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This exploratory study assesses use of the group study rooms at North Carolina State University D.H. Hill Library. Two approaches were used to collect data: observations by the researcher, and surveys distributed to users of the group study rooms. The study focused on collaboration amongst students, and technology usage. It was discovered that the students using the Libraries collaborative learning spaces value flexibility and control of their learning spaces, and enjoy working with their peers. The results of this study identified the strengths and weaknesses of the current collaborative learning spaces, and provided recommendations for design of the group study rooms for the new Hunt Library, scheduled to open in 2013.

Headings:

      College and university libraries -- Evaluation

      North Carolina State University -- Libraries

      Study environment

      Surveys -- College and university libraries

Technology, Collaboration, and Services in an Academic Library: An Assessment of the Collaborative Learning Spaces in the North Carolina State University Libraries.

by
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Introduction

Traditional libraries no longer satisfy the needs of the 21st century college student. Today's students expect the library, its services, and its tools to fit right in with their everyday lives without much extra effort. Students are accustomed to the integration of modern tools into every aspect of their daily lives, often using multiple technologies at once. (Manuel, 2002) With personal access to many devices, students use these technologies throughout the day, and they have come to expect access to the technology for their academic pursuits as well. (Merritt, 2003) Students turn to the library for the tools they need, and the spaces they require to do their work, often collaborating with their peers. (Gardner and Eng, 2005) No longer are many academic libraries the silent, intimidating buildings of the past, filled with stacks of books and the shushing librarian – many are transforming into hubs of activity. They are common grounds for students not only to study, but to meet with their peers to do research and work on collaborative projects in a welcoming, accessible, and modern space. However, there is still much to learn about student behavior and attitudes beyond the general expectation of accessibility to technology and spaces. The North Carolina State University Libraries (NCSU) has made changes to its services in the past ten years that reflect the new trends, such as building a learning commons and integrating new technologies into much of its spaces. Now that the changes have been in place for a few years, the Libraries wishes to gain a better understanding of how students are actually using the services.

NCSU has transformed parts of their physical space to become more user-focused, service-oriented, and technologically advanced to help students. D.H. Hill Library has incorporated new technologies into their group study rooms such as projection screens and writable walls. Additionally, D.H. Hill has developed a variety of alternative collaborative learning spaces featuring various new technologies. The Digital Media Lab, located in the Learning Commons, provides software and workstations for video editing, audio production, and document and image scanning. One of the Libraries' newest developments, the Technology Sandbox, provides students access to large-scale display and gesture-based computing tools, in addition to writable surfaces and moveable furniture. These high-tech learning spaces allow students to come together and work collaboratively, using new equipment in creative and experimental ways to advance their unique projects. Students have embraced the idea of a collaborative space in the library, as shown through the constant activity in D.H. Hill's Learning Commons. The library has become a comfortable, social place where students can come together to engage in a variety of activities. Through these innovative services, NCSU demonstrates a new model for modern libraries to follow, showing that in order for libraries to provide the best services it can in regards to information and research, technology must now play a major role.

Effective library spaces should respond to the needs of its users. This exploratory study is to determine those user needs to make the collaborative study areas in NCSU's main library, D.H. Hill Library, more suitable. According to McDonald (2006), "A library should be functional, adaptable, accessible, varied, interactive, conducive,

environmentally suitable, safe and secure, efficient, and appropriate for information technology." The group study rooms in the library need to fit this description in order to provide students with the best service possible. The library provides other collaborative learning spaces, but these group study rooms were selected for study because they were specifically designed to provide enclosed spaces for groups to study and work on projects together. Other spaces throughout the library incorporate more advanced technology for student use, but these study rooms serve the basic need for students to collaborate and work together without disturbing others. The Libraries at NCSU recognized the need to fulfill this need, but took its spaces a few steps into the future by equipping the study rooms with a few pieces of relevant technology, such as writable walls, and multi-display projection screens.

Although the Libraries knows that the group study rooms are popular - as witnessed by most rooms being reserved for most hours of the day – the Libraries has little idea about how students used the rooms when they occupied them. How many students gather to study together? Do they use the technologies in the rooms? Are they using the rooms and the technology in them for reasons other than for working on academic projects? This study sought to gather information about how students use the rooms. Advanced technology can be integral for student learning and development, and the findings of this study will be used to improve the group study rooms in D.H. Hill Library, as well as influence plans for group study rooms in NCSU's new Hunt Library, which will open on Centennial Campus in 2013. This study seeks to discover how students are using the group study rooms. Are NCSU students using the group study

rooms to collaborate? How are they using technology? What do students like about the collaborative learning spaces? What does the Libraries need to improve? The study will gather information from students, in order to discover the specific needs of NCSU students.

Background

Description of Group Study Rooms

D.H. Hill is one of the few places on NCSU's campus where students can go to study and work together. There are other specialized libraries on campus[1], but as the main library, D.H. Hill is the largest and supports all disciplines. The main floor of D.H. Hill is mostly a collaborative floor. In the West Wing, the main collaborative space is the Technology Sandbox, which features large-scale displays and gesture-based computing tools, such as Microsoft Surfaces and a perspective pixel. However, the East Wing serves as the main hub for library activity, with most of the space dominated by the Learning Commons. The Learning Commons provides students access to a computer lab with both PCs and Macs, the reference collection, the Digital Media Lab, GIS workstations, two group study rooms, a practice presentation room, and a variety of flexible, movable furniture for studying or lounging. The Learning Commons is typically a loud, high-energy area, providing students with various technology and spaces to work both collaboratively and independently, while surrounded by other students.

Until recently, D.H. Hill Library had one group study room on each of the floors 2-8, each of which provided students with chairs, a table, and space to work without disturbing silent studiers. In response to requests from students that the library expand the number of reservable study spaces, the Libraries recently divided six existing group study rooms (the rooms on floors 3-8) in half and outfitted them with new, more flexible furniture and display technology. By doing this, D.H. Hill was able to almost double the number of groups able to be accommodated. Instead of larger rooms that can hold up to 12 people and accommodate only seven groups, the new structure can accommodate 13 groups: 12 groups of up to six people, and one group of up to 12 people. See Figure 1, and Images 1-5. The newly divided rooms on floors 3-8 are almost all identical with the following features:

A. Table, flush with the outer wall, which also doubles as a surface to be written on with dry-erase markers. Rooms on each floor designated as room "A" have square tables, rooms designated as "B" have round tables. With the exception of Floor 3, all tables are at a height of 30", so the average person can sit in a chair with their feet resting on the floor. The rooms on the third floor contain higher tables, at a height of 38.5", and stools with seat backs. See Image 5.

B. Six chairs that can be moved about the room.

C. Wall that can be written on with dry-erase markers. The walls vary in color between white (floors 3 and 6), orange (floors 4 and 7) and red (floors 5 and 8). See Images 2-3.

D. Two large display monitors to which laptop computers can be attached. Each room contains six hook-ups, so multiple computers may be displayed. The cord attachments can be put away underneath a lid that contains the cords underneath the table, keeping them easily accessible, but out of the way when not in use.

E. Connectors to projection screens, and outlets.

F. Glass windows on two sides.

G. Tray for dry erase markers.

The study room on the second floor remains its original size, but it was updated at the same time as the rooms on floors 3-8, and contains the same glass walls, two display monitors, the same chairs, and a large table. However, this room is twice the size of the others, and instead of a writable wall, contains two double-sided moveable whiteboards that students can use and move about the room. See Image 4.

Students at NCSU can reserve the group study rooms by using an online room reservation system. The system is password protected, allowing access only to users with an NCSU identification name and password. The reservation will show up online, with their name, and the description of their group, as determined by the students. A student may make a reservation for, "Chem 207 study group," or, "English 300 group 3," for example. Group study rooms can be reserved online for 2-hour blocks, limited to one reservation per day, and can be made up to seven days in advance.[2]

Figure 1. Floor plan of group study rooms.

D. Projection Screens

Exit

A. Table

E. Connectors to projection screens

F. Window

F. Window

B. Chairs

G. Tray for dry erase markers
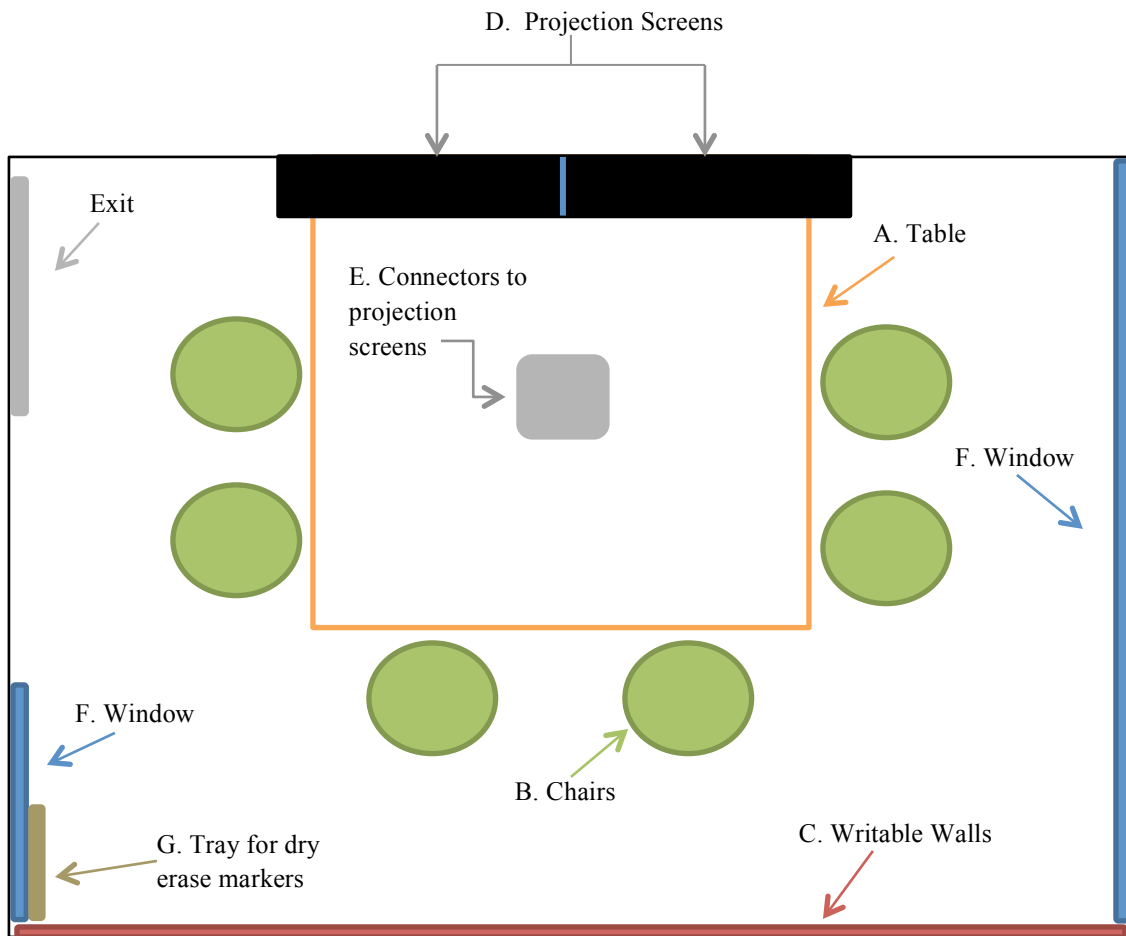
C. Writable Walls

Image 1. Group Study Room.

Image 2. Writable Walls, white.

Image 3. Writable Walls, colored.

Image 4. Group Study Room, Floor 2.

Image 5. Group Study Room, Floor 3.

Hunt Library

NCSU's new library will be located on its Centennial Campus and serve as a main library for that section of the university. This library seeks to be a collaborative space for NSCU students, and focus its services on the faculty, students and staff of the College of Textiles, the College of Engineering, and some of the sciences and veterinary programs. According to the library's website, the mission of the Hunt Library is to serve as a "vibrant intellectual and social forum for the campus community, showcasing the latest technologies and research achievements of the university."[3] To fulfill this mission, the library will include a dynamic set of various spaces to serve students, including a café, reading rooms and two research commons, individual study seats, and almost 100 group study rooms. The library already knows that there is a need for the large number of group study rooms, but there are not yet plans for the furniture and technology that will be in them.

Lin (2010) stresses how important it is to consider the uses of particular library spaces before they are designed. NCSU already has a captive audience to draw information from in order to make more appropriate decisions for the new design, and the results of this study can help the design staff of the Hunt Library make informed and appropriate decisions in equipping the new spaces. This study looks to evaluate the way students are currently using group study rooms. The observations and surveys address collaboration, nature of work, and technology in various ways. The current set-up of the rooms may not prove to be the most appropriate for the new library, considering the

findings here. Furniture design, lighting, colors, and flexibility of the furniture can all be

reconsidered based on these results. Additionally, the type of technology that should be

included, such as the projection screens, writable walls, and new ideas from student

responses can be included. However, this study can certainly be expanded further to

address the various concerns brought up by students in the surveys, and follow-up

assessments and other methods, such as focus groups and interviews, can help further

identify various student needs. The collaborative learning spaces in Hunt Library could

end up having a very different feel and structure than the current rooms in D.H. Hill.

Literature Review -- Technology, Spaces and Library Services

The main focus of most academic libraries is to serve the academic and

professional development of its students, faculty and other members of the university

community. Student needs often drive the direction of many academic library services,

and a change in these needs can sometimes dramatically change the face of a library.

Recent technological changes have made it easy for some students to avoid using a

tangible book in the physical space of the library, and rely solely on electronic resources

for research. Because of this change, libraries have been able to shift into different

service areas, such as providing spaces and technology for students to complete their

work. Libraries have become "a forum for students to collaborate, enjoy fellowship,

engage in healthy debate, create and challenge ideas, and experience learning and

discovery in a multitude of meaningful ways" (Sens, 2009). The advent of the Internet in

1993 has made it easier for students to get information from sources outside of the

library, and students are using the physical spaces and materials in different ways. (Bennett, 2003) However, since providing these types of services, spaces and equipment to students is a relatively new phenomenon, most libraries do not have a model to follow, or even many examples from which to learn. Libraries like NCSU are forging ahead on their own, experimenting with new technology, design, and services.

The trend in providing learning spaces is not limited to just academic libraries. Other types of libraries, including public libraries, are experiencing the need to provide similar spaces for their users to come together to collaborate (Cohen, 2009). This indicates that it may not just be a trend amongst college students who need more dynamic study spaces, but a larger movement in the way people live and work together. Therefore, design of collaborative learning spaces should not just be temporary solutions to present problems, but long-term, strategic planning goals for libraries to effectively serve their populations. (Cohen, 2009)

To meet the developing changes in student learning, the traditional library space is no longer sufficient. Even if a library starts to provide certain technologies for student use, if the space in which the technology is used fails to change as well, both the technology and the space can be insufficient and ineffective. Learning and study environments must reflect the way modern students work, and library spaces must be reevaluated in their design, funding, and maintenance (Hundley and Jacobs, 2005). Students expect continued and uninterrupted access to information and services in various forms. (Gardner and Eng, 2005, Merritt, 2002, and Oblinger, 2003)

Additionally, students prefer to work together in groups rather than alone, even if they are not working on the same projects. (Howe and Strauss, 2000) Studying and learning has become more social, and the spaces needed to allow for this need to change as well. Foote (2004) identifies new design practices in libraries that foster collaborative learning, an important feature being the provision of ample space with characteristics that encourage active, collaborative learning. Due to the potential for high energy and activity, it will not be enough to just provide sectioned-off spaces, but to also attend to the acoustic needs of spaces when they become more active and collaborative. A collaborative learning space, such as a group study room, that is situated near or in the middle of a more traditional, silent study area, as are the group study rooms at NCSU, can be counter-productive in student learning if the walls are not soundproof. Simply sectioning off an area, or hastily putting up dividers is not enough – serious thought must be put into the design and development of these spaces. (Cohen, 2009 and Forrest, 2005)

The mere presence of a group study room will not meet the expectations of the students who will use them. Many libraries such as Emory University have identified the key components of a successful and appropriate room in which students can collaboratively learn and work. Forrest and Hinchliffe (2005) describes the accommodations of the Emory University Library:

> Chairs should roll and stack, and tables should move…Paint colors should be warm and inviting, and fabrics should be interesting and durable. Computing should be wireless and mobile and should be taken out of the way when it is not in use to minimize distraction.

These variables such as color, lighting, noise, and arrangement are all environmental factors that have a strong influence on social behavior, and, as indicated by Graezt and Goliber (2002), may have an effect on collaborative learning as well. Another example, the main library at the University of Illinois at Urbana-Champaign also demonstrates its commitment to modern, relevant library spaces through its "Statement on Learning Spaces." This statement outlines the library's commitment to providing appropriate and comfortable spaces for the campus community, committing to learning spaces that are, "varied, flexible, and conveniently co-located with library services and collections, as well as designed specifically for learning, instead of being re-purposed on an ad-hoc basis." (Forrest and Hinchliffe, 2005) These libraries, along with many others, are demonstrating the larger trend of a shift in the design of library spaces, keeping up with the changing nature of student learning.

New trends in higher education have changed the way students study and interact with each other. Rather than sitting in a lecture hall, taking notes, and memorizing facts and theories, student learning has become more interactive through the deliberate efforts of educators. While lecture-based classes are still the norm, students are more active in their own learning, doing research and applying their knowledge to both independent and collaborative creative projects. (Graetz and Goliber, 2002, and Hundley, 2005). As the nature of learning in higher education changes, so should their study spaces. As Wilson (2002) points out, "Collaborative learning requires collaborative space." NCSU has been one of the forerunners in providing new technology to its students, but we can look to

studies similar to this one at other institutions to learn more about student needs and trends in regards to collaborative learning spaces and technology.

Research has shown that technology in academic libraries, and particularly in study spaces, is welcomed, and even expected by students. Technology is expected in the library, especially in today's overloaded world of information. Without advanced technology, students may spend more time looking for information than they are actually understanding, analyzing and applying it to their own work. (Freeman, 2005) Universities, and especially their libraries, are expected to be innovators in teaching and learning, and today, that means using technology effectively (Twigg, 2003). It has been shown that in interactive learning environments such as group study rooms, "energetic group discussions and intense conversations accompany learning and sharing." (Lin, et. al., 2010) Technology is important to the development of student research, and libraries must evolve with new technology in order to stay relevant, and helpful to its students. Technology enriches both the library and the library experience for students. Bringing technology into the library is logical, in that it allows libraries to become more of a hybrid space that better suits the needs of students. Students need information and resources, as well as a place to study. In addition, students have a higher need for certain technologies not only to enhance their learning or help encourage creativity, but to complete basic assignments. (Lin, et. al., 2010)

Hundley and Jacobs (2005) hint that technology should be appropriate to the specific and unique needs of the student body on any campus. They suggest that

institutions should "rethink the specific ways in which they are unique and to leverage unrivaled strengths in pursuit of leadership in certain fields of study." Applying this idea to technology in libraries, it would be important for libraries to consider their student populations before incorporating new technologies. Just because a new technology is innovative, exciting, and appealing, it may not be useful to that university's particular students.

However, some universities have discovered that their collaborative learning spaces have not been used for collaboration. After opening technology-enhanced classrooms and group study spaces in the Perkins Library in August 2008, Duke University Library conducted an assessment of this new collaborative learning space and its technology. The study found that students were satisfied with the type and availability of technology, such as rooms with multiple projections and videoconferencing technology, but were concerned about prioritization of group study spaces. They found that some students use the group study rooms for individual study, in order to gain a quiet place for better concentration. ("Assessment of the LINK," 2008) However, such practices can make it more difficult for groups to find a space to study where they will not disturb other students in quiet areas. While this was not a known concern at NCSU, it became a variable to look out for during the analysis observational and survey data of this study.

The increase in the desire for more collaborative learning spaces in the library corresponds with the advent of new technologies, especially those that promote

socialization and interaction. Bennett (2005) suggests that library study spaces for 21st century students are responsive to both academic and social dimensions of study. Socialization is one of the major facets of university life, and the lines between intellectual and social interaction are often blurred. Traditionally, university libraries were the centers of intellectual study, which in the earlier days of American higher education, implied independent and silent study. But today, intellectual and social interaction walk hand and hand, and new technology often helps this bond grow stronger. Instead of trying to resist this change, libraries can embrace it, by supporting the modern social dimensions of intellectual interaction and provide the spaces in which such interaction can occur. For students on some campuses, the library is the only place for them to gain access to certain technologies, and spaces for them to meet and work with other students (Cohen, 2009).

> Freeman (2005) nicely sums up the main drive of this case study:
>
> Although it is difficult to predict how exactly technology might shape library space, more and more libraries have provided technology-supported group study rooms…which have been designed to be easily responsive to new technologies and pedagogies. In this interactive learning environment, energetic group discussions and intense conversations accompany learning and sharing.

The NCSU Libraries incorporates a great deal of new technologies into various spaces throughout the library, but has not yet done a study as to how students are using it. The Libraries recognizes that as Freeman says, they do not know how exactly technology is shaping the library space, and how students are using it, but they hope that it is helping to foster a highly interactive, energetic, and productive learning process. But, due to the

unpredictable nature of human behavior, especially the behavior of college students, there is really no way of knowing how students are interacting with each other and with technology, unless a systematic study is done to capture information about that behavior.

Methodology

Much of the data collected in library and information science studies is quantitative. For this study, an evaluation of the group study rooms could have been conducted by counting things such as the number of people using the rooms at any given time, and the number of times a projection screen was used. However, this study sought a deeper understanding of student use of the group study rooms, and therefore, more qualitative data was obtained. The NCSU Libraries already knew that the group study rooms were popular and served as highly coveted study spots, but to really gain a better understanding of student needs, more specific data was needed. The qualitative data, used with some quantitative statistics, provided a deeper look into the needs of these particular students.

This exploratory study focused on a specific type of collaborative learning space, the group study rooms in D.H. Hill Library at NCSU. Thirteen such rooms were included. This case study collected data via multiple means (observations and surveys), and took place in the natural setting – right in the rooms addressed here. Many students use these group study rooms, and a sample of students was observed and surveyed. Because D.H. Hill is most busy in the evenings, and other studies such have shown that college students prefer to study in the evening, observations were done and surveys were

distributed on weekdays between 5:30p.m. and 11 p.m. (Gardner and Eng, 2005) Each time observations were done, the researcher started by observing the rooms on the 8th floor, and working down each level to the 2nd floor. Rooms that did not contain students were not counted. The same group of students was not observed more than once on the same day, however, it is possible that some students were observed using the rooms on different days. Surveys were also distributed in the same time frame, but on different days from the observations in attempt to reach different students. They were given to students as groups were entering or leaving a room, or left on the table in empty rooms, and collected a few hours later.

Interaction (verbal or non-verbal communication between two or more students), activity, and technology use was observed, and students were surveyed about their time in the rooms. The results of these observations and surveys provide insights into the type of technology and services students deem necessary and expect in the rooms, and what they currently need changed. The findings of this exploration can make recommendations for making these specific rooms, and future collaborative learning spaces, more appealing and useful to students.

Population

NCSU is the largest four-year institution in North Carolina, with almost 35,000 students (about 25,000 undergraduates and 9,600 graduate and professional). NCSU offers bachelor's degrees in 106 fields, master's degrees in 104 fields, doctorates in 61 fields, and a Doctorate of Veterinary Medicine. Although this is a large student body,

D.H. Hill can only support five percent of the student population at a given time. The group study rooms can in turn only support a small fraction of that percent. Therefore, this study was only able to represent a very small sample of the overall NCSU student body, but the students in the sampled population are key stakeholders in the future of the group study rooms. A majority of the students in the room were most likely undergraduate students, but also may have included graduate students, faculty, and NCSU staff. In order to make a reservation for the rooms, a user must have an NCSU identification card, so it is unlikely that anyone in the rooms was a not affiliated with NCSU. Demographic information about users of the group study rooms was not obtained for this study, because the Libraries was more interested in how the rooms were being used, rather than who was using them. Future work may take into account user characteristics such as gender, level of study, and major, do further identify the needs of students in different disciplines and departments, or support the efforts of other dimensions of the university community.

Data Collection

The goal of this study was to discover how students used the group study rooms. Use is defined as, *occupying the physical space of the room*. Data was gathered from students indiscriminately even if their behavior was obviously non-academic, such as consuming food in the room with no additional materials on the table or nearby. Additionally this study was particularly interested in student interaction with technological tools in the study rooms, defined here as the *presence of a type of technology or technological tool in the hands of students, on the table, or powered on.*

To discover these phenomena, two types of field research were conducted. The first step was naturalistic research, making observations over the course of a few weeks during late February and early March, the point in the semester leading to mid-term examinations before spring break. To capture observation data, each study room was observed for about five minutes on a rotating basis in order to cover different groups and different floors. Observations were kept short in order for the observer to remain inconspicuous, and allow the students to behave naturally. Observations were made to notes things such as the number of students in the rooms, and the type of technologies being used.[4]

During observations, students were not approached. From a short distance away, the rooms were observed a total of 50 times through glass windows that made their activity publicly viewable. In the event that a student questioned the data gathering, a description of the project was ready to be provided to them.[5] By conducting non-participant observations the results remained unbiased. Bias was also prevented by adhering to a checklist during the observation period, to record only what was actually happening in the rooms, rather than the interpretations of the observer. By conducting an unobtrusive evaluation, the data collector remaining inconspicuous, students in the rooms were unaware that they were being observed, and were therefore unable to adjust their behavior in any way. However, one of the disadvantages of observational data is that some behaviors may be only intermittent, so perhaps some behaviors were missed, but with the inclusion of over 80 students during observation, a wide variety of activities were indeed captured.

The observations sought information on two types of behavior: collaboration and technology usage. Some questions in the observation protocol could provide indications of both behaviors.

Collaboration indicators:

1. *Does the activity seem academic or social?*

Observations looked for indications of academic work, such as Word Documents, PowerPoint Presentations, journal articles, textbooks, calculators, and writing equations on the whiteboards. Social indicators were Netflix movies on the projection screen, or playing games.

2. *Are students interacting with each other working silently?*

Interaction between students was also noted by students speaking to one another, comparing notes, or sharing resources. Silence and students wearing headphones was an indication of non-collaborative use of the rooms.

Technology use indicators:

1. *How many students are using laptops?*

A count of the number of laptops was taken. Notations were made if the number of laptops did not match the number of students, or if laptops were in the room, but inactive.

2. *Have students used the whiteboard markers on the writable surfaces?*

Notations were made if students were actively writing on the surfaces, or were holding markers in their hands. These instances were differentiated from instances when

writing was visible on the walls, but it was unclear whether or not the students currently

in the room had done the writing. Nevertheless, it was determined that it was more

important to note whether or not the writable surfaces were being used, rather than if the

students were using the technology at the very moment they were being observed.

3. *What other materials or technologies are the students using?*

To identify technology that may be lacking in the rooms, any technology and

other study materials brought into the rooms by students was recorded.

Indicators of both collaboration, and technology use:

1. *How many students are using headphones?*

The observer counted the number of students wearing headphones.

2. *Are the students using the projectors in the room to display content from the
laptops?*

The observer first looked whether or not the screens were powered on and

displaying content. If content was displayed, it was recorded whether both screens were

in use, or just one. If both were in use, the observer noticed whether the content on the

screens was the same, or different.

3. *Are students charging their various technological instruments by using the outlets
in the room?*

If students had plugged in their laptops, cell phones, music players, or other

devices, the response was recorded as 'yes.'

The second phase of data collection involved surveys that directly asked the

students about their activities in the collaborative learning spaces. These surveys asked

students some questions similar to what was earlier observed, but tried to get a better

understanding by asking the students directly about their activity and opinions about the space. Survey questions included inquiries as to their reasons for using the room, how they knew the other people in the room with them, and questions about their experience with the technology in the rooms.[6] Surveys were distributed by approaching students who were in the rooms, when they were entering or leaving the room, and asking once if they were willing to participate. The goal was to gain as much data as possible directly from the students. To cover a greater variety of students, those who were observed were not given surveys. It is possible that a student who occupied a particular room at one time and was observed was later given a survey at a different time. However, even if that occurred, the data gathered covered two distinct instances of group study room use.

Like the notes made during observations, the survey sought insight into collaboration and technology use.

Collaboration questions:

1. *How do you know the students who were in the room with you?*

    Students could choose from three answers, or fill in a response for "Other". This question sought insight on why students may be forming a group to meet the rooms.

2. *What kind of project/assignment were you working on?*

    This question inquires about the nature of their work, whether it was academic or social.

Technology questions:

1. *What technology or equipment would you like in the room that is not already present, and how would you use it?*

This is where students had the opportunity to provide input.

Questions about both technology and collaboration:

1. *Did you use the projection screen? For what purpose?*

    The projection use question was to evaluate whether or not the screens are actually being used, and how they may be helpful for students.

2. *Why did you choose the group study room as a place to work, rather than another location in the library or on campus?*

    This question helps the Libraries to understand what they may be doing well.

Exploratory questions:

1. *What do you like best about this room?*

    This question helps the Libraries to understand what they may be doing well.

2. *If you had the power to change this room in any way, what would you change about it?*

    Allows for student input, and helps the Libraries to identify improvement areas.

Data Analysis

The data from both the surveys and observations were coded to identify major themes and patterns. Use of a conventional qualitative analysis – creating coding categories by directly and inductively capturing information from the raw data – allowed both latent and manifest themes to emerge beyond just those indicated by the high frequency of some particular word. The observations were recorded on paper, and then entered into Survey Monkey for organization and analysis. Likewise, information obtained from the paper-based surveys was entered into a separate collection in Survey

Monkey. Additionally, certain data from both collection methods were later combined to demonstrate higher frequencies of certain behaviors.

An open coding method was used to identify key words in every answer, and coded to fit major, broad themes that emerged throughout the analysis process. A coding unit is a word or group of words that can be characterized under a single category. In cases where a single response had multiple themes, each theme was indicated and coded separately. The open coding method was used because the purpose of this research was exploratory, and pre-conceived biases and predictions were inappropriate here. The goal was to obtain information from the students about their needs, in order to define and address them more accurately. Besides looking at basic data about frequency of projector and whiteboard use, analysis of student survey responses identified major themes that brought to light new or overlooked student needs. Student responses were very direct and made the coding process easy to identify major themes such as privacy, space, and quiet.

Expected Results

This study will most directly benefit the staff and students at NCSU, as well as future planners of collaborative learning spaces in libraries. The D.H. Hill Learning Commons staff can immediately implement changes to their amenities by adjusting furniture, removing or adding technological equipment, or otherwise altering the current space. Students will benefit from the Libraries' response to their needs during group study. Additionally, library staff that will plan the layout, furniture and technology at the

Hunt Library will be able to make better decisions about purchasing equipment and

organizing the almost 100 group study rooms to be installed in the new building.

Students will find spaces that are more welcoming to their comfort, and more conducive

to their academic needs, allowing them to collaborate and interact on projects with each

other, without struggling to find a space that suited them. If it was discovered for

example, that the laptops students were using were more technologically advanced than

the projectors in the study rooms, and therefore incompatible, the library could resolve

this issue by providing adaptors for the current projectors, and purchasing more advanced

projectors for the new facility. An issue like this would then be on the radar of the

librarians, who could then be on the lookout for future advances in technology that may

have adverse effects on their available equipment. With the presence of necessary and

advanced technology, students can work together with ease, allowing them to focus on

their projects and creativity, without being limited technologically or logistically.

Limitations of Study

There are a few ways in which this study may be limited. Currently, D.H. Hill

Library serves as the main library for NCSU, but it can accommodate only five percent of

its population at one time. This has limited the number of students from which data

could be collected. Since this data can be used for planning in the new Hunt Library, the

students using D.H. Hill may not be the most accurate representation of the students who

may use the new library, since the Hunt Library will be on the Centennial Campus, and

will focus its collection resources for the College of Textiles and the College of

Engineering, as well as resources for various other sciences.[7] It can sometimes be

difficult to convince students to even take the time to fill out a survey, and not all questions received complete answers. This is an exploratory study of one specific library, and the result here may not be relevant to all academic libraries. However, the hope was that by using two types of data collection, enough information could be gathered to make concrete conclusions to apply to the development and adaptation of the NCSU Libraries.

Results

A total of 234 students were observed and surveyed from February 27-March 12, 2012. Fifty surveys were distributed, and 29 were completed, a 58% response rate. Students in the same room were asked to complete the survey as a group, and the 29 completed surveys covered opinions and experiences of 111 students. Observations were conducted of 50 different groups using the group study rooms, covering 123 users.

With one exception, the range of students in a room at a particular time was between 1 and 6. There exception, in which a group of 11 students met in one of the rooms meant for six people, was one of the three groups indicating a desire for a bigger room. (See Figure 15) The average number of students in a room was about 3, but most often, as shown in Table 1 and Figure 2, rooms were occupied by only two students at a time.[8]

Table 1. Students per Room.

Number of students in room	Number of rooms counted	Total Students (number of students x number of rooms)
1	10	10
2	28	56
3	18	54
4	12	48
5	5	25
6	5	30
11	1	11
Total in study	**79 rooms**	**234 students**

Figure 2. Students per Room
Combined Observations and Surveys
(Number of rooms/Total rooms)
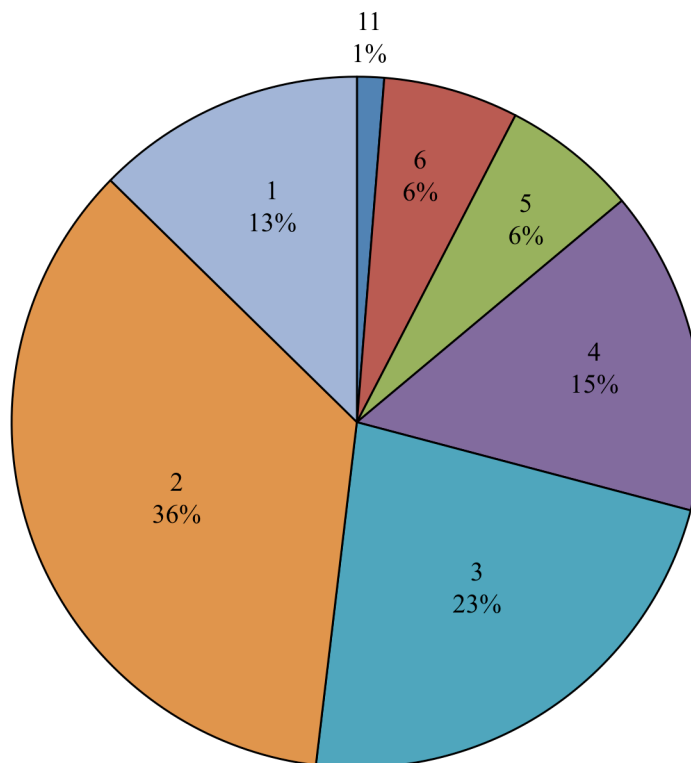
Activity in the Group Study Rooms

     The Libraries was interested in what type of work students were doing in the rooms. Two survey questions, S2 and S3, and one part of the observation protocol, O5 sought this information. S2 asked how students knew each other, and S3 asked what type of project they were working on in the rooms. See Figures 3 and 4.

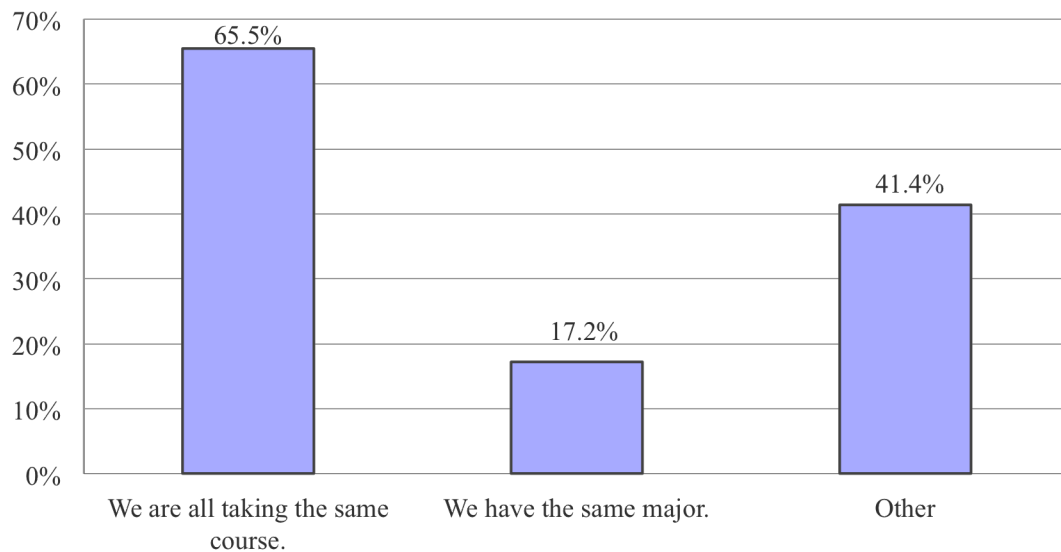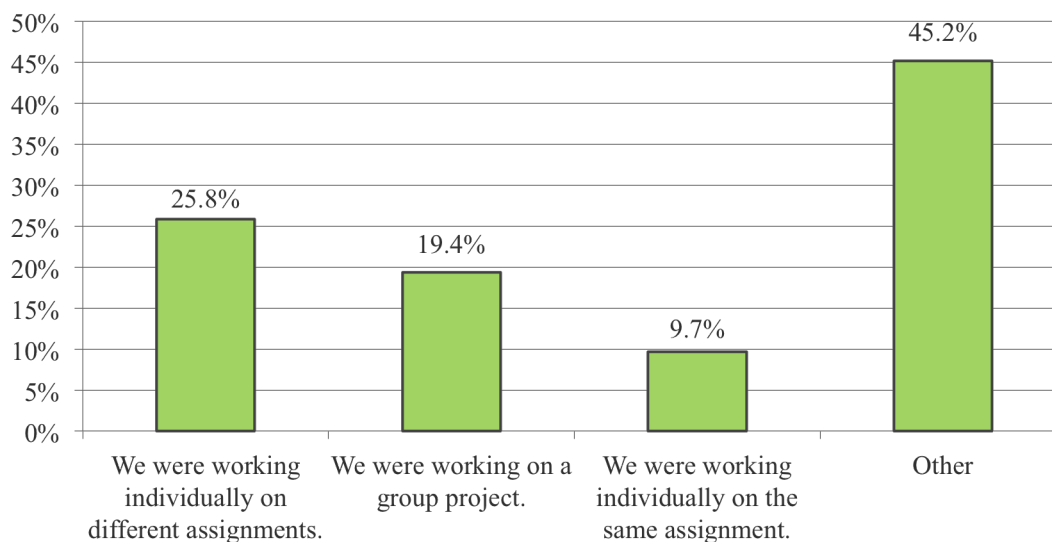**Figure 3. Relationships between Surveyed Students**

Figure 4. Type of Project of Surveyed Students

Most of the time, surveyed students were taking the same course. Comments in the "Other" category included students who were friends, roommates, student clubs and organizations, and even a romantic couple who were taking same class. However, there was a varied range of work being completed, both academic, and non-academic. Half of the comments in the "Other" category for S3 indicated that students were studying for a quiz or test. This data can be separated out from the remaining responses in the "Other" category, to show a better visual representation of the events.[9] See Figure 5.

Although Figure 5 shows what type of work students were specifically doing, the libraries was also interested in a broad sense of whether the room activity was academic-related or social. One part of the observation, O5, prompted the researcher to determine whether or not the activity observed was academic or social. Figure 6 shows these results.

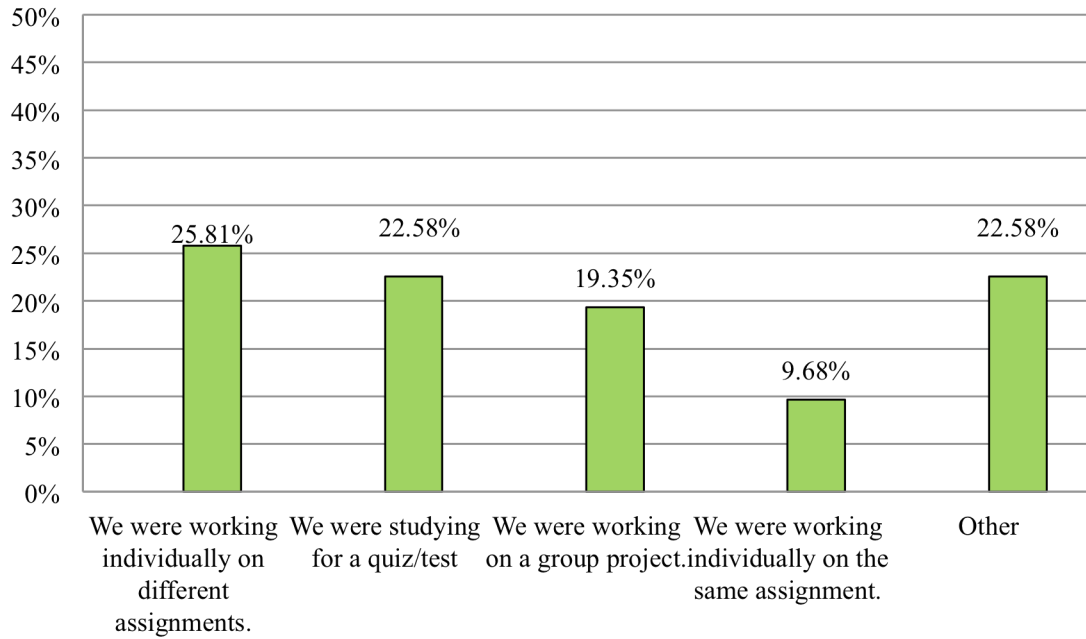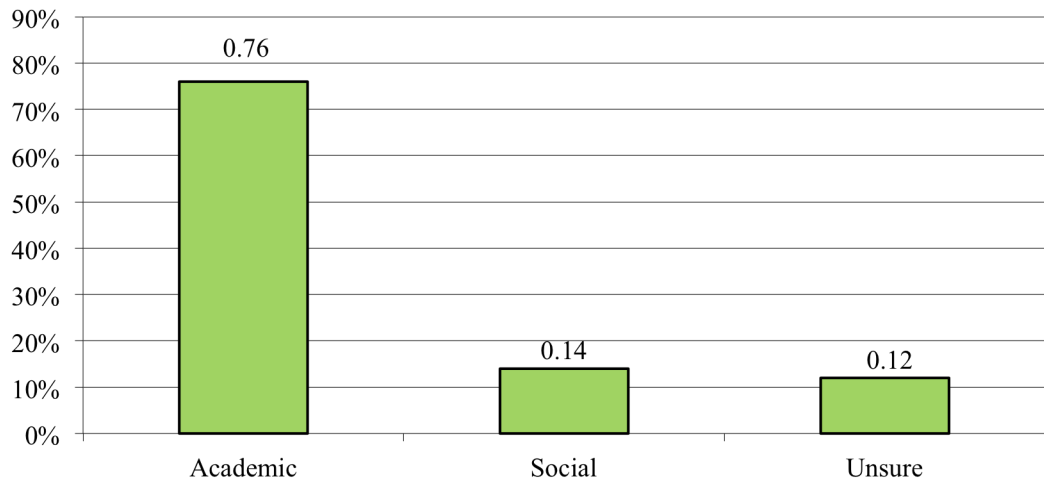**Figure 5. Type of Project of Surveyed Students, Separated "Other"**

Figure 6: Observed Activity: Academic vs. Social

If the data from S3 (Figure 5) is recoded into categories of "academic," "social," and "unsure," it can be combined with data from O5 (Figure 6). By doing this, it can be more clearly seen that most often, the activity in the group study rooms was related to academics.

Figure 7. Academic vs. Social Activity,
Combined Observations and Surveys
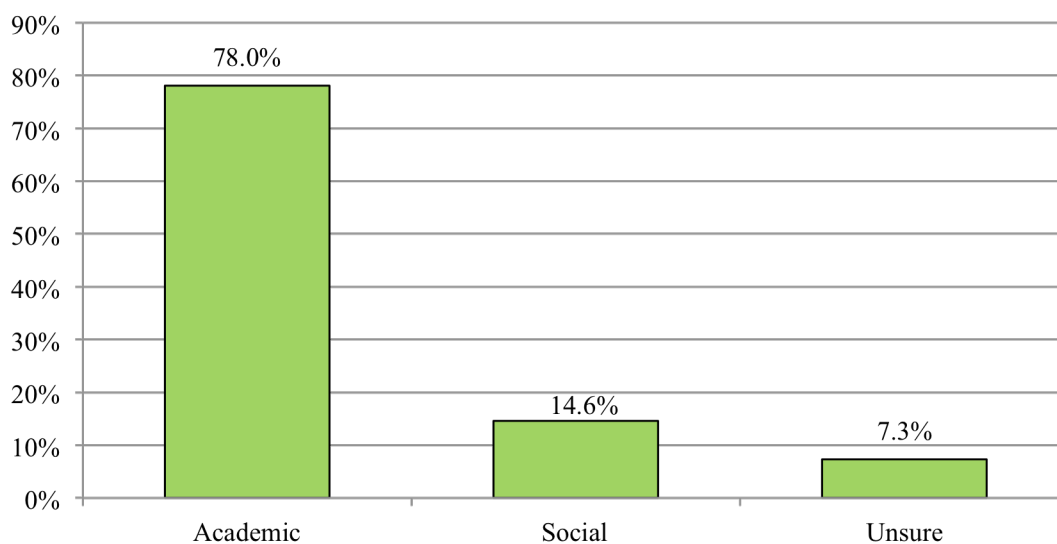
Writable Walls

Design of the group study rooms allowed the actual walls to serve as writable surfaces, equipped with dry erase markers. O6 prompted the researcher to look for signs of whiteboard use. As shown in Figure 8, students more often than not declined to use the walls to write on, actively engaging with this technology only 14% of the time.

Figure 8. Observed Whiteboard Use
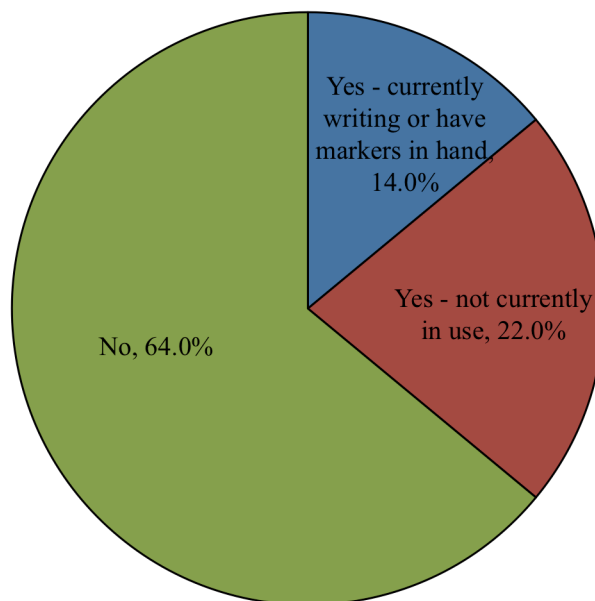
Writable surface technology comments also appeared in S5, S6, S7, and S8. Students complained that there were not enough dry erase markers available in the room when needed, and 21% of the groups did not like that some of the writable walls were not white. (See Figure 15) One group commented that they would like to "have all the boards on the walls white because colors make it hard to read." However, although there were complaints about the wall color and availability of markers, 31% of the groups indicated that the writable surfaces were one of the things they liked best about the rooms, or one of the reasons why they chose to study there. (See Figure 14.)

Projection Screens

As shown in Table 2, both the survey and the observations sought information about the projector use (S4 and O4). Observations found that 70% of the time students were not using the screens, and only 2% of the time were students using the screens to their greatest capability, by viewing different content on each of the two screens. The

researcher observed activity such as students working on presentations, watching movies,

viewing journal articles.

Table 2. Observed Use of Projectors.

Are students using the projectors?	Number of Rooms	Percentage (Number of rooms/total)
Yes - same content on both screens	7	14%
Yes - different content on each screen	1	2%
Yes - one screen only	7	14%
No	35	70%
Total	**50**	**100%**

Similarly, S4 results, shown in Table 3, indicated almost the same response rate, that 69%

of student groups were using the projection screens.

Table 3. Self-reporting of Projector Use.

Did you use the projector?	Number of Rooms	Percentage (Number of rooms/total)
Yes	9	31%
No	20	69%
Total	**29**	**100%**

Students said that they used the screens to pull up documents and presentations, and one

group even said they used the projection screen, "Just because it is awesome." The

projectors were also mentioned in other parts of the survey, in responses to questions S5-

S8. Some students were frustrated when they were unable to get the screens to work,

others wanted Mac adaptors in the rooms, and some said that projectors were one of the

reasons they chose the rooms or what they liked best about the study space. (See Tables

6 and 7, Figures 14 and 15)

Identification of Lacking Technology

Observations and surveys sought to identify gaps in services that the library could improve upon. S8 asked students if the room was lacking anything; observations looked for outlet use (O9), and the tools students were bringing into the rooms themselves, specifically looking for laptops (O2), in addition to other materials (O7).

As shown in Figure 9, 72% of the students observed were using a laptop in the room.

**Figure 9. Students Observed Using Laptops**
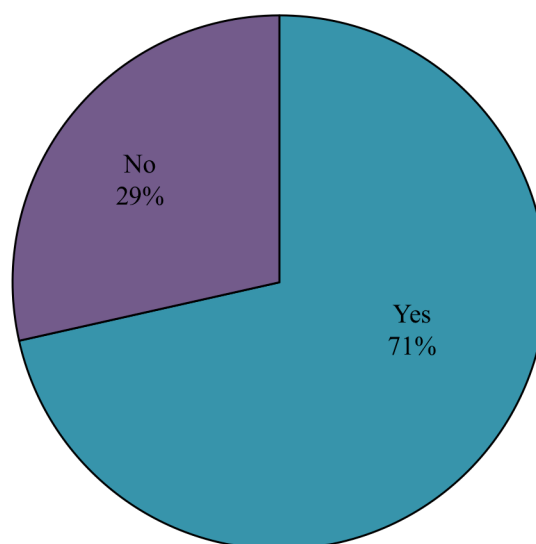
About 50% of the time, all students in a given room were each using a different laptop. See Table 4. Students were sometimes sharing computers, or doing different tasks without one at all. In only six of the 50 surveyed rooms were no students using laptops. Only one survey specifically asked for computers to be present in the group study rooms,

as a suggested change (S5), but the data indicates that students brought their own (or

borrowed) laptops into the rooms when needed.

**Table 4. Ratio of Students to laptops per room.**

Students in room	Number of students using laptops						Number of rooms	Correspondence of number of students to number of laptops
	0	**1**	**2**	**3**	**4**	**5**		
1	2	6	0	1	0	0	9	66.67%
2	3	8	9	0	0	0	20	45.00%
3	1	4	1	6	1	0	13	46.15%
4	0	0	2	0	3	0	5	60.00%
5	0	1	0	0	1	1	3	33.33%
							Average	**50.23%**

Students often use multiple types of technology at once that may need to be

charged at an electrical outlet. Because the rooms only had six outlets, this could have

proposed an issue for some groups that may have needed more. Initially, observations

tried to count the number of outlets used in the room. This proved too difficult to do

without drawing the attention of the students being observed, so observations were

modified to record only whether or not students were using the outlets at all. Figure 10

shows that students were only charging their equipment about 58% of the time. The

survey did not show any mention of outlets in any way, so this part of the study did not

lead to any indication that more outlets were needed, or that any change was necessary.

Figure 10. Power Outlet Use
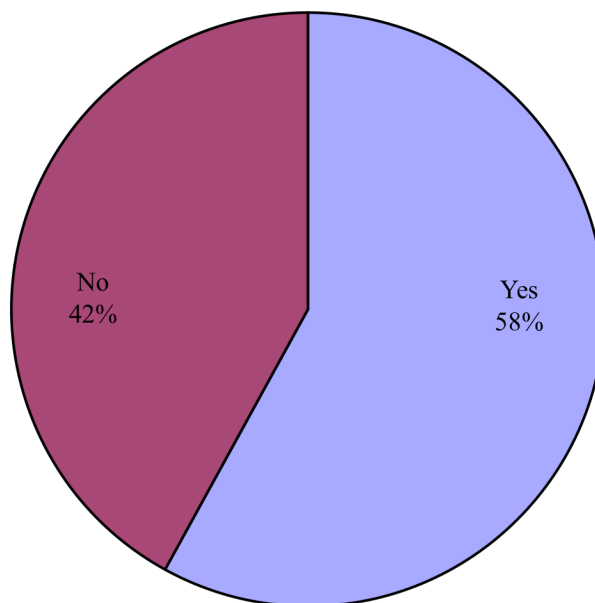
The observations looked for other materials students were bringing into the rooms besides laptops, to see if there was any particular need for something new to be available on a regular basis. However, these results did not provide any significant data indicating that a change was needed. Besides bringing in their own study materials such as binders, notebooks, paper, and calculators, and personal items such as iPods, tablets and mobile phones, few students were using other materials that were visible. One group had a video game controller sitting on their table, and another had a complex mechanical gadget. But, neither of these groups were actively using this equipment. Figure 11 shows the other materials students were using, besides laptops and the equipment already provided in the room.

Figure 11. Materials brought into the Study Rooms by Students
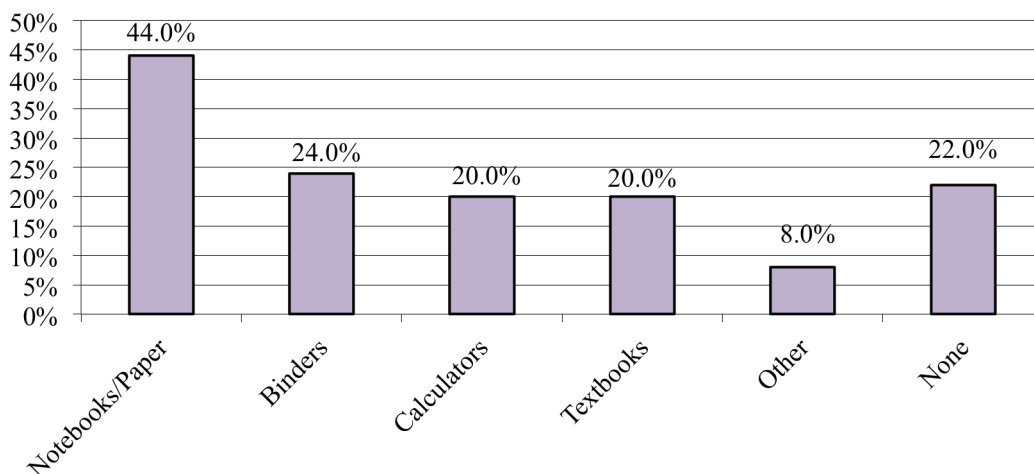
The best way to find out what students needed in the group study rooms was to ask them directly through the surveys. When asked S5, "What technology or equipment would you like in the room that is not already present, and how would you use it?" students were given the opportunity to provide ideas specifically about technology. Through open coding, four main categories emerged, with a fifth category for "Other," as shown in Figure 12. Only two responses were applied to the "Other" category: one request for bean bag chairs and pillows, and one for making the dividing wall between study rooms more soundproof. Audio requests called for speakers for students to play music, and the ideas varied in the visual technology category. Students suggested in-table iPads, SMART boards, and "One of those touch screen things in Hawaii Five-0."

Figure 12. Suggestions for New Technology
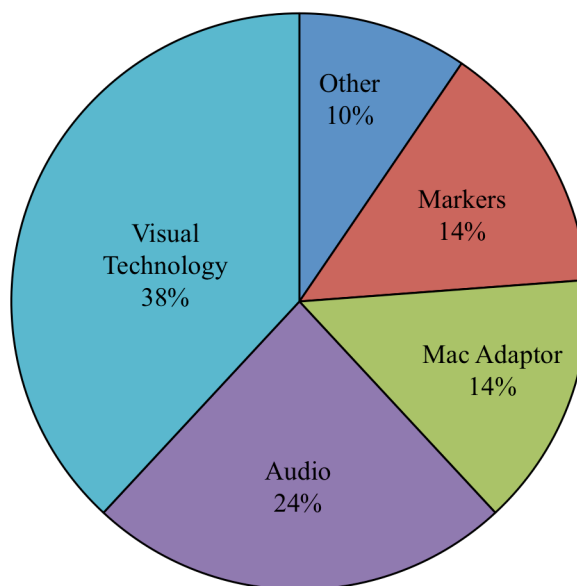
Collaboration

The collaborative learning spaces were meant to be just that – collaborative. But as noted earlier, in some libraries, such as Perkins Library at Duke University, some students may use the room for independent use. ("Assessment of the LINK," 2008) The study sought to identify this as a problem through O1 and S1 by asking how many students were in the room at the time the survey or observation was completed. Only 12.7 percent of the time was the room occupied by a sole student. (See Table 1 and Figure 2.) Additionally, notes were made if students were speaking to each other and sharing materials (O8), or wearing headphones (O3). Very few students were observed wearing headphones, in fact, 91.1% were not. (See Table 5.) Table 6 addresses O8.

Groups in which interaction was apparent were coded as "collaborative," and those

working silently were coded as "non-collaborative."

Table 5. Observed Headphone Use.

Headphone Use	Number of Students	Percentage (Number of students/Total)
Students Wearing Headphones	11	8.9%
Students Not Wearing Headphones	112	91.1%
Total	**123**	**100%**

Table 6. Observed Collaboration.

Collaboration	Number of Rooms	Percentage (Number of rooms/Total)
Collaboration	33	66%
Non-Collaboration	18	36%
Total	**50[10]**	

To take this a step further, the above data in Table 6 can be combined with the

data in Figure 4, to cover a broader scope of student activity. The data from Figure 4 was

recoded as "collaborative," "non-collaborative," or "unsure." Those responses recorded

as "We were working on a group project," was coded as "collaborative." The responses

recorded as "We were working individually on the same assignment," and "We were

working individually on different assignments," were both coded as "non-collaborative."

Review of comments made for the "Other" category were reviewed on an individual

basis and coded. Those who wrote in that they were studying for a quiz or test were

coded as "unsure," recognizing the flaw noted earlier. The comments, "Bible study,"

"organizing an event," and "lab report" were coded as "collaborative." The final

comment, "Working on a test," was coded as "unsure." The combined data is shown in

Figure 13.

Figure 13. Collaborative Work: Combined Observations and Surveys
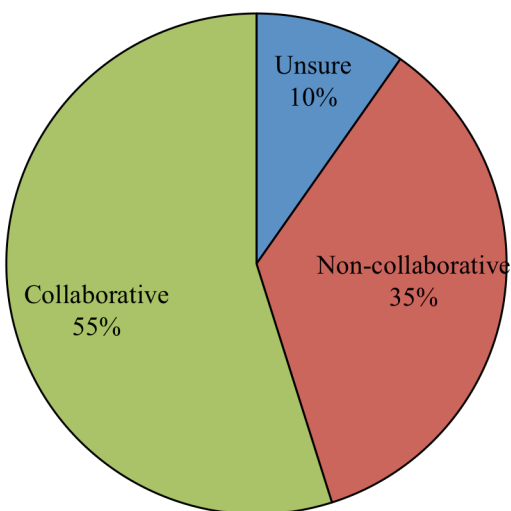
Exploratory Questions

Two survey questions showed responses with similar themes. S6 asked why

students chose this room over others, and S7 asked what they liked best. The themes that

emerged were almost identical for both questions, although respondents did not always

list the same opinions for both questions in a single survey.

Table 7. Student Reasons for Using the Group Study Rooms.

Theme	Frequency
Quiet	11
Not disturb others	10
Privacy	8
Location	7
Table Space	6
Concentration	3
Whiteboard	3
Technology	2
Comfort/Furniture	1

Table 8. Features Students liked best about the Group Study Rooms.

Theme	Frequency
Comfort/Furniture	7
Whiteboard	6
Quiet	5
Table Space	4
Technology	4
Location	3
Privacy	3
Size	3
Lighting	1
Not disturb others	1

Because these themes were identical in most cases, the data has been combined in Figure

14 give greater impact to the features of the study rooms most often noted.

Figure 14. Common Themes: S6 and S7
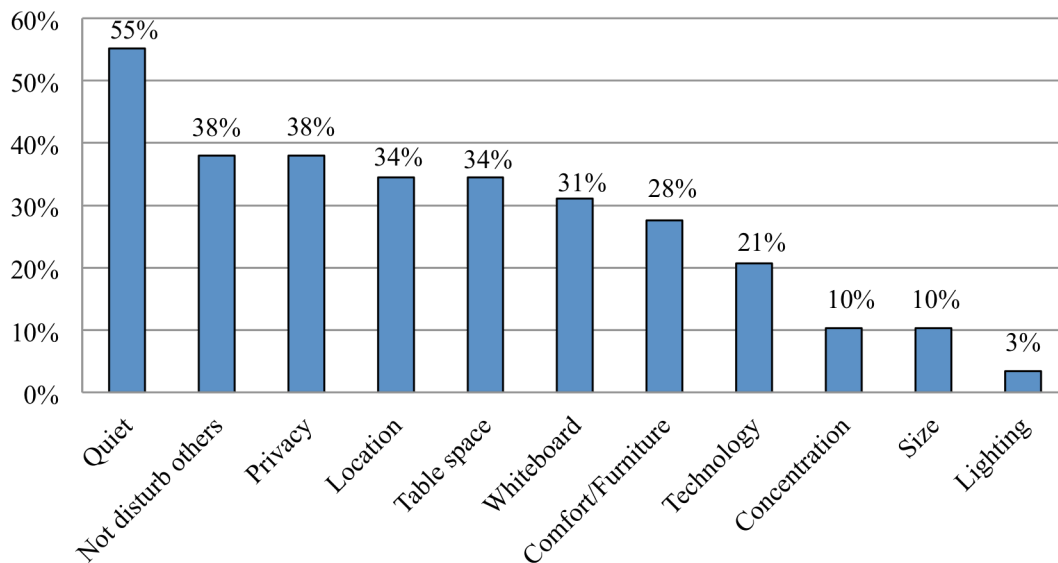
Lastly, students were given the opportunity to provide their opinions on what they would change about the rooms. The most common complaint, shown in Figure 15, was the wall color, which students said made writing difficult to read.

Figure 15. Suggested Changes
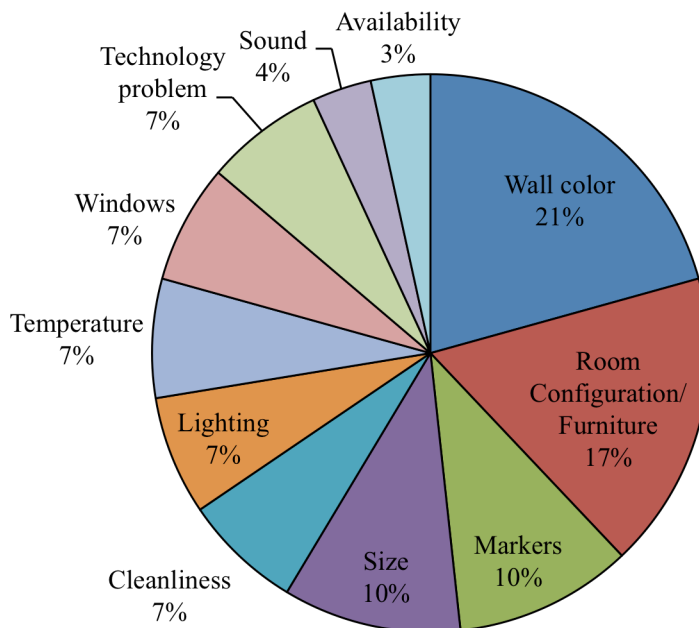
Discussion and Recommendations for New and Old Space

Activity in the Group Study Rooms

The number of students in a room averaged three people, although the rooms could hold up to 6. With one exception, all groups were between one and six users. However, since three groups indicated that they needed a bigger room, the Libraries should reevaluate the options for larger groups. There are only four reservable rooms in D.H. Hill that can accommodate more than six people.[11] Since the majority of groups did not indicate a problem with the size of the rooms, these rooms may not be the problem. Instead, the Libraries should further evaluate the size of groups, and instead of making changes to the current group study rooms, consider adding additional rooms that can accommodate more than six people.

The study found that most of the time, the work done in the rooms was academic by nature, and students were together because they were in the same course. Further study could explore the non-academic use of the study rooms. For the few groups not doing academic work, such as the bible study group and the group of students planning an extracurricular event, why were they using the library space, rather than somewhere else on campus? Was there a shortage of space throughout campus for students to use for small group meetings? Do the rooms in the library provide access to technology or resources that other campus locations lack? Such follow up questions and perhaps interviews with students could provide more insight into this phenomenon. This data could allow the Libraries to make changes to its services in order to cater to these non-

academic uses, and further market D.H. Hill as a gateway to knowledge - indiscriminate between academic and non-academic learning and collaboration efforts.

Writable Walls

Evidence of whiteboard use was observed only 36% of the time. While students were not specifically asked about the writable walls in the survey, they were frequently mentioned in the free response categories. Students valued their presence, but complained about the colors. While one student said that the "orange wall causes [a] less stressful environment," the colored walls were less than ideal as a writable surface, because students found that the writing on them was difficult to read. To balance these needs, a solution would be to replace the colored writable walls with white ones, and paint one or more of the remaining walls a different color. Students would still have the benefit of some color contributing to the atmosphere of the room, while retaining the writable surfaces.

Projection Screens

Over two thirds of studied students did not make any use of the projection screens. However, in free response questions, the projectors were cited as features that students particularly liked. Some students were unable to get the screens to work, and shared their frustration in the surveys. This could be addressed by installing clearer instructions near the hook-ups. The researcher would have liked to be able to expand on this part of the study by asking follow up questions to the students who had technological difficulty, particularly, if they asked library staff for help. One of these respondents

suggested that one of the things they would like changed about the rooms was to "have someone monitor the technology to make sure it worked." This was an interesting remark: students expected the technology to be ready exactly at the moment of need.

Further exploration could study more specifically why students were using the projectors, and what they projected onto them. The observer noted social content, such as movies, but also academic content such as journal articles, presentations, and documents. Student descriptions of their personal use of the screens was vague, and did not provide much insight. Additionally, more information could be obtained to judge whether or not two screens in each room was really necessary, since only 2% of the time were students viewing different content on each screen.

Identification of Lacking Technology

Today's students are multi-taskers, often using various types of technology simultaneously. (Manuel 2002) The study tried to address this by identifying the technology students were bringing into the rooms themselves, which the library could possibly turn into a service. Besides laptops and calculators, few students were using other technologies besides their personal study materials; however, one frequent request was the desire for audio hookups or speakers of some sort. A few survey results indicated the desire to listen to music through provided speakers, and perhaps those who were watching movies through the projection screens would also benefit from this feature.

The requests for dry erase markers and Mac adaptors for the computers further support the idea that today's students want resources available at their fingertips, looking for instant gratification. Both of these materials were available for students to pick up from the Learning Commons, but students may not have known this information. This problem can be addressed by installing clear, visible, permanent, signs in the group study rooms directing students to the Learning Commons Service Desks if they need these items. There are already tent cards in every group study room, directing students to use the Libraries' text messaging service for assistance, but they are non-permanent, and easily be removed or discarded. More durable signs directing students to library staff should be installed, and should include all ways staff can be contacted, and for what purposes. Students may not know when it is appropriate to ask for help. Additionally, the Libraries should consider installing Mac adaptors or direct hookups in each room, so if students miss or ignore the signage, the issue of their absence can be resolved.

These issues and others can also be addressed by adding more content to the description of the group study rooms on the Libraries' website. The current description reads:[12]

The fifteen study rooms available in D.H. Hill include:

- two group study rooms in the Learning Commons with a large display capability
- a large 12-seat study room on the 2nd floor of the bookstacks with multiple display switching capabilities
- two 6-seat study rooms on each floors 3-8 of the bookstacks with multiple display switching capabilities

All study rooms contain large writable walls or movable whiteboards.

Group Study Rooms are limited to one reservation per day. Reservations can be made up to seven days in advance.

This description says nothing about obtaining dry erase markers, Mac adaptors, or use of the projection screens. Nor does it indicate how students can get help when they are in one of the rooms. This webpage provides the direct link to the reservation system, and could reach many students who use this avenue to make a reservation. Richer description can be added to inform students of the services and resources associated with the rooms.

Furthermore, it is clear that today's students not only expect the latest technology, such as iPads and other types of touch-screen technologies, but they look to popular culture for examples. The reference to the touch screen technology in the Hawaii Five-0 television show is an excellent example of how students see and relate technology to their everyday lives. The "Surface Table" in the television show is similar to Microsoft Surfaces, which D.H. Hill does have in its Technology Sandbox. Using a Microsoft Surface, students can manipulate digital content with their fingertips by touching the screen. Hawaii Five-0 makes its technology appear similar, but in the television show, the data on the "Surface Table" can be swept up onto a monitor hanging from the ceiling.

Students can use the Microsoft Surfaces in the Technology Sandbox to play games and use NCSU Libraries learning tools, but currently nothing else. The student who mentioned this technology may have made the connection between the television show, and the equipment NCSU already owns.

Collaboration

The study found that indeed, students were using the room to collaborate. The library is a place for students to complete their academic assignments, and the group study rooms were cited as favorable study areas because they were quiet, private, and allowed students to work together in a group without disturbing the silent studiers throughout the stacks. However, their availability was still an issue for some students. There are just not enough spaces for them to collaborate without disturbing others, and groups noted that since they were in such high demand, it was sometimes difficult to make a reservation for a room when they needed one. Currently, D.H. Hill may not be able to accommodate these requests, but after the opening of the Hunt Library, which will have over 100 study rooms, this problem may be lessened, as Hunt Library will double the current library study seating. However, even with the new library, NCSU will still only be able to seat about 10% of its student body.

Conclusion

The Libraries is always hoping to improve its services to further advance the academic and professional development of their students. Particularly in regards to technology, NCSU Libraries works to keep up with current trends, and provide the best to

their students in an effort to foster creativity and further research projects. D.H. Hill even has an experimental collaborative learning space, the Technology Sandbox, where students can experiment with innovative technologies that encourage collaborative learning through large-scale displays and gesture-based computing tools. Such technology will be found throughout the Hunt Library, but the specifics of what is needed in smaller-scale, more private collaborative learning spaces is still a question.

Hunt Library can look to include the large tables and comfortable furniture students enjoyed. Instead of installing colored writable walls, Hunt Library should adhere to white writable walls, and add color to other parts of the room. Mac adaptors should be included with the PC connections to the projection screens, and signs pointing students toward help from staff should be clearly posted. Speakers built into the monitors, or installed separately will allow students to play music, or listen to other types of audio. Students also like control: control of room configuration, lighting and temperature. Chairs should be able to move about the room, and lights that can be dimmed or adjusted should be installed instead of just an on/off switch. Additionally, large numbers of students in a small enclosed room with lots of running technology can quickly make a room hot and uncomfortable, and students should be able to control the temperature within their room.

NCSU is already at the forefront of leading academic libraries in advanced technologies available for their students. A concrete study of the needs and behaviors of their students can help other similar academic institutions make better decisions about

their own current or potential collaborative learning spaces. The issues encountered by

NCSU can be an example or warning to other libraries, who can then anticipate the needs

of their students. While this is a study of one unique library, the results can easily

transfer as valuable ideas and practices to other institutions across the country. Student

demands are constantly changing, and libraries must constantly reassess their services to

keep up with growing trends, and support their students to the best of their ability.

Notes

1 The NCSU Libraries consist of the main library, D.H. Hill, the Design Library, the Natural Resources Library, the Textiles Library, and the Veterinary Medicine Library. Three additional campus information centers, the African American Center Cultural Reading Room, the College of Education Media center, and the Mathematics Working collection also contain library materials.

2 The group study rooms in the Learning Commons are not used in this study because their location in the Learning Commons differentiates them from the rooms on floors 2-8, which are all situated on designated quiet floors.

3 See http://www.lib.ncsu.edu/huntlibrary/vision.html to read the full vision for the Hunt Library.

4 See Appendix A. Observation Protocol.

5 See Appendix B. Description of Project.

6 See Appendix C. Group Study Rooms Survey

7 The location for Hunt Library is about two miles from the current location of D.H. Hill Library.

8 Exact calculation for the average number of students in a room is 2.96.

9 This phenomenon presents a flaw in the question because it was unable to be determined whether the students studying for quizzes and tests were studying individually, or as a group.

10 Room totals and percentages do not add up to 50 for this table because in one room, two students were interacting, and another was wearing headphones and working silently, so this room was coded as both collaborative, and non-collaborative.

11 Reservable rooms for students that can accommodate large groups are the group study room on the second floor, and three rooms in the Learning Commons. The three rooms in the Learning Commons were not included in this study.

12 See: http://lib.ncsu.edu/studyrooms/groupstudy.php

References

Assessment Committee. (2008). Assessment of the LINK Teaching and Learning Center in Perkins Library. Duke University. URL: http://link.duke.edu/about-the-link/assessment [accessed 10 October 2011]

Bennett, S., et al. (2005), February. Library as Place, Rethinking Roles, Rethinking Space. Washington, D.C.: Council on Library and Information Resources.

Bennett, S. (2003). Libraries Designed for Learning. Washington, DC: Council on Library and Information Resources. URL: http://www.clir.org/pubs/reports/pub122/pub122web.pdf [accessed 2 February 2012].

Cohen, A. (2009). Learning Spaces in Public Libraries. *Public Library Quarterly,* 28: 227-233.

Foote, S.M. (2004). Changes in library design: an architect's perspective. *Portal: Libraries and the Academy,* 4(1): 41-59.

Forrest, C., and Hinchliffe, L.J. (2005). Beyond Classroom Construction and Design. *Reference and User Services Quarterly,* 44(4): 296-300.

Freeman, G.T. (2005). The library as place: Changes in learning patterns, collections, technology, and use. In: *Library as place: Rethinking roles, rethinking space, 1– 9. Washington, DC: Council on Library and Information Resources*. URL: http://www.clir.org/pubs/reports/pub129/freeman.html [accessed 30 November 2011].

Gardner, S. and Eng, S. (2005). What Students Want: Generation Y and the Changing Function of the Academic Library. *Portal: Libraries and the Academy*, 5(3), 405-420.

Graetz, K.A. and Goliber, M.J. (2002). Designing Collaborative Learning Places: Psychological Foundations and New Frontiers. *New Directions for Teaching and Learning,* 2002(92), 13-22.

Howe, N. and Strauss, W. (2000). Millenials *Rising: The Next Great Generation.* New York: Vintage Books.

Hundley, S.P., and Jacobs, F. (2005). Designing Postsecondary Education to Meet Future Learning Needs: Imperatives for Planning. *Planning for Higher Education,* 34(1) 12-18.

Lin, Pei-chun, Chen, K. and Chang, S. (2010). Before there was a place called a library – library space as an invisible factor affecting students' learning. *Libri,* 60(December), 339-351.

Manuel, K. (2002). Teaching Information Literacy to Generation Y. *Journal of Library Administration*, 36(1/2), 195-217.

McDonald, A. (2006). The Ten Commandments revisited: The qualities of good library space. *Liber Quarterly*, 16 (2).

Merritt, S.R. (2002). Generation Y: A Perspective on America's Next Generation and Their Impact on Higher Education, reported by Shelley Neville. *Serials Librarian*, 42(1/2), 43-44.

Oblinger, D. (2003). Boomers, Gen-Xers & Millenials: Understanding the New Students. *EDUCAUSE Review,* 38(4), 37-47.

Sens, T. (2009). Twelve keys to library design: Improving the academic experience. *Library Journal*, 15 May. URL: http://www.libraryjournal.com/article/CA6656754.html [accessed 1 December 2011]

Twigg, C.A. (2003). Improving Quality and Reducing Cost: Designs for Effective Learning. *Change,* 35(4): 22-29.

Wilson, L. A. (2002). Collaborate or die: Designing library space. *ARL Bimonthly Report,* No. 222. URL: http://www.arl.org/bm~doc/collabwash.pdf. [accessed 2 February 2012].

Appendix A. Observation Protocol

Date: _____   **Time:** _____   **Room:** _____

1.	Number of students in room	
2.	Number of students using laptops	
3.	Number of students wearing headphones	
4.	Are the students using the projectors in the rooms to display content from the laptops?	
5.	Does the activity seem academic or social?	
6.	Have students used the whiteboard markers on the writable surfaces in the room?	
7.	What other materials or technologies are students using?	
8.	Are students interacting with each other or working silently?	
9.	Are students charging their various technological instruments by using the outlets in the room?	
Other Notes:		

Sketch of room.

Appendix B. Description of Study

       The NCSU Libraries is undertaking a research project to observe use of and activity in the group study rooms in D.H. Hill Library. Our findings will be used to improve the group study rooms and help with planning for the group study rooms in the new Hunt Library. No specific information about users of the group study rooms is being captured. All information is anonymous. If you wish for your activity to be excluded from this study, I will skip observation of your use of the group study room.

The following data is being captured about use of the group study rooms:

1. How many students are in a given room?
2. Are the students using laptops? How many?
3. Are the students using the projectors in the rooms to display content from the laptops?
4. Does the projected content seem academic or social?
5. Have students reconfigured the furniture?
6. Have students used the whiteboard markers on the writable surfaces in the room?

If you have questions about this study, please contact Kim Duckett, Principal Library for Digital Technologies and Learning, kim_duckett@ncsu.edu, 513-3653.

Appendix C. Group Study Rooms Survey, D.H. Hill Library. Spring 2012.

The NCSU Libraries is undertaking a research project to observe use of and activity in the group study rooms in D.H. Hill Library. Our findings will be used to improve the group study rooms and help with planning for the group study rooms in the new Hunt Library. No specific information about users of the group study rooms is being captured. All information is anonymous. By answering this questionnaire you agree to have your responses included in the study. All questions may be filled out on a voluntary basis, and you are not required to answer all questions. If you wish for your activity to be excluded from this study, do not fill out this survey.

If you have questions about this study, please contact Liz Johns, emjohns@ncsu.edu.

_____

 Please answer the questions based on your most recent activity in the group study rooms.

1. How many students were in the room with you? _____

2. How do you know the students who were in the room with you? (You may choose more than one answer.)
       a. We are all taking the same course.
       b. We have the same major.
       c. Other: _____

3. What kind of project/assignment were you working on?
       a. We were working on a group project.
       b. We were working individually on the same assignment.
       c. We were working individually on different assignments.
       d. Other: _____

4. Did you use the projection screen? For what purpose?

5. What technology or equipment would you like in the room that is not already present, and how would you use it?

6. Why did you choose the group study room as a place to work, rather than another location in the library or on campus?

7. What do you like best about this room?

8. If you had the power to change this room in any way, what would you change about it?