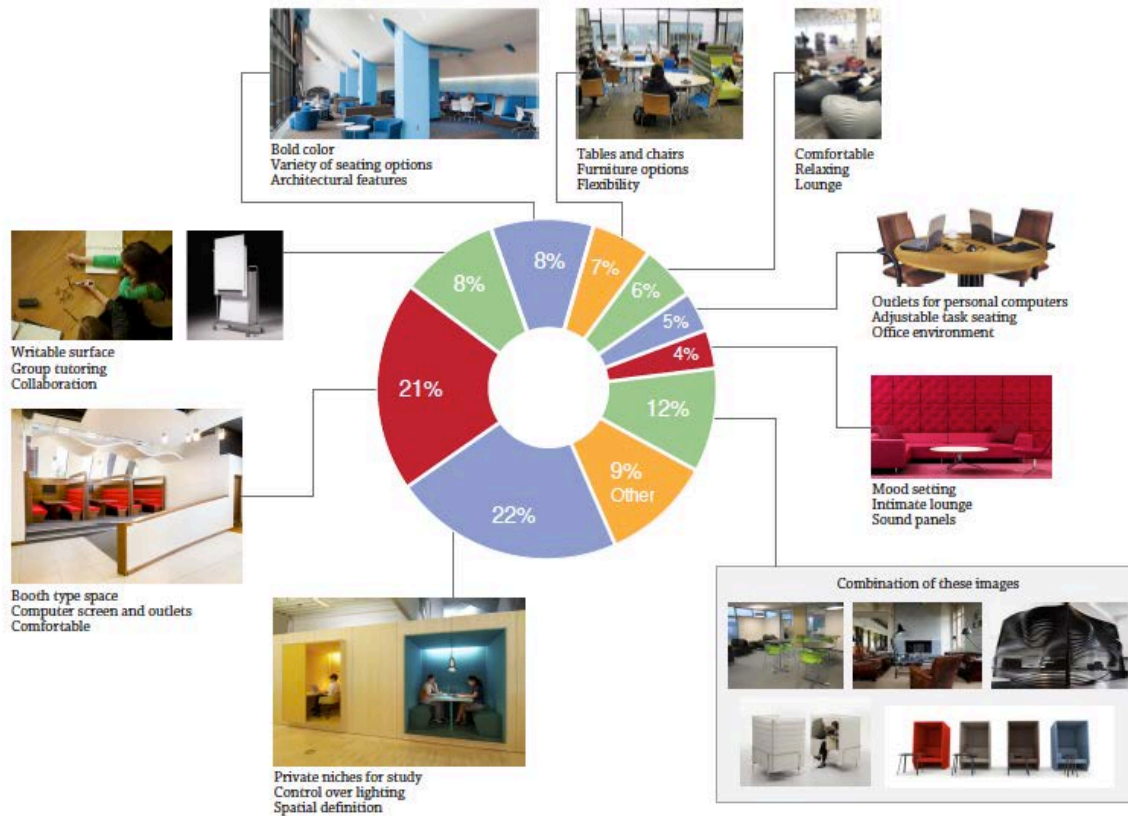
- Hypothesis 4 (H4): Individuals prefer to study in spaces with greater amounts of privacy at the library. [PREFERENCES DATA]
 - Contingency table analysis of Q13 (Satisfaction with privacy while studying individually at the library) and Q 28 (Overall satisfaction)

Hypothesis 5

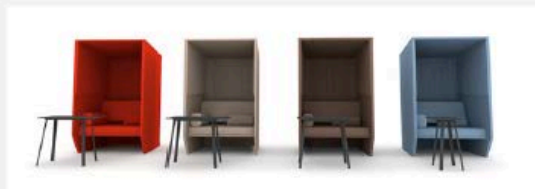
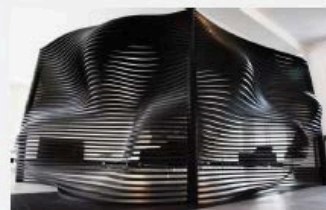
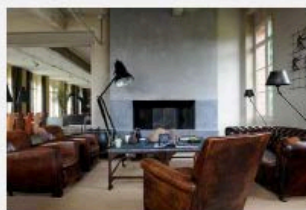
- Hypothesis 5 (H5): Students prefer to study in a space where customer service is a top priority to a more private environment. (Amenities such as an information desk, computers, printing services, refreshments) [PREFERENCES DATA]
 - Two proportion z-test and z-interval on Q20 (Do you prefer to study in a student learning commons or private environment?)
 - Contingency table analysis and chi-square test on Q20 and Q28 (Satisfaction with the overall interior environment at the library)

APPENDIX H: IMAGE BOARD

APPENDIX I: IMAGE BOARD PIE CHART



Combination of these images



APPENDIX J: GRAFFITI WALL OUTLET IMAGES

