THE UNIVERSITY OF CENTRAL OKLAHOMA

Edmond, Oklahoma

Jackson College of Graduate Studies

THE APPLICATION OF SENSORY DESIGN ELEMENTS TO ACADEMIC LIBRARY'S

LEARNING SPACES

A THESIS

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements

for the degree of

MASTER OF FINE ARTS IN DESIGN

By

Mei Wang

Edmond, Oklahoma

December, 2019

THE APPLICATION OF SENSORY DESIGN ELEMENTS TO ACADEMIC LIBRARY'S
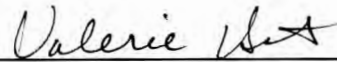
LEARNING SPACES

A THESIS

APPROVED FOR THE UNIVERSITY OF CENTRAL OKLAHOMA'S

SCHOOL OF DESIGN

December 6, 2019

_____

Dr. SeonMi Choi, Committee Chair

_____

Dr. Valerie Settles, Committee Member

_____

Dr. Oksun Lee, Committee Member

Acknowledgements

I am humbled to receive great support from many people throughout my graduate studies at the University of Central Oklahoma. Dr. SeonMi Choi has played a key role in guiding and helping me with my academic career and this thesis. I would like to thank her with the deepest appreciation for her professionalism, dedication, and gracious patience as a teacher, mentor, and advisor. She gave me so much support and encouragement. She spent many nights to help me with my thesis paper. Without her guidance and constant feedback, this thesis study would not have been achievable.

I would like to show appreciation to my entire thesis committee for their guidance, professionalism, and valuable feedback. Dr. Valerie Settles has helped me in every area of the study process as a teacher over three years during my time in the Masters of Fine Arts program. She has exuded kindness and understanding while I learned from her knowledge and wisdom. Dr. Oksun Lee has shown kindness and dignity while lending support and feedback during my thesis process.

Indeed, this thesis project is not just a paper but an entire multi-semester process benefitting from the support of many teachers, colleagues, staff, family, and friends. I am also very grateful to Professor Amy Jacobson-Peters for her help and encouragement in and out of the classroom. I owe thanks to the school of design, the library staff, and the staff in the print center and letter press.

In addition, I would like to thank my friends, in and out of UCO, who showed kindness and support through my busy days. I am heartily thankful to my father Mengli Wang, for his love and support in helping me attend UCO and finish this master degree, and my boyfriend, Jason

Hayes, for his boundless patience while helping guide my voice in all of my English based endeavors.

Finally, I wish to appreciate my mother Xiuyan Li in making me the good person I am today. She was not only my best friend, but she is also my good example, whose kindness, support, and love are like a lighthouse to guide the direction of my life. I believe she would be proud.

Abstract

Learning spaces in the academic library provide students with the opportunity to undertake individual or group learning activities, socialize with other students, and use library sources; therefore, these spaces must meet students' needs and expectations for improved learning outcomes and better quality of academic life. Students require different types of learning spaces depending on their individual or group work; for instance, spaces for private/alone, public/alone, private/together, and public/together, learning commons, and reading areas (Andrews & Wright, 2015).

"Sensory impressions obtained through hearing, seeing, touching, tasting, and smelling contribute to the way in which people experience their surrounding environment" (Sonneveld, Ludden, & Schifferstein, 2008, p.1). The sense of sight makes people recognize and understand the "visual" information from the space, such as color, light, pattern, visual texture, and shape elements (Ching & Binggeli, 2012), while the sense of touch helps people to perceive and feel their environments by touching the object and keeping the actual connection with tactile texture and haptic technology (Magagula, 2018). These visual and tactile sensory design features create a harmonious, aesthetic, and impressive ambience and have a positive effect on user behavior, experience, mood, and emotion (Sufar, Talib & Hambali, 2012). It is expected that students tend to be more engaged in the library with attractive and functional learning spaces designed by the sensory design approach.

To suggest design alternatives of library learning spaces at Chambers Library of University of Central Oklahoma, the aim of this research was to explore how well existing learning spaces met students' needs in terms of satisfaction and expectation with physical environments and sensory design attributes, especially visual and tactile features. The researcher

observed existing learning spaces (i.e. furniture, lighting, finish materials, layout, arrangement, circulation, technology usage) and identified current issues that should be modified or upgraded based on the researcher's experience and other case studies. A survey questionnaire composed of close- and open-ended questions was used to collect data from UCO students (n = 146) who have used learning spaces for their individual and group study work, and their use of library sources. A 7-point Likert scale was used to determine students' satisfaction, agreement, and expectation levels.

Research findings indicated that students frequently used private/alone learning spaces for their individual study work, and public/together spaces for collaboration and communication activities. Students were satisfied with the overall learning spaces (i.e. furniture arrangement, space layout, location) and thought those physical environments met their expectations of the academic library learning spaces. However, many respondents were not satisfied with sound and visual privacy issues, furniture size and type, aesthetics, and technologies of learning spaces. They mentioned that library furniture was uncomfortable due to poor ergonomics. Some students responded that ceiling lighting fixtures were not bright enough for their study, and motion sensor lights were actually inconvenient. They expected to access natural light and have more task light options. The aesthetics of learning spaces were major concerns; for instance, color, pattern, and texture were bland. To enhance the aesthetics of physical environments, students suggested adding green plants, art installation, and decorations. These findings showed that many students were not satisfied with visual and tactile design features of learning spaces. The researcher utilized research findings to solve existing problems and support design solutions by applying visual and tactile stimuli to meet students' needs and expectations.

The researcher used visual diagrams, charts, and pictures for explaining research findings as well as hand-drawn sketches, and computer-generated perspective renderings for presenting design solutions and outputs. For instance, the researcher suggested creating more enthusiasm in the learning spaces by changing the color collocation; for furniture selections, chairs can adjust their height to fit tables, and could be flexibly moved to meet multiple work needs. At the same time, the researcher selected soft textures and bright color for finish materials of the furniture while imparting fresh tones, textures, and temperatures to be incorporated with the entire design. In the open-ended questions, the students mentioned lighting was not bright enough in the learning spaces, and the findings indicated that 16.5% of respondents were not happy with task lighting, so the researcher suggested applying various luminaries in the learning spaces such as the manufacturer that professionally provides positive lighting as options of ambient lighting. The dash mini LED task lights were applied to the individual study areas since it is easy to adjust the light brightness for users' needs. The findings, in addition, indicated that 21.2% of respondents were not satisfied with technology; therefore, the researcher suggested technology be applied in the learning spaces, such as interactive illuminated flooring, induction wall, movable TV, and so on. These technologies provide not only convenient learning but also modernize the spaces.

Through visual and tactile design theory, these design alternatives presented some insights and ideas for the future academic libraries. As the learning spaces of the academic library are about serious study and learning, what might be discovered is unique learning spaces from the perspective of vision and touch.

Table of Contents

List of Tables

List of Figures

CHAPTER ONE: INTRODUCTION

Background of the Study

The academic library has been described as being at the heart of any higher education university campus and an extension of education (Child, Matthews & Walton, 2013). Indeed, the academic library is considered an "informal learning space" to support students, staff, and faculty in their learning, work, research, and education (Montgmery, 2014). Students read books, do research, and other relative activities in the library in order to achieve their learning goals. Historically, the library's mission has been to provide books, journals, newspapers, and related materials on its shelves for students to consult, print, and borrow to supplement their classroom learning (Montgmery, 2014). Therefore, this traditional and operational pattern has existed for hundreds of years. With the progress of higher education, as a result, academic libraries have gradually extended the scale of the learning and studying interior space. Nowadays, students need the academic library not only to read books to satisfy their hunger for knowledge, but they also use it to focus more on their learning and studying. During the last half of the 20th century, many researchers and practitioners have predicted that academic libraries will go through dramatic changes in the next several decades (Jantz, 2012). In fact, interior designers have been seeking new approaches to renovate the original space of learning while keeping the traditional function of the library. In other words, the academic library will support student learning by enhancing people's hunger for knowledge and providing a high-quality learning space.

In order for the academic library to truly become a learning center, the learning space should be designed to facilitate and meet all the needs of students because they consider the library as an essential part of their college life (Oliveira, 2016). The learning space should also provide a variety of areas and services for students to study, read, write, consult materials, and

print resources either individually or collectively. Can these basic functional services meet the

students' needs in the 21 century academic library? Higher educational institutions should offer

more flexible spaces and harmonic places that successfully promote student engagement and

optimize their experience in the learning process (Andrews & Wright, 2015). Actually, the use of

learning spaces within libraries needs to be allocated reasonably through functional partitions

such as social meeting, study places, and read spaces with book shelves where students might

study with a group of classmates, meet friends, reading materials, or consult online sources for

research (Barclay, 2007). Designers still continue to seek the physical environment of learning

spaces to support the academic library basic function: to fully accommodate the students' needs

in one of the most important buildings on the university campus.

The academic library mainly targets students. The well-designed learning spaces can

attract students both individually and collectively for collaboration and individual study, and can

also encourage students to engage and interact instead of having a conservative study approach.

Hence, the importance of spatial design needs to support and meet students' needs, inspire their

experiences, and strive to meet their expectations. In addition, learning spaces convey a message

to connect a library design concept to an attitude of lifelong learning (Turner, Welch &

Reynolds, 2013). As a hub of informal learning space, the academic library not only needs to

demonstrate the advantages to students' learning, but also needs to create a variety of

collaborative and independent spaces to promote students' self-directed learning. Based on these

descriptions, it is easy to imagine that learning spaces first should be multi-functional including

several zones, and these areas conduct their specific missions such as private silence and public

collaborative spaces for learning. Second, modern learning spaces necessarily provide high

technology equipment to assist students' study like large touch screens, smart boards, document

cameras, and projectors to accommodate collaborative working. Robot search technology also helps students to consult information materials in a place equipped with comfortable ergonomic furniture, adjustability, and mobility. Meanwhile, learning spaces may divide amenities into food supplies and coffee machines for students' self-serve options (Andrews & Wright, 2015). The importance of ambience in the academic library keeps students away from feeling high pressure and displeasure. Thus, learning spaces are arranged in a way where there are natural plants, posters, and several pieces of art to make the place look more appealing. Indeed, Turner, Welch, and Reynolds (2013) have summarized the goals of the appeal of libraries in the following quotation: "The development of the learning spaces concept within academic libraries is about providing more varied spaces to contribute to accommodate and support the differing needs and preferences of different communities of learners".

Why are many students not interested in visiting libraries? It may be related to less attraction to visit, underutilized spaces, lack of facilities, and less comfort in the interior space. Despite the development of e-information age and the application of the highly technological internet equipment today, the physical environment of the learning space is still considered an important ingredient in an academic library, facilitating the acquisition of knowledge and fostering the habit of studying. So how can learning spaces play a positive role to cater to students' needs? In fact, sensory designs influence the physical environment, and they can influence the user's behavior, experiences, mood and emotion (Sufar, Talib & Hambali, 2012). This sensory information, including sight, hearing, smell, touch, and taste, helps people experience their surrounding environment. Everything connects sensory items. In this study, the researcher strives toward the sensory design approach. Through observations and surveys, the researcher tries to help accomplish a practical, complete learning space inside the UCO

Chambers Library, which obtains more visual and tactile impact and makes this environment more attractive and functional to serve students. Sensory design acknowledges the role of the total sensory experience in influencing human attitudes and behaviors in the physical environment (Clements-Croome, 2012).

The renovation of the UCO library interior design is about both the sensory design approach and interior space elements to remold and supplement existing physical spaces and environment. Examples of interior space elements are the arrangement, physical layout, selection of furniture, and equipment application (Sufar, Talib & Hambali, 2012), and factors of sensory design, including color application, light exhibition, shape models, finishing materials and sense of touch. The two aspects of sensory design factors and physical interior design elements create a cooperation: the sensory design approach would help the physical environment of learning spaces gain a more harmonious, aesthetic, and impressive ambience to meet student long-term learning needs; meanwhile, without sensory design, the physical environment would be passive, without user engage (Lehman, n.d.) in the academic library. The purpose of transforming the physical environment of the learning space with sensory design is to create an optimized atmosphere of learning where students seek the fun of study, and exert their enthusiasm for learning.

Statement of Problems:

It is challenging to develop and structure library services and ambience to better meet the student's academic needs. Today, the academic library strives to become a facilitator of education to accommodate and support the learners' expectation (Oliveira, 2016). The academic library not only accomplishes a simple functional distribution, but also a renovated spatial organization (Thaler, 2013).

The Chambers Library at the University of Central Oklahoma (UCO) is a four-story building, the learning space is 102, 656.9 sf; its total useable area for student learning space is 45% of the whole library, and it includes circulation paths, clearance spaces around furniture, and bookshelves. Consequently, the underutilization of UCO learning space lacks precise spatial planning, spatial functional partitions, the consideration of sensory design, and the understanding of student learning needs and expectations. For example, route conflict of staff passage and student learning areas, non-uniform furniture arrangement of the group study areas, dim lighting, and outdated technology reveal the learning spaces of the UCO academic library need to change to meet the modern library character. Students usually spend more than 3 hours per day in class where they might not have much choice to control their class time or how they behave in this space, but the library, as an informal learning place, should provide a leisurely and relaxed environment to be worthy of students' desire from heavy studying rather than leading them to struggle again with learning (Oblinger, 2006).

The Purpose of the Study and Research Questions

The purpose of this study, therefore, is to propose design suggestions of learning spaces with sensory design approach in the academic library which can facilitate student learning and different types of educational activities by prioritizing students' needs and expectations. The UCO library was a base for conducting a case study to collect data from students and observe the physical environment.

The major research questions of this study are:

1. What are the students' satisfaction levels, needs, and expectations of the physical environment features of the learning spaces at the UCO Chambers Library?

2. How can visual and tactile design elements be applied to the learning spaces to meet students' learning needs?

CHAPTER TWO: LITERATURE REVIEW

This paper collected and utilized available literatures, viewpoints, evaluations, and theory principles that would be conducted in the field of the UCO academic library design suggestions. The discussion may redefine the academic library, what features of physical environments are appropriate to use in the academic learning spaces and explore students' needs and expectations with their experiences.

Learning Space in the Academic Library

Space, whether physical or virtual, can have a significant impact on learning. Learning spaces focus on how learner expectations influence such spaces and the principles and activities that facilitate learning (Oblinger, 2006). The 'informal learning space' of the academic library is unlike a formal classroom or research lab. It has formal learning and reading spaces because it does not have class requirements or course schedule limitations (Montgomery, 2014). In Harvard, North Carolina State University, and the University of Amherst Massachusetts, the learning space includes traditional book-filled quiet spaces, group and individual study places, faculty and graduate student commons, flex classrooms, multimedia labs, and makerspaces (Andrews & Wright, 2015).

In the last century, academic planners have tried to develop a modern and highly technological academic library (Barclay, 2007). Currently, the academic library provides various learning spaces, information collections, and comprehensive services so as to support students, staff, and faculty in their learning, work, research, and education. Meanwhile, planners, designers, and researchers have been exploring a change in the twenty-first century academic library (Montgomery, 2014; Andrews & Wright, 2015). The academic library also strives to

create a learning environment in which users can have a comfortable feeling, including bright, spacious, fresh, quiet study places. (Mei, 2014).

In fact, the academic library has entered a new design phase that contributes to the informal learning spaces (Oliveira, 2016). Furthermore, the spatial practicability and function of libraries have been improved to meet the diverse learning needs and interests of today's students (Montgomery, 2014). Andrews and Wright (2015) points out that the academic libraries not only need flexible and integrated technology, but they also need a wide variety of comfortable, adjustable, and movable furniture types and an ambience of well-being. Libraries should provide students with a social space where they can meet friends, work together, chat, or simply relax after their intense day-to-day studies (Oliveira, 2016). Adding plants, posters, art, and desk light makes spaces more appealing, and students desire more informal, fun areas where they can do both collaborative or individual work (Andrews & Wright, 2015). Indeed, informal learning spaces give students the opportunity to linger, meet, and talk informally outside of class (Montgomery, 2014).

Students' Use of Learning Space

Students see the library as a good place to go because the atmosphere is conducive to study (Sullivan-Windle, 2013). Their ideal space should have multiple zones such as private/ alone space, public/alone space, private/together space, and public/together space to meet their individual and group study needs, and the model of the traditional library can also be combined with this informal fun space (Steelcase, n.d; Andrews & Wright, 2015).

Private/Alone. Individual spaces support quiet, personal areas for users who want alone spaces. Users focus on their study; this space considers appropriate human scale for individuals'

well-being and guarantees the security of users' personal items for long or short terms (Steelcase, n.d.).

Public/Alone. Students want both social 'face time' and alone areas of privacy (Andrews & Wright, 2015) in a variety of open settings. Users need co-existing focused work and social interactions that allow areas to switch from individuals to groups. Furnishings need to be highly flexible and self-customizable to serve this space (Steelcase, n.d.).

Private/Together. These rooms are perfect for small groups of two or four people to large conference rooms. Group rooms are also enclosed to mitigate sound and can accommodate multiple uses such as active learning, computing, and distance learning (Steelcase, n.d; Andrews & Wright, 2015), and these spaces support multiple meeting modes, provide tools for visual display and collaborative technology, as well as acoustical privacy. They also provide highly flexible, ergonomic, customizable furniture to meet collaborative and private needs (Steelcase, n.d.).

Public/Together. Students often do group work in open areas to stay connected to others with multiple sizes and levels. Due to different schedules and number of meetings, the space is more flexible and adaptable for impromptu teaching and collaborative activities by removing barriers between groups (Steelcase, n.d.).

Individual Study Areas (Private/Alone and Public/Alone)

"Academic Library is in the crossroad" (n.d.) states: students in a university academic library prefer to study alone and look for more quiet places where they get more high study efficiency, and the article indicated that 73% of students focus on working alone. Studying alone is on top of the list of study habits. "Students' preference for individual work is also supported

by the behavior of the highest performers —'A' students report more time studying alone than

average" (Thaler et al., 2014, para. 5).

Figure 1. Hofstra University Library and Nova Southeastern University Library

Figure 2. The Medgar Evers College Library of the City University of New York (Medgar Evers College, 2017)

The reference room is a silent individual study area in the Hofstra University Library that

has individual study carrels (Hofstra University Library, 2018), similarly Nova Southeastern

University in Florida provides a quiet environment with study carrels for individual study (Nova

Southeastern University, n.d.), where students will be able to study intensely without interruption

(see Figure 1). In the Medgar Evers College Library, individual study areas, combined with book

collections, support a more collaborative learning environment, and individual study areas

include collaborative study areas, technology classrooms, a new media center, and casual seating

throughout (see Figure 2).

Group Work Areas (Private/Together and Public/Together)

Group space is the name for several group collaboration spaces used at Stanford

University. The physical spaces consist of one or more large computer displays, custom

furnishings, and nearby whiteboards for two to six people doing group work (Holeton, n.d.).

These spaces are designed to increase group work. They also have soft furniture, four to six

tables, and computers. In addition, all spaces facilitate interpersonal communication, are

controllable, and promote the integration of basic human needs and desires like eating and

drinking mixed with learning activities (Hunley & Schaller, 2009). In Nova Southeastern

University, the group study area is designed specifically for social learning, collaborative study,

and group work. Each room is outfitted with state-of-the art technology as well as comfortable

and flexible furnishings that encourage the sharing of group project ideas. Thus, students can

easily connect multiple devices (see Figure 3). In Axinn Library, group social study areas are

Figure 3. Nova Southeastern University Library.

arranged next to the elevators because there may be occasional noise from people getting on and

off the elevators or walking to the bathrooms down the hall. The private/together study areas are

typically very quiet with comfortable chairs, tables, and power outlets (Hofstra University

Library, 2018). In the Agora Learning Centre at the University of Leuven, Belgium, (Designing

Libraries, 2013) the social study space is an open zone where students can go for a cup of coffee

and have a fun time with friends using moveable furniture for group study (see Figure 4).

Furthermore, the group study area provides presentation recording facilities. Each group, with a

minimum number of 3 persons, can reserve a space up to 4 hours a day (see Figure 5).

Figure 4. The social study space (Designing Libraries, 2013).

Figure 5. The group study area (Designing Libraries, 2013).

Learning Commons

"A learning commons as a shared space that can be both physical and virtual" (Franz,

2016, para. 3) and it "consists of flexible spaces that supports technology, communication, and

collaboration to connect learners and help them construct knowledge" (Djkopas, 2018, para. 2).

McMullen & Williams (2008) Stated learning commons components include:

- Computer workstations: cluster keeping flexible arrangements of computer workstations
  for students do computer work.

- The service Desk: it support students' needs, help, and gives consultation.

- Collaborative Learning Spaces for non-traditional group study spaces which facilitate
  collaborative learning and social interaction.

- Presentation Support Centers for supporting students in developing multimedia projects.

- Instructional Technology Centers for faculty development support blend teaching
  assistance with digital technologies.

- Electronic Classrooms are for staff training and occasional classroom support.

- Writing Centers and other academic support units include Academic Advisement,
  Tutoring, and Service Learning.

- Spaces for meetings, seminars, receptions, programmers, and cultural events: reinforce
  students' scholar community and provide new ways for students, faculty, and community
  members to interact.

Other types of learning commons spaces are basic amenities, informal zones, or places for study breaks such as Café, lounge areas, or outdoor spaces that serve as informal social spaces with the availability of serving food and drinks, provide comfortable soft seating, and ingenious tables and chairs that encourage students to spend more time in these spaces which create opportunities for a break from strenuous studying and social communication (Lux, Snyder & Boff, 2016).

Reading Areas

"For many years, people visited libraries to seek and find information, and also to find appropriate spaces for their reading" (AL-Ayash, 2015, p.1). Reading is the main function in a library (Perera & Swaris, 2017). While, libraries have a variety of materials, reading books is still a high percentage of people's use of libraries (Lacović, 2014). Libraries also provide spaces for general reader seating, typically furniture that includes seating tables, carrels, and lounge chairs (Dahlgren, 2009).

"The library should strive to create a friendly atmosphere, embodying humanistic care, and making the reader comfortable and promoting an unforgettable reading situation" (Mei, 2014, p.1144). At the same time, users can appreciate a panoramic view from transparent windows. Additionally, libraries should create special lounge furniture in a small space or cozy chairs for readers' use. For example, seating areas might provide 25 square feet per seat in the reading area with a broad average allowing 30 square feet per seat, while seating in a lounge setting requires 40 square feet per seat; individual seats should also supply a folding tablet to support a person's use of a laptop for wireless access to the library's network (Dahlgren, 2009).

The UC Merced Library (Barclay, 2007), for instance, has three reading rooms: the first floor reading room serves the campus of students, and furnishings look like the café area with flip-top tables that can be rolled out of the way for opening. The third floor reading room is a space in which furniture and popular magazine stacks are arranged so that readers can appreciate the good view of the campus with a big window while they are reading. The fourth floor is the quietest space that has high-ceilings and formal furnishing decorations (Barclay, 2007). Amara (2013) has suggested that bookshelves should be organized but do not need to be consistent for all collections, and can be open.

Design Ideas of the Library

The academic library provides a fun and comfortable space for students to study (Gensler et al., 2016); at the same time, every school library needs a flexible learning space to support multiple learning and teaching styles by vivid learning environments and high-touch technology supplies instead of heavy, immovable tables, and chairs or built-in workstations (Sullivan, 2011). This is good for collaborative teamwork, searching sources from computers having flexible facilities, ergonomics, and aesthetics that are easily and quickly moved into the activities (Gensler et al. 2016).

In the San Jacinto College Lee Davis Library (Hickson, 2014), graphic design is everywhere with the bold colors to clearly point and identify the locations of major functions. The partition glass wall creates a colorful graphic design pattern that is friendly to the community. Moreover, many libraries reduce the number of physical books on display and offer off-site book storage locations and E-books and then make way for wide spaces for independent and collaboration places (Hickson, 2014). Another example is the OSU Institute of Technology Library that encourages students to relax and rest after intense studying by providing board games, puzzles, crafts, adult coloring sheets and refreshments as well games with prizes (Plummer, 2017).

Create Layout and Wayfinding. "It's important to take scale into account, and everything should fit in the space and allow proper circulation throughout" (Amara, 2013, para. 2). The furniture should be arranged not only to allow for a clear pathway to different areas of the library but also to create a space such as using shelving to create walls for a quiet reading area, a small meeting room or a comfortable lounge area. (Amara, 2013). The learning spaces are supposed to have a big open porch to enable students to have a break from projects; hence, the work station

could be a semi-closed space that needs a transparent glass wall for a visible view (Amelar, 2019). Interior signage and wayfinding should help customers orient themselves and guide them in looking for various places.   Furthermore, signs should be scaled appropriately to be seen from a distance and can be viewed from the main paths of travel. The signage should be simple, visually appealing, and consistent with the overall design and decoration of the library. (Amara, 2013).

   Library Furniture Selection. "The best libraries are filled with furniture that is designed, built, and chosen with users' enjoyment in mind" (AGATI Furniture, 2017, p. 4). Selection of furniture for the library, prevent musculoskeletal problem when students stand and sit posture because students have taken long time in libraries (Reddy, 2015). This is also considered ergonomics for students and customers, offering high adjustable chairs, workstations, and computer monitors (Amara, 2013). At the same time, furniture needs to be durable, functional, comfortable, esthetically, pleasing, and secure so that it fits students best to learn for a long time, and furniture design needs to be combined with specific technology such as charging plugs, USB ports, and power outlets (AGATI Furniture, 2017). Additionally, some chairs come with cup holders because many college libraries allow students to bring food and drinks. Meanwhile, students can use writeable glass walls for notes and drawings; fixable furniture can be rearranged for individual or group work, including conferencing devices in the closed study room (Deruy, 2017)

Sensory Design

   "The core focus of human-centered design is not only research its actions, and rational analysis surrounding environment, but also important is how the sensory design influence human's senses, and perceive this world" (What you need, 2016, Para. 1). Sensory impressions

obtained through hearing, seeing, touching, tasting, and smelling all contribute to the way in which people experience their surrounding environment (Sonneveld, Ludden & Schifferstein, 2008). "The physical environment contains both architectural elements such as physical layout, furniture, and equipment, and visual sensory elements such as color, texture, and lighting" (Sufar, Talib & Hambali, 2012, p. 134). "The library environment must be attractive and aesthetically pleasing to the eye and hand" (Sufar, Talib & Hambali, 2012, p.134).

Sensory design acknowledges the role of the total sensory experience in influencing human attitudes and behaviors in the physical environment (Clements-Croome, 2012). The influence of environmental attributes is based on the design of an environment through a variety of means such as temperature, sounds, layout, lighting, and colors, and it can stimulate perceptual and emotional responses in users and affect their behavior (Sufar, Talib & Hambali, 2012). For example, the office and the retail have a different human experience. The store experience has been used to improve brand and to increase unplanned purchases. Office sensory experience, however, focuses on functional requirements, so both spaces have different experiences connecting all the senses together (Clements-Croome, 2012). Therefore, sensory design activates touch, sound, smell, taste, and the wisdom of the body, and supports everyone's opportunity to receive information and explore the world (Lupton & Lipps, 2018).

The Sense of Sight

Eyes move, scan, focus, and refocus to discover visual information via the brain that interprets the visual data, thus, people can recognize and understand many concepts; for instance, people are able to perceive an object's shape, size, color, and material (Ching & Binggeli, 2012). Scientists say that more than half of the brain is devoted to processing visual images, and 80% of learning is based on visual input (Leone, 2008). Designer Roca (2003) indicates that colors, light,

and shapes are elements that establish the visual space. Space is "a place for many senses: sight, sound, touch, and the unaccountable things that happen in between" (Wastiels, Schifferstein, Hendrik N. J., Wouters, I., & Heylighen, 2013, p. 31).

Color. Without light, colors do not exist (Ching & Binggeli, 2012). Indeed, color is the easiest material to see (Jalil, Yunus & Said, 2012). Color can add definition and beauty to any space and convey meanings and information about surroundings through people's vision (Al-Ayash, 2015). Colors can also influence human behavior, decision making, health, and much more with or without human realization; color affects human lives physically, psychologically, physiologically, and sociologically on a daily basis (Jalil, Yunus & Said, 2012). Color stimuli can support or inhibit students' ability to process and retain information, and influence students' mood and how they learn and absorb information. For example, blue and green can give feelings of calmness and serenity to facilitate learning; blue creates a sense of well-being; sky blue is tranquilizing and can lower temperature; deep red can help stand out more in the room; red creates alertness and excitement, encourages creativity; yellow creates a positive feeling, maintaining attention, and creativity; brown promotes a sense of security and relaxation, which reduces fatigue (Magagula, 2018). "Orange can be a welcoming and mood-lifting color for learners, which in turn promotes comfort and improves neural functioning" (The Psychology of Color, 2019, para. 13). People think white color has a professional quality; green hues have calming and stress reducing effects (Jalil, Yunus & Said, 2012), and plum and red colors have similar effects (Andrews & Wright, 2015). "A learning environment should be visually stimulating as learning itself requires motivation, mood, and action from the learner" (Jalil, Yunus & Said, 2012, p. 60). Colors help learners increase their attention levels and their learning efficiency. Warm colors, like red, orange, yellow, and yellow hues, show higher arousal (Chang,

Xu & Watt, 2018). Traditionally, paler colors (low chroma) are used on larger surface areas such as walls and ceilings. These low chromatic colors can make a room appear larger, lighter, and airier (Haller, 2017).

Shape. All visual objects can be analyzed in terms of shape. "Shape is defined by the specific configuration of the lines or planes that separates a form from its background or surrounding space" (Ching & Binggeli, 2012, p. 95). There are three categories of shapes: natural shapes, geometric shapes, and nonobjective shapes. Geometric shapes dominate the building environment of both architecture and interior design; these including squares, circles, straight lines, and rectangles. Straight lines and right angles of squares and rectangle shapes give a sense of discipline, strength, courage, security, and reliability. The triangle is an energetic and dynamic shape, which is always associated with motion and direction, and it also brings the feelings of stability and balance. Circles, ovals, and ellipses have a long association with the sun and earth and the eternal because they have no beginning or end. These round shapes may give the feeling of magical mystery and eternity. Natural shapes represent the symbol and the language of the natural world like shells or flowers that are often associated with the circle of life and growth as well as creativity, calmness, and intelligence (Ching & Binggeli, 2012).

Nonobjective shapes make no obvious reference to a specific object or to a particular subject matter. Their shapes usually transfer a new shape from its base to its original form (see Figure 6). "Abstract shapes are an effective way to transfer a message quickly without text" (Tubik Studio, 2017, para. 6).
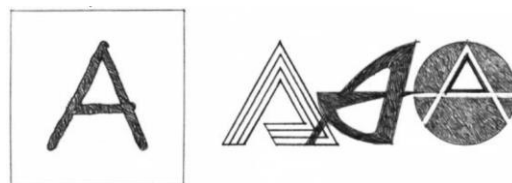

Figure 6. Transfer letter 'A' to new shapes (Ching & Binggeli, 2012).

Lighting. "Visual comfort is intrinsically related to light" (Perera & Swaris, 2017, p. 2). According to International Association of Lighting Designers (as cited in Malman, 2005), "Quality lighting is a powerful tool than can greatly impact and enhance an architectural and interior design project." Interior environments of libraries should provide good artificial lighting for the general ambient environment, book shelves, and students' work to help promote the wellbeing of students and impact their health and learning outcomes. Similarly, natural lighting can help students avoid glare and bright reflections on computer screens, which is extremely important in any library (Branz Ltd, 2007, p. 6).

"Daylight is the main source of light which is healthy, naturally attractive and productive" (Perera & Swaris, 2017, p. 7). Natural light can affect learning abilities, performance, concentration, health and psychology, and affects students in their academic performance (Katerina, 2012). When designing a space, "the overall architecture of the building should realize that the orientations, sizes, shapes, and differences in access to natural light act as cues for behaviors and thus impact the activities within the place, intentionally or unintentionally" (O'Kelly, Scott-Webbe, Garrision, & Meyer, 2017, p. 858). Natural lighting can exert students' high energy, and classrooms with good lighting can improve attendance, test scores, and increase the speed of learning (Magagula, 2018). The students in the classrooms with higher amount of daylight were 26% faster in reading and 20% faster in solving mathematical equations than the students in classrooms with less daylight, so natural light affects the students' learning outcomes (Katerina, 2012).

Different types of lighting can enhance learning performance, such as students' concentration, motivation, and behavior. For example, cool white fluorescent lighting can help reading speed and attentiveness; so relaxed lighting improves students' learning (Robinson,

2012). "The students in the full-spectrum lit classrooms were able to pay attention better which led to improved performance" (Robinso, 2012, p. 8).

General lighting is a crucial illumination for library opening spaces; the lighting fixture is flexible to suit the diverse needs of students' learning activities (Malman, 2005). Proper lighting is very important for reading and learning in the overall success of a library, and should avoid dramatic lighting (Malman, 2005; & Perera & Swaris, 2017). In academic libraries, the light of entrance hallway and lobbies should have less intensity than that of reading areas because readers will feel low intensity when they enter a brightly lit entrance since "the eye adjusts more slowly from bright to dark than the other way about" (Metcalf, 1970, p. 15).

Bookshelves need adequate lighting to help users look for books on the shelves without any visual discomfort; the linear LED fixtures centered above each aisle can reach the bottom shelf with no dark areas (see Figure 7). "The indirect scheme uses up-lights on top of the stacks or suspended from the ceiling; the illumination on book stacks is very soft and visually comfortable" (Malman, 2005, p. 10).
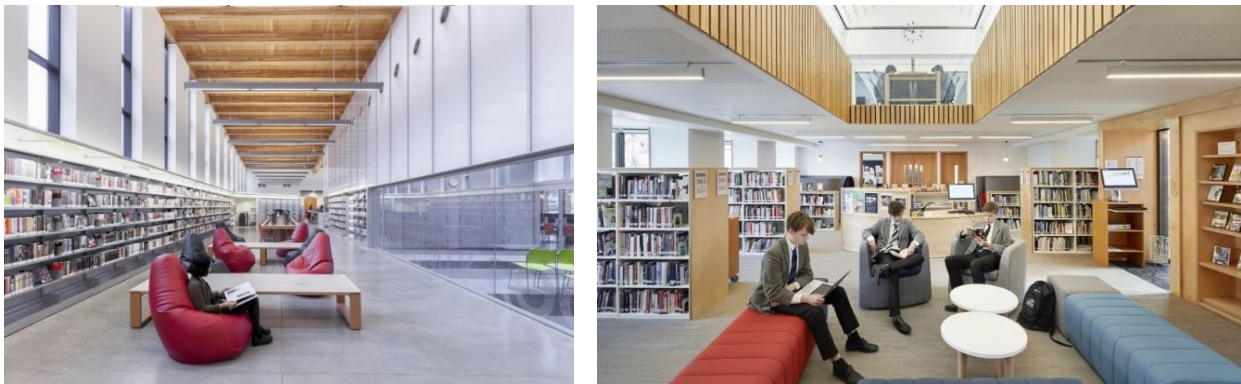
Figure 7. Stack lights at the perimeter shelves highlight the stars of the library on the Staten Island's Stapleton Library (Donoff, 2015)

Task lighting should be designed to spread light across the work surface with soft illumination. If the lamp can be adjusted, it is good for users' needs (Malman, 2005; Zeiger,

2017). Direct lighting uses down-lights to illuminate the reading tables; it has low reflectivity on

computer screens (see Figure 8). Good reading light helps the reader feel alive and enhances the

connection with the book and the light level is "approximately 300 lux" (Perera & Swaris, 2017,

p. 10). If the library has art exhibition cases, they present more light than surrounding areas, such

as learning and reading areas, the high intensity would have a strong reflection on the work areas

(Metcalf, 1970).

Figure 8. Custom desk task lighting provides illumination for the reading tables (Zeiger, 2017).

     Visual Connection with Nature. "Humans have an innate affinity toward nature. Visual

and physical access to natural environments has been shown to restore cognitive abilities and

reduce physiological arousal" (Magagula, 2018, para. 7) , therefore, biophilic design for learning

can increase contact with nature throughout, and natural environment is best suited for thinking.

     When students work at their desk for a long time, to avoid eye fatigue their eyes need to

adjust rapidly for distance, views, angle and lighting (Branz Ltd, 2007). Visual connection with

natural patterns provides an environment to help relax the eye muscles and temper cognitive

fatigue. Nature patterns are visible regular forms found in the natural world including

symmetries, trees, spirals, meanders, waves, tessellations, cracks and stripes (Christensen, n.d.).

Nature views in the space can reduce stress, attenional fatigue, sadness, anger, and aggression, to

make people feel calm, have more postive emotions, and improve concentration, mental

engagement attitude, and overall happiness (Hon, Ryan & Clancy, 2014). According to

Tsunetsugu & Miyazaki (as cited in Hon, Ryan & Clancy, 2014), viewing nature for ten minutes

can reduce heart rate pressure, and internal organs digestion; viewing a forest scene for twenty

minutes can help return cerebral blood flow and brain activity to a relaxed state. The natural

environment delivers human benefits. Benefitting physical health and psychological well-being,

the natural elements are typically indoor plants, pictures of nature, or window views of nature

(Keniger, Gaston, Irvine, & Fuller, 2013). Since the word of "biophilia" was popularized in

1985, designers and architects have strived to create a healthier, happier work environment and

establish a visual connection with nature view. For example, "on 45,000 square metres and three

levels Sky Central in West London is covered 24,776 plants, including mature trees every 20

metres, and sunlight roof canopy with 400 triple-glazed skylights;" it shows biophilic design

ideas: fresh air, nature and well-being, daylight, noise control, and comfortable interior

temperatures in order to create a healthy work environment by incorporating nature (see Figure

9).

Figure 9. Biophilic Design is Bringing Nature into the Office in the Sky Central in West London
(Jackson, 2018, para. 4)

     Visual Texture. "Visual texture is the way a surface appears through the sense of vision" (Smore, n.d. p. 3). Eyes that watch the visual texture of a surface usually respond to its apparent tactile quality rather than actually touching it, but people can perceive its smoothness or roughness. In other words, it is the way something looks like it would feel. On the other hand, visual texture has two aspects, illusory and real (Ching & Binggeli, 2012). For instance, patterns painted on the wall or ceiling may not have 3-D effect, but a surface can create the illusion of a specific tactile texture (see Figure 10). Actually these wallpaper or paneling surface remains essentially smooth but have the appearance of texture (Moody Monday, 2015 & Deziel, n.d.).
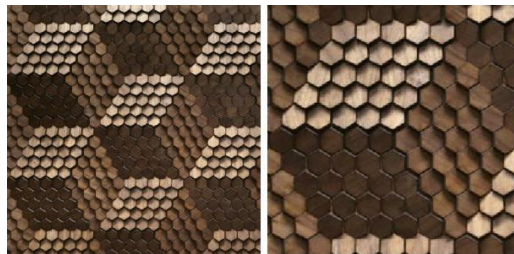
Figure 10. Visual texture creates the illusion of a specific tactile texture (Moody Monday, 2015).

The Sense of Touch

     Touch is an important sense which helps people to understand and explore their environment by recognizing different textures and shapes (Magagula, 2018); the tactile sense is people's direct experience through touching materials (Chen & Chuang, 2014). Touching via skin that is the body's largest organ and the source, shares people's feelings with others (Gallace & Spence, 2010). Touch is a powerful sense, and it can release a series of emotions and memories that aid in learning (Learn Through Experience, 2018). Designers create tactile experiences that not only focus on functional requirement, but also to meet emotional needs as well (Chen & Chuang, 2014).

     "Touching and being touched are two simultaneous aspects of the human experience. Humans get information about the environment through the sense of touch" (Pohl & Loke, 2012,

p. 1). There are three sensing modalities of touch: first, "Kinesthetic (muscles, joints, and tendons) describes human's body perception such as orientation and rotation when moving; second, tactile stimuli are applied on the skin when it is passive; third, haptic sensations are produced during the active exploration of an object" (Pohl & Loke, 2012, p. 2). "The word haptic refers to the ability to experience the environment through active exploration, typically with hands, as when touching an object to measure its shape and material properties" (Kreij, 2010, p. 29). In the modern interior environment, touch-based technologies are already creating high-touch programs to serve environmental needs, such as walls, floors, and ceilings. For instance, while the user touches or sits on an interactive surface, sensors can detect changing temperature or dynamic movement and react to them by changing color or forming different geometrical shapes (see Figure 11).

Figure 11. Slow interactive wall detail (Pohl & Loke, 2012).

Tactile Texture. Designers would consider technical and functional aspects in the interior environment, and related to sensory effects and experience as well as when people select materials in the design process (Wastiels et al. 2013).

The tactile system involves human sense of touch (Ross, 2009). "People obtain perception of warm-cold, tough-tender, light-heavy, and soft-hard through touching furniture and finishing material. Certain components of a material's personality are associated with its sensory

attribute" (Wastiels et al. 2013, p. 32). Tactile natural materials can reduce stress, to energize or to relax, (Magagula, 2018), for example, wood product brings users a natural beauty, peace, and comfort (Zeiger, 2017), moreover, wood material gives feelings of warmth, coarseness, roughness, striped, rustic and peace of mind (Chen & Chuang, 2014). Glass has the feeling of smooth, matte, hard, and accurate (Zeiger, 2017). The physical characteristics of fabric feels soft, warm, light, cute, feminine, and childlike as well as happiness, mildness and affinity; as leather materials produced feelings of flexibility, warmth, and fashion (Chen & Chuang, 2014). Brickwork was associated with rough, blue stone and concrete with cold, hard, heavy, natural, reliable, stable, and peace of mind; steel with glossy (Chen & Chuang, 2014).

Electronic textiles currently have a strong influence on research and exploration, for example Softswitch textiles technology has already applied to armrest upholstery to remotely control televisions and stereos (Rewi, n.d.). "Google's Project Jacquard is building a network oftouch sensors and haptic feedback into clothing and household upholstery like curtain and furniture to allow users to control them through gestures, or movements" (Postscapes, 2015, para.1). According to Miller (as cited in Breffeilh, n.d.) "London designer Giles Miller used over 65,000 polypropylene fibers 'hairs' attached to create a wall mural sitting in a silicon base layer.

Figure 12. Fiber wall mural (Breffeilh, n.d.) and Touch – Thermochromic Paint (Breffeilh, n.d.)

The hairs can be brushed in different directions to create images or patterns on the wall" (see

Figure 12). Another smart material, "thermochromic can change color in response to temperature

change and the interaction of users" (see Figure 12). Other tactile products such as weighted

objects, weighted lap pads, pea pod, and bean bag chairs help the person relax, remain calm and

overcome fears in a warm and natural environment at home or school (Enabling Devices, 2019).

Technology of Touching. "Haptic Technology is defined as the technology of virtually

touching and feeling the objects and forces" (Mathur, Singhal, & Bhardwaj, 2014, p. 388).

Technologies are used to enhance the learning process of an academic library with a larger social

and spatial scale (McMullen & Williams, 2008). Technology is an essential part of library life

(FG Library, 2019). Haptic technology incorporates tactile experience or haptic feedback from

interface of tactile products creating a sense of touch, thus, this technology via computers,

mobile devices, and wearables, receive more sensory cues improving the use of products such as

high-tech tables, kiosk, touch screen; tactile technology can advance connections and

communication (Library of the Future, n.d.). For example, interactive touch tables give users a

unique discovery experiences with the potential to display a huge of amount digital information

(FG Library, 2019).

In Iowa City public library, they are using high-tech touch tables that are fun, and bring

people together with the community (see Figure 13). Kiosk (touch screen) technical application

(see Figure 14) utilize digital capture system to capture bitmaps, and trace user's finger

movements (Jabi, Passerini, & Hall, 2008). The digital age has actually raised the importance of

spaces for people to actually come together (Deruy, 2017). Touch screens embedded in tables is

a good example of a technology that is innovative, and in future they will be mounted in

furniture that will be more easy and convenient use (AGATI Furniture, 2017). Touch screen

displays enhance customer experience enabling people to seek information or perform

presentation. Touch technology enhances public space environments and provides a fast and

intuitive interface for users interactions (Planer, n.d.). The Midland County Library, Texas has

touch screen application for viewing, selecting, reserving and locating resources of all types—

from books and CDs to DVDs and periodicals. Users can quickly see if an item is available, view

detailed descriptions, resource images, or even map its location within the library (Array

Interactive, 2013). This haptic technology can improve students' learning abilities, and make the

learning environment fun (Salvador, Sanchez & Awat, 2013).

Figure 13. Children play a game together on an interactive touch screen table (McKinley, 2019).

Figure 14. Interactive touch-screen poster kiosk deployed in the architecture library (Jabi, Passerini, & Hall, 2008).

The technology device could also keep track of all borrowed books, as well as remind the user of the return dates. Another app on the phone can locating the books on the shelves. The application would guide readers to find the book or point to similar books (Kowalczyk, 2018). Washington and Chicago campus libraries already have superfast robotic retrieval systems to help students look for information materials they need (Broz, 2011).

Printed materials are also an essential tool (Sullivan, 2011). Fujitsu Laboratories, Japan, have developed a user interface that can accurately detect a user's finger and what it is touching, creating an interactive touchscreen-like system to scan and print physical materials. For example, a user may put a book on a library desk, and a camera can read the info from the physical book. Following the finger movement, this technology automatically adjusts the shape of physical objects and then the projector displays digital information/images on the surface desk to be saved and manipulated (See Figure 15).
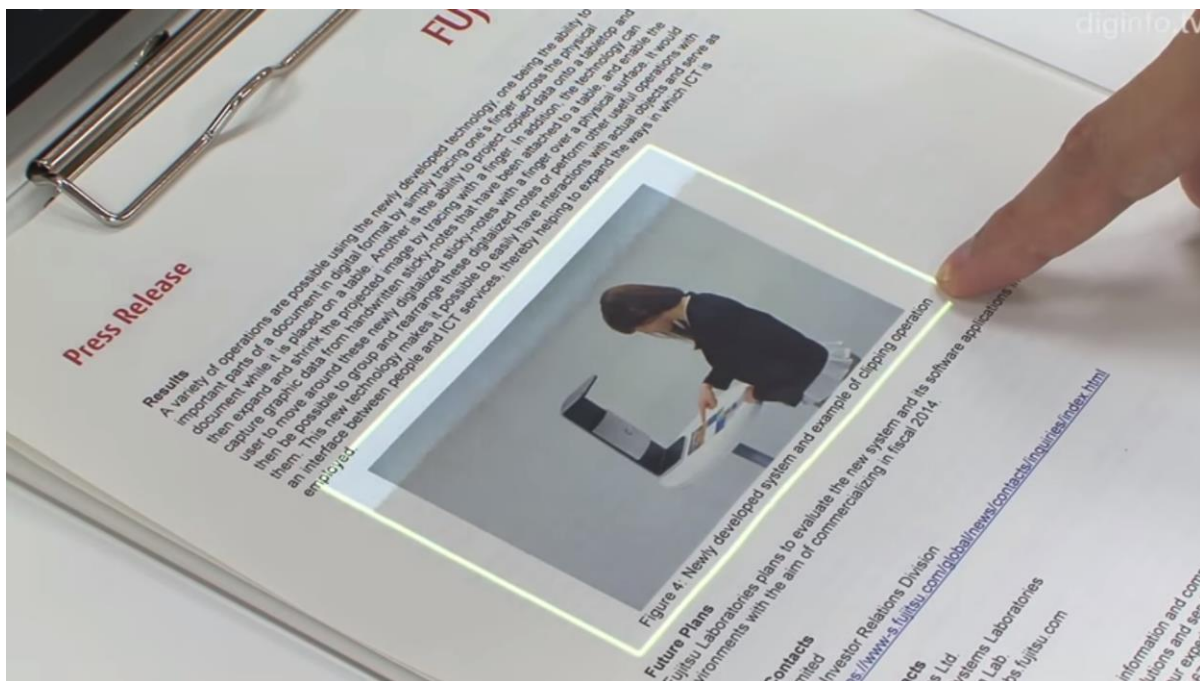

Figure 15. Digital interface for print books (Kowalczyk, 2018).

The Table 1 shows clearly sensory design theory of the literature review.

Table 1.

Sensory design theory

Category		Checklists
The Sense of Sight	Color	Blue creates a sense of well-being. Deep reds can help stand out more in the room. Red color creates alertness and excitement, encourages creativity. Yellow color creates a positive feeling, maintaining attention, and encourages creativity Brown color promotes a sense of security and relaxation, and reduces fatigue (Using Color to Enhance, 2014; Magagula, 2018). Orange can be a welcoming and mood-lifting color for learners, which in turn promotes comfort and improves neural functioning (The Psychology of Color, 2019). White color has a professional quality, gray and beige have less attention or concentration. Green hues have calming and stress reducing effects (Jalil, Yunus & Said, 2012). Color help learners increase their attention levels and their earning efficiency, such as warm colors like red, orange, and yellow, and yellow hue shows higher arousal (Chang, Xu & Watt, 2018).
	Shape	1. Straight lines and right angles of squares and rectangles shapes give a sense of discipline, strength, courage, security, and reliability. 2. Triangle brings the feelings of stability and balance, whereas the reversed one looks risky and dangerous to give people a sense of tense. 3. Circles, ovals, and ellipses shapes may give the feeling of magic, mystery eternity, female, universe, softer, and milder. 4. Spirals shapes can be often seen in nature like shall, or flowers; it is often associated with the circle of life and growth as well as creativity, calmness, and intelligence (Ching & Binggeli, 2012). 5. Nonobjective shapes make no obvious reference to a specific object or to a particular subject matter. Their shapes usually transfer a new shape from their base on the original form (UX Planet, 2017).
	Lighting	Daylight: "daylight is the main source of light which is healthy, naturally attractive and productive" (Perera & Swaris, 2017, p. 7). Natural light can affect people learning abilities, performance, concentration, health and psychology, and affects students in academic performance (Katerina, 2012). Bookshelves Light Bookshelves need adequate lighting to help users look for books on the shelves without any visual discomfort; the linear fluorescent fixtures centered above each aisle can reach the bottom shelf and no dark areas (Malman, 2001). General lighting (Ambient Light) General lighting is a crucial illumination for library opening spaces; the lighting fixture is flexible to suit the diverse needs of students' learning activities (Malman, 2001). Task lighting was built into furniture at communal tables and shared workstations. 28.9W-per-meter 3000K linear LED fixtures to create an ambient lighting scheme that allowed for multiple arrangements and functions (Zeiger, 2017).
	Visual Connection with Nature	A Visual Connection with Nature is a view to elements of nature, living systems and natural processes (Hon, Ryan & Clancy, 2014). "Humans have an innate affinity toward nature. Visual and physical access to natural environments has been shown to restore cognitive abilities and reduce physiological arousal" (Magagula, 2018, para. 7).
	Visual Texture	"Visual texture is the way a surface appears through the sense of vision" (Smore, n.d. p. 3).
The Sense of Touch	Tactile Texture	The tactile system involves human sense of touch. People obtain perception of warm-cold, tough-tender, light-heavy, and soft-hard through touching furniture and finishing material. Certain components of a material's personality are associated with its sensory attribute (Wastiels, Schifferstein & Wouters,…, 2013).
	Technology of Touching	Today, the touch-based technologies are already created mature programs to serve environmental needs, such as walls, floors, and ceilings (Pohl & Loke, 2012).

CHAPTER THREE: METHODOLOGY

Data Collection

The researcher used multiple data collection methods to answer research questions, including the physical environment observation of learning spaces and student survey. Multiple different data collection methods can help the researcher shed light on students' needs and expectations about learning spaces at the Chambers Library of the University of Central Oklahoma by producing robust evidence related to the participants' perspectives.

Setting

The Chambers Library is located in the mid-west of the UCO campus so that students, staff, and faculty can easily come to the library in less than ten minutes from any campus building. It is a four-story building. The first floor includes the learning commons (computer workstation clusters, information desk, and innovation studio), reading areas, group study areas, and staff offices. The second floor has library classrooms, reading areas and bookshelves (archives & special collections), group study areas, individual study areas, learning commons (computer workstation clusters), and offices. There are reading areas and bookshelves (main book collection, children's collection), group study areas, individual study areas, learning commons (computer workstation clusters), and offices on the third floor, and group study areas, individual study areas, learning commons (computer workstation clusters), and offices on the fourth floor.

As shown in Figure 16, the library provides students with four different types of learning spaces distributed throughout each level of the library for studying, meeting, reading, and searching materials: group study areas (public/together, private/together), individual study areas (public/alone, private/alone), learning commons (computer workstations, information desk, and

innovation studio) and reading areas (seating areas for reading and bookshelves). The majority of

computer workstation clusters and group study areas are located in the first and fourth levels.

The second, third and fourth floors provide more individual study areas (private/alone) and

reading areas with bookshelves. The fourth floor also offers abundant group study areas
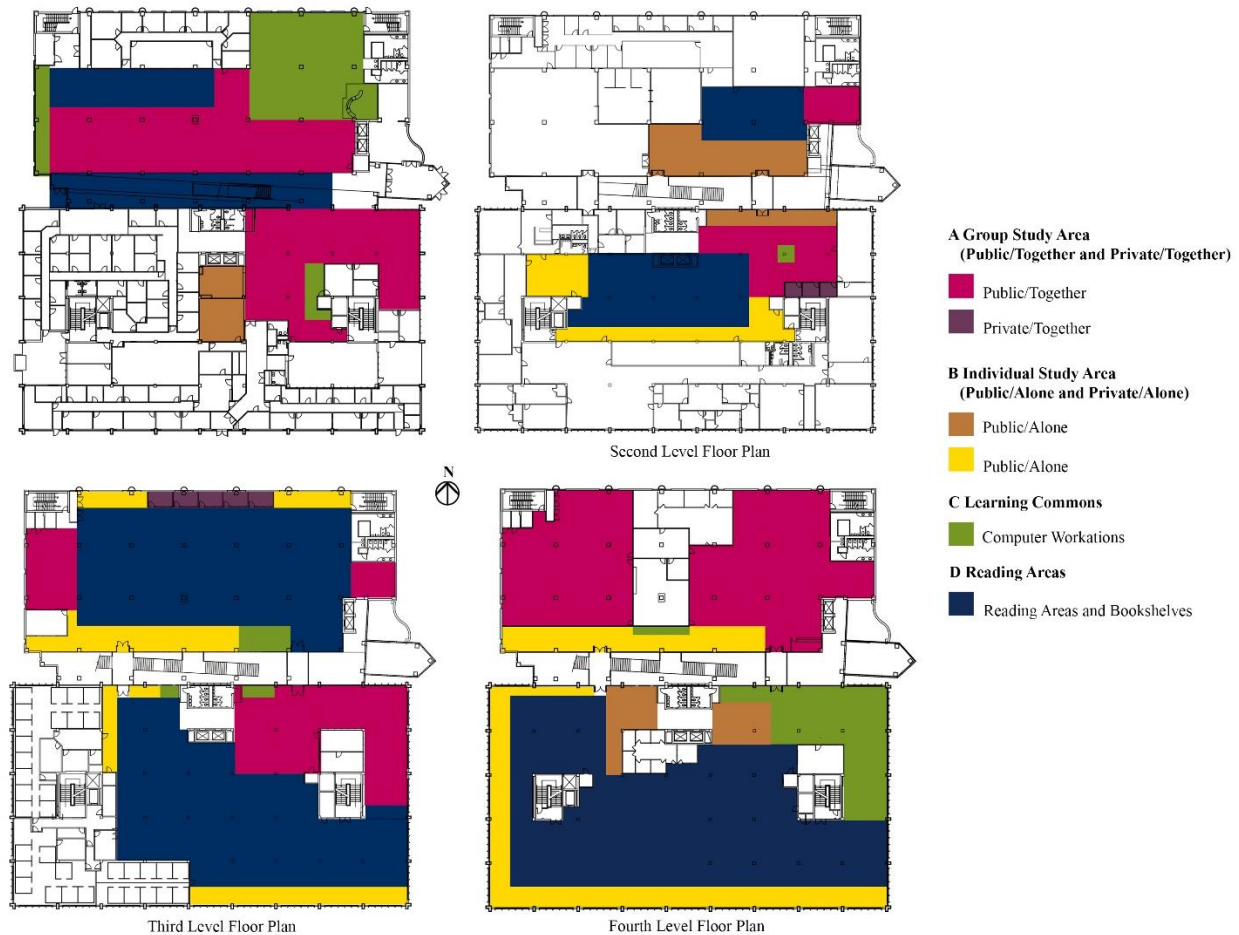
(public/together).

Figure 16. Color-coded zoning map of the UCO library

Samples

The target samples of this study were UCO students who have used the Chambers

Library learning spaces. The researcher randomly selected students in the library and handed out

174 paper surveys to participants. A total of 160 people participated in the survey and the

response rate was 92% (160/174). The survey participants were freshman (n=21, 13.1%),

sophomores (n=23, 14.3%), juniors (n=34, 21.3%), seniors (n=48, 30.0%), graduate students

(n=27, 16.9%), and others (faculty, alumni, and visitors, n=7, 4.4%). Through the data screening

process, the researcher excluded samples who did not answer most survey questions as well as

those who were not current UCO students. Eventually 146 respondents' answers were used for

data analysis.

Instruments

To collect the data, the researcher observed the physical environment of learning spaces,

tracked the space usage rate by checking the number of students who used each learning space,

and conducted the paper survey to ask students' needs, expectations, and satisfaction levels about

the library learning spaces.

The Physical Environment Checklist. The researcher developed a physical environment

checklist to collect data about furniture items, lighting fixtures, and finish materials of each

learning space (see Table 2). In the table, each zone represented a learning space type: A for

group study areas, B for individual study areas, C for learning commons, and D for reading

areas. From each learning space, detailed information on furniture shape/size/material, lighting

fixture type/lamp, and wall/floor/ceiling finish materials was collected with the use of this

checklist and a zoning map (Figure 16). In order to effectively organize the collected observation

data, the researcher created four sets of checklist tables (first to fourth floors) and added photos

of each category in the table. The checklist information was used for developing the survey

questionnaire and suggesting design solutions.

Table 2

The physical environment checklist for observation

| Zone | Learning Spaces | | Location | | Furniture | | | | | | | | Light fixture | | | Finish Materials | | | | | |
| | | | | | Seating | | | | Table/Desk | | | | | | | Floor | | Wall | | Ceiling | |
			North	South	Material	Shape	Size	Photo	Material	Shape	Size	Photo	Type	Lamp	Photo	Material	Photo	Material	Photo	Material	Photo
A	Group Study Area (GS)	Public/ Together (PUT)																			
		Private/ Together (PT)																			
B	Individual Study Areas (IS)	Public/ Alone (PUA)																			
		Private/ Alone (PA)																			
C	Learning Commons (LC)	Computer Workstation (CWC)																			
D	Reading Areas (RA)	Reading Areas (RA) Bookshelves																			

Table 3

The learning space usage rate checklist for observation

| Zone | Learning Spaces | | Photo | Location | | Library Open Hour and the Number of Students | | | | | | | |
| | | | | | | Morning (7:30–12:00) | | Afternoon (12:01-18:00) | | Evening (18:01–21:00) | | Night (21:01–2:00) | |
	Type			North	South	Date/Day/Time	Count	Date/Day/Time	Count	Date/Day/Time	Count	Date/Day/Time	Count
A	Group Study Area (GS)	Private/ Together (PT)											
		Public/ Together (PUT)											
B	Individual Study Areas (IS)	Public / Alone (PUA)											
		Private / Alone (PA)											
C	Learning Commons (LC)	Computer Workstation (CWC)											
D	Reading Areas (RA)	Reading Areas (RA) Book Stacks (BS)											

The Learning Space Usage Rate Checklist. The researcher also observed what areas were frequently used by students and what learning spaces students preferred in each level of the library. The usage rate checklist was developed to precisely and conveniently record the number

of students in each learning space (see Table 3). The checklist table enabled the researcher to

collect data during four different timeframes: morning, afternoon, evening, and night. Total four

sets of checklist tables were utilized to count the number of students for all levels of the library.

Survey Questionnaire. The survey questionnaire was developed to explore students'

needs, expectations, and satisfaction levels about the existing learning spaces of the UCO library.

The questionnaire (see Appendix I) is composed of five sections: 1) questions about

classifications of students, frequency and purpose of visiting a library, and the effect of learning

spaces on learning outcomes; 2) students' satisfaction levels with the physical environment

features of the overall learning spaces and preferred learning spaces for different types of

activities; 3) students' satisfaction levels with the use of group and individual learning spaces; 4)

students' satisfaction levels with learning commons and reading areas; and 5) students'

expectations about furnishing, lighting, finish materials, and aesthetics features of learning space.

Student responses were evaluated by using the 7-point Likert-type scale with one being "very

dissatisfied" or "far short of expectations" and seven being "very satisfied" or "far exceeds

expectations." Open-ended questions were used to ask students about suggestions to improve the

overall physical environment of learning spaces related to furnishing, lighting, finishing

materials, and aesthetic features. In addition, when collecting data, the researcher prepared the

survey questionnaire along with a visual handout including photos of learning spaces for helping

participants more accurately answer each question.

Procedure

The researcher first developed observation tools (a color-coded zoning map, a physical

environment checklist, and a learning space usage rate checklist), and then carried out

observations of furniture, lighting, finish materials, aesthetics, and technologies of learning

spaces. In each floor level, the researcher spent one to two hours to observe and take pictures of

the physical environment, and record detailed information on the checklist form for four days

during the 2018 fall semester. The researcher also checked the number of students who used each

learning space by visiting the library multiple times in the morning (between 7:30 am and 12:00

pm), afternoon (between 12:01 pm and 18:00 pm), evening (between 18:01 pm and 21:00 pm)

and night (between 21:01 pm and 2:00 am) during the finals week of the fall semester in 2018,

and the beginning and middle of the spring semester in 2019. It took approximately one hour to

collect data from all learning spaces. The collected data were sorted according to different types

of learning spaces and recorded in the Excel table.

  After finishing the observation, the researcher developed the survey questionnaire based

on observation findings and literature review information. The questionnaire was revised through

the expert review process to avoid confusion and bias and make it clear for helping respondents

to answer easily. To conduct a survey with students, the researcher completed the Collaborative

Institutional Training Initiative (CITI) online training that concerns the protection of human

subjects, and then applied for institutional Review Board (IRB) review. The IRB determined that

this project is not human subjects research and aimed at generalizing the data, so eventually IRB

review was not required for collecting survey data. Instead, the researcher contacted the

exclusive director of the UCO library and explained the purpose of the research to get permission

for conducting a paper survey with students.

  After getting the permission letter, the researcher started to visit the library and randomly

selected students to hand out the survey questionnaire. The selected students were first asked

whether or not they could participate in the survey, and if they agreed, the researcher explained

the purpose of the research, information about the survey questions, and the use of a visual

handout including photos of each learning space to answer each question, and requested them to

read the informed consent form. The survey forms were handed out to ten random participants at

a time. During the survey, the researcher left the site, and once the survey was done, participants

left them on the table or the researcher came back to collect them directly. Students who

participated in and finished the survey received a bookmark as an incentive. The survey data

were collected for seven days from the finals week of the spring semester to the beginning of the

summer semester, 2019.

Data Analysis

The researcher collected the data from the physical environment of learning spaces in the

UCO Library by taking photos, sketching furniture, measuring furniture, and observations. The

collected data of physical environment facilities including furniture, finishing materials, lighting,

and aesthetics were recorded using Microsoft Word and Excel. Photos were categorized

according to all learning spaces as well as facilities of physical environment observations by

Adobe Photoshop. Overall these sources and information were used to analyze the existing

learning spaces of UCO Library. The collected data from in-person surveys were then put in

Microsoft Excel, and then the Excel sheet was imported into IBM SPSS software to produce

descriptive statistics data information including Mean, Standard Deviation, and Frequency. Other

open-ended questions were recorded into Microsoft Word and Excel files. All data collection

were used to design alternatives.

CHAPTER FOUR: RESULTS

In this chapter, the research findings which include three parts will be presented and discussed: the first part is about the findings of facilities observations of learning spaces; the second part is about the findings of rate of learning spaces usage; the last part is about findings of in-person surveys with various participants.

Observation Findings

Observation of the Physical Environment Features

The Chambers Library at the University of Central Oklahoma (UCO) is a four-story building. Each level of the UCO library consists of an area of 52,250.26 sf, with a total of 209, 001.04 sf sf. The large spaces are not merely for learning, but they also contain offices and other public spaces. Indeed, each level has specific areas for learning. From fall 2018 to spring 2019, the researcher observed several features of learning spaces for study needs. For more accurate recording of the information, the researcher used physical environment checklist and a color-coded zoning may to collect the observation data from the first to the fourth floor. This is a huge process of data collection as the researcher spent eight weeks at the UCO library with an average of two hours each day. The researcher observed the physical environment of learning spaces facilities of learning spaces, including location, space planning and layout, aesthetics, furniture, lighting, and finishing materials. The researcher also took photographs to record the details of features.

According to the learning space distribution in the literature review, 39 different locations of existing learning spaces at the UCO library could be integrated into four types of learning spaces: Group Study Areas (public/together (PUT) and private/together (PT)), Individual Study Areas (public/alone (PUA) and private/alone (PA)), Learning Commons (LC), and Reading

Areas (RA). The purpose of this latter was to reorganize those chaotic learning spaces, and

further to use those categories for investigations and design suggestion. Each floor is divided into

north and south areas connected by corridors. When people stand on the corridor, they can

overlook the first level. There are many areas in each level north and south, but the usage rate of

the learning spaces is totally different. Offices take up most of the areas, for instance, the

learning areas of the second floor has the lowest usage rate in the entire learning spaces; the third

floor has the largest book collections, and the fourth level has the largest group study spaces and

individual study areas. Thus, the learning spaces random distribution and irregular spatial

division are serious issues in the library.

According to observations and measurements of the physical environment and facilities

of learning spaces, the total sgares footage of the learning spaces 102, 656.9 sf, which is 45% of

the entire library areas. As shown in Figure 17, among the learning spaces, group study areas

include 35% of areas, which include PUT and PT areas. Individual study areas take up 15% of
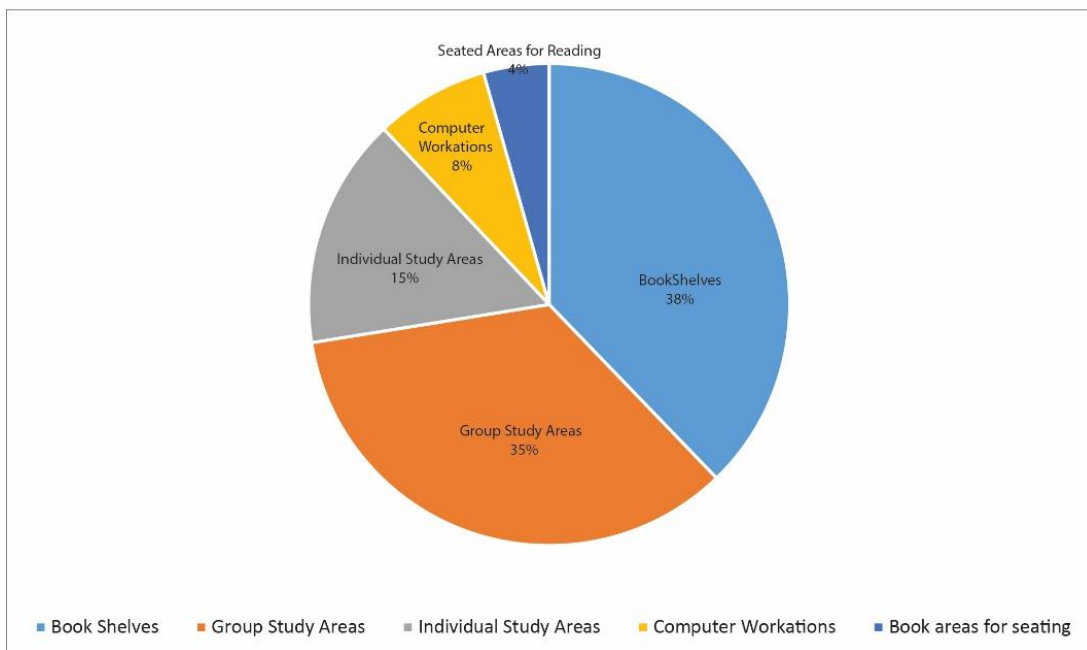
Figure 17. Percentage of different types of learning spaces in the UCO library

students' private study areas because they include PUA and PA areas. For this study, the

researcher has focused on students' needs and expectations of computer workstations of

Learning Commons (LC), totalling 8% of areas of the entire learning spaces that can be used for

computer studying. In addition, the UCO Library has extensive physical book collections; its

Reading Areas (RA) include reading spaces and bookshelves; 38% of all spaces are filled with

bookshelves that are even larger than group study areas; 4% is real reading spaces for students

sitting to read in the entire learning spaces. In fact, Broz (2011) suggested libraries' space should

be allocated 50 percent seating and 30 percent collection.

      In the modern education library environment, learning spaces provide as much flexible

space as possible to meet students' needs, whether open or enclosed areas are a unified

combination. Students can easily find spaces where they meet friends or use for collaborative

and private study since orderly, distributed spaces enable students to quickly immerse in their

activities. Furthermore, during study activities, good visual and sound privacy can be extremely

effective. At the UCO library, most learning spaces are open and combined with each other, so it

is hard for users to avoid disturbing different study activities. For example, the layout of learning

spaces in the first level in group study areas, reading areas, and computer workstations are very

close to each other. Additionally, there is no sound or visual privacy, and there is no clear

circulation route to guide students to their destinations. As a result, people have to walk for a

while through group study areas to finally access the reading places.

      Corridors, circulation paths, hallways, and clearance spaces around the furniture are wide

enough to accommodate wheelchairs and walk side-by-side, but due to the random placement of

furniture, several spaces are not wisely used. There are two main entrances (east and south

doorways) to enter the learning spaces of the library. Because of construction, the south doorway

is too narrow and crowded during traffic peak. The main corridors also adjoin elevators and

offices between learning spaces; hence, the noise caused by people walking, talking, as well as

the vending noise ruin the learning atmosphere. Good wayfinding plans in the library

environment reduce disorientation and limit confusion. However, most of learning spaces do not

have region signage and also do not have specific wayfinding cues. People only follow the paper

sign that stands on each table or the sign on the side table to understand in which learning spaces

they are. In order to access the learning spaces, wayfinding is necessary for students to quickly

find their destination, which helps them save a lot of time.

   Lighting issues might be one of the paramount parts of facilities in the learning spaces.

Natural light is not the main illuminant at the UCO library. Thus, it needs artificial light to

balance with daylight to make the uniform light level beneficial to student learning activities.

Indeed, the light fixtures are indirectly suspended linear fluorescent/LED fixture light,

fluorescent/LED, Pendant lights, and task lights. These luminaires are mostly general lighting. In

other words, this general lighting cannot meet every learning activity need, especially some

individual learning areas against the wall that do not have adequate ceiling light to support

students' learning. These monotonous lighting fixtures merely meet the functional requirement,

but it is not enough. The lighting scheme should also provide multiple lighting levels to facilitate

the needs of different learning activities, and need to consider contributing to the aesthetic

enjoyment of the library.

   Looking around the entire library, most of the floor finishing of the learning spaces is

covered by dark gray pattern carpet which is good for noise reduction, but having the same

carpet everywhere inevitably makes people feel a little bored. Most wall materials of learning

areas are mostly painted in white color to make the space look larger and to give an impression of a clean environment. The white color, nevertheless, makes students have an aesthetic fatigue.

Furniture is another important component of learning spaces. If learning spaces are without furniture, they will be invisible. The library furniture is not only functional for students' use, but it also display aesthetics to complement surroundings and attract satisfied users. The tables and the chairs of the library should be flexible in the sense that they can stand alone for users and can accommodate for socialites, who can move them together for group discussions (AGATI Furniture, 2017).

Group Study Areas: Public/Together. Group study areas are the largest learning spaces for students' seating. They are one of the most popular areas in the library for students studying and socializing with each other. PUT study areas are completely open spaces where students do not have to pay attention to other surroundings to collaborate or socialize. Usually PUT study areas are louder in the evening than they are in the daytime. There are a total of 99 sets of tables and chairs to service PUT study areas, and 13 sets of sofas and coffee tables are distributed from the first to the fourth floor. Most of these chairs have the same shape, materials, and size, and have wood structure with upholstery. One type of chair is a rocking chair that makes students afraid of falling down when they sit on them. These chairs which are without casters are too heavy to move. Wooden chairs are a little bit bigger when students sit on them, especially to use them for writing. Consequently, users may feel back pain and discomfort. These chairs also do not fit the learning needs of users. Similarly, other chairs with wheels still are not suitable for learning because the height cannot be adjusted to fit tall students. Students suggested in the survey "open-ended questions" they hope the library would add more moveable adjustable chairs in the learning spaces.

Table 4

Observation findings of the physical environment and sensory design features in Public/Together study areas

Areas: 34,718.5sf^2

Checklists	Type
Space Planning	Complete opened spaces, Circulation space, Enough clearance around furniture and corridor, Adjacent to elevators, public corridor, offices and restrooms, No cues for wayfinding
Finish Materials	Floor: Dark gray carpet Wall: Paint Ceiling: Paint, Acoustic ceiling tile
Furniture	Total 99 sets of group chairs around tables, 13 sets of sofa with coffee tables
Lighting	Direct light & linear troffer with len, Direct suspended linear fluorescent / LED light fixture, Pendant light
Sensory Design	Simple aesthetics, repetitive floor finishing materials and paint wall, Simple light without change, Barely using technology using, Not much visual connection with nature like plants

Image

First Level   Second Level   Third Level   Fourth Level   Fourth Level (MAX Room)
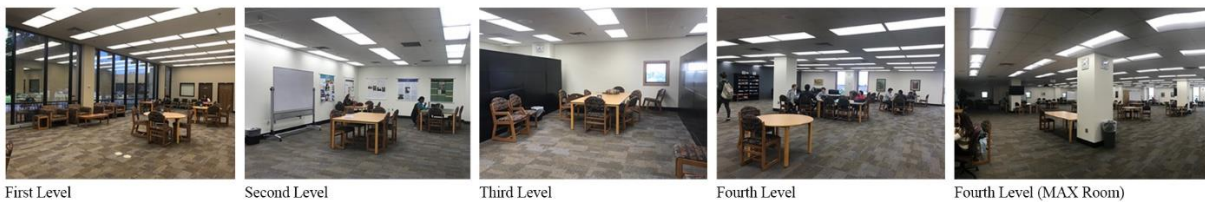
As shown in Table 4, the tables in the PUT study areas have nine different types with different colors. In fact, the variety of these tables directly cause a visual clutter and an aesthetic fatigue in that the different measurements of tables do not have a uniform layout in the limited place and produces a crowded and chaotic space. Some rectangular tables are 5 feet wide and 7.6 feet long. They far exceed teamwork scope since circle tables are adaptable to team discussions.
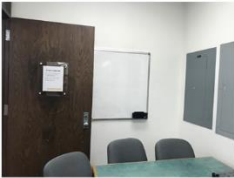
Some other tables are about 5 foot long, which are inconvenient for both group and individual use. Another complicated type of crossed tables is very unsuitable for students. Therefore, these tables might hurt students' legs and offer no space to give them the freedom to place their legs. Because laptops, tablets, and smart phones are necessary supplies for learning, the furniture should be compatible with technology and include charging plugs, USB ports, and power outlets (AGATI Furniture, 2017). Its purpose is that users can easy charge their devices rather than users looking around for power sources, and then long wires spread out from the wall to tables. Thus, some tables are not used because they are far away from power supply ports.

   Group Study Areas: Private/Together. The PT study areas are enclosed to mitigate sound with multiple technology rooms for small group meetings (Steelcase, n.d; & Andrew & Wright, 2015). As shown in Table 5, the function of PT group study areas at the UCO library is basically to meet the requirements from literature review, but the layouts, aesthetics, and facilities selection of PT study areas are not enough to reflect the characteristics of a modern library due to furniture obsoleteness, non-acoustic measures, and simple artificial lighting. Eight enclosed PT group study rooms are good for students' collaborative study with private space, including configured whiteboards and TVs. Nevertheless, the height of the TV is higher than the eye visual angle; hence, users have to look up at the TV, which might lead to neck soreness. Furthermore, the ceiling troffer light reflects on the TV screen, which ruins the visual effect. Another PT study room has a wide pillar between two big windows that cause this small room to feel more crowded; it could not accommodate a standard group study table (2.1x3.1ft), so users find it difficult to access this room. Because these rooms lack good sound privacy during group discussions, the sounds and noises might bother students who are learning in neighbor rooms. Obviously, libraries should pay attention to some details related to noise, especially in enclosed

learning spaces. When opening or closing the door, this latter usually makes a loud noise that

frightens users who are trying to concentrate on their studies. PT study rooms have a good

control of lighting system to save energy, but the lights turn off automatically at regular

intervals, so users have to wave their hands to turn on the light again, which is not convenient for

long-term studies.

Table 5

*Observation findings of the physical environment and sensory design features in
Private/Together study areas*

Areas:900sf^2

Checklists	Type
Space Planning	There are 8 enclosed rooms for group private study, Three study rooms connect on the second floor, other five study rooms on the third floor, Adjacent to public corridor and book shelves, No cues for wayfinding
Finish Materials	Floor: Dark gray carpet Wall: Paint Ceiling: Acoustic ceiling tile
Furniture	Total 8 sets of group chairs around tables
Lighting	Direct suspended linear fluorescent / LED light fixture
Sensory Design	Simple aesthetics, repetitive floor finishing materials and painted wall, Simple light without change, TV and white board available, Not much visual connection with nature, like plants
Image	

Second Level   Third Level

   Individual Study Areas: Public/Alone. These existing study areas actually do not have a

clear name. According to observations and surroundings, the researcher speculated that they are

supposed to be PUA study areas. According to literature review, PUA study areas allow students

to work, interact, and switch from individual to collaborative studying. But another PUA study

area on the first level of the library of the Chambers Library is a good example of a semi-closed

individual study place. This study zone was redesigned 2 years ago, so their facilities and

aesthetics are newer than other learning spaces; for example, the study tables connect to charging

plugs, and USB ports are conveniently available for students to use, especially when they bring

their electronic devices. Good movable adjustable chairs around the tables in the PUA study area

allow adjustment for height and angle sitting. But designers also should consider how limited

space can accommodate a 4' by 8' table with 6 chairs on the corner, which make it very difficult

for users to walk through the furniture. Study carrels are good for students' privacy. They,

therefore, can accommodate either group or individual study. Carrels are also combined with

power supplies. The individual lounge seating with tablet arm provides a convenient work

surface, and casters mobility accommodate multiple functions for casual conferencing among

students.

   Other PUA study areas are distributed scatteredly in the second and the fourth floor of the

library. As shown in Table 6, Simple circle and rectangular tables with heavy wooden chairs

constitute PUA study areas. The researcher found the study areas of the PUA to meet the

functions of the public social learning, but they do not accommodate private use. In other words,

PUA study areas basically keep traditional furniture layouts, but they do not considering users'

needs such as whether or not these areas have good sound and visual privacy, and whether their

furniture is flexible and aesthetically pleasing.

Table 6

Observation findings of the physical environment and seonsory design features in Public/Alone study areas

Areas: 4432.6sf^2

Checklists	Type
Space Planning	Semi-closed individual study place, and open group study places, Circulation space, Enough clearance around furniture and corridor, Adjacent to public corridor, main entrance, some places next to the elevator, No cues for wayfinding
Finish Materials	Floor: Dark gray carpet Wall: Paint Ceiling: Paint, Acoustic ceiling tile
Furniture	5 sets of lounge armless chair with tables, a set of rectangle table with office chairs, Somes tables connect to charging plug, and USB ports
Lighting	Direct suspended linear fluorescent / LED light fixture, Pendant light, Task light
Sensory Design	Simple aesthetics, repetitive floor finishing materials, the wall of some places are colorful paint, Simple light, Little technology available, Not much visual connection with nature, like plants
Image	

First Level　　　　Second Level　　　　Fourth Level

Individual Study Areas: Private/Alone. PA study areas are quiet, private places for student learning (see Table 7). The open PA study areas are relatively hidden, and are usually around the perimeter of the learning spaces and against the walls. Most of them are far away from the elevator, so noise barely disturbs students' learning. PA study areas are close to

Table 7

Observation findings of the physical environment and sensory design features in Private/Alone study areas

Areas: 11459.44sf^2

Checklists	Type
Space Planning	Relatively hidden and opened, and usually around the perimeter of learning spaces and against the walls, Far away the elevator, close to book shelves, Adjacent to public corridor, No cues for wayfinding
Finish Materials	Floor: Dark gray carpet Wall: Paint, Brick Ceiling: Acoustic ceiling tile
Furniture	Total 166 sets of carrel desks with office chairs, 4 sets of single table with offices chairs
Lighting	Direct suspended linear fluorescent / LED light fixture
Sensory Design	Simple aesthetics, repetitive floor finishing materials and painted wall, Simple light without change, Little technology available, Not much visual connection with nature, like plants
Image	

Second Level   Third Level

Fourth Level

bookshelves; thus, these individual silent zones can be used for reading books, but their furniture

is not cozy. The carrel desks are very simple pieces of furniture. However, they can visually

isolate its user from surroundings either partially or totally. If the student brings a laptop to the

carrel desk, the countertop of the desk will be crowded to place other books. There are power

outlets on the wall that are very convenient for the students to use with electronics. Hardly

noticeable decorations are displayed in the PA study areas, so the study atmosphere is simple.

Because mostly PA zones are against the wall, the general lighting like ceiling troffer lighting

fixtures cannot offer adequate brightness to meet the student's learning. Consequently, many PA

zones are rarely being used. Randomly arranged furniture in the PA study areas is another layout

issue. For example, on the fourth floor, there are 75 sets of carrel desks around the border of

27,791sf learning spaces. In other words, if students walk around this individual study place, they

might need to take more than 5 minutes.

   Learning Commons. The first level consists of large open learning commons (LC); these

areas mainly include computer workstations and innovation studios (see Table 8). Other learning

commons, like electronic classrooms and the academic support writing center, are not a target in

this research; therefore, for this study, the researcher focused on studying the students' needs and

expectations of computer workstations within learning commons. There are 24 sets of carrels, 12

sets of public office tables, and 3 sets of individual tables with computers in the computer

workstations on the first level. In addition, the second and third levels have the largest

distribution of books, and have 10 sets of individual computer carrels, mainly for students to

search for materials from the website. However, on the fourth floor, these computer workstations

are mostly dominated by multiple media use with an electronic piano. The total computer

workstations constitute 12% of the entire learning spaces. Carrels are the main types of furniture

in these workstations. As far as the first level, computer workstations are located in the best

position; not only do they have a relatively independent space, but they also have adjoined

windows with plenty of natural light. Good natural light can increase students' energy and

Table 8

Observation findings of the physical environment and sensory design features in computer workstations of learning commons

Areas: $7857sf^2$

Checklists	Type
Space Planning	Complete opened spaces, Circulation space, Enough clearance around furniture and corridor, Adjacent to elevators, public corridor and restrooms, No cues for wayfinding
Finish Materials	Floor: Dark gray carpet Wall: Paint Ceiling: Acoustic ceiling tile
Furniture	Total 34 sets of carrel desks with office chairs, 12 sets of public office tables and 22 sets of individual tables
Lighting	Direct light & linear troffer with len, Direct suspended linear fluorescent / LED light fixture
Sensory Design	Simple aesthetics, repetitive floor finishing materials and painted walls, Simple light without change, Computers using, natural light from 6 windows on the wall with good view

Image

First Level   Second Level   Third Level   Fourth Level

affect people's learning abilities, but when students face the windows when using computers, the skylight is sometimes too bright, which can disturb the users' eyes while looking at screens. The computer occupies most countertops of the 2.11 wide feet carrel to cause insufficient space for use. The dark wood veneer carrels make the environment look dim. PUT and LC do not have

clear borders, so group discussions might bother individual who are working in the computer

work and distract the users in some reading areas.

Table 9

Observation findings of the physical environment and sensory design features in reading areas

Areas: $43289.36sf^2$

Checklists	Type
Space Planning	Reading area with seats and book shelves constitute reading areas, The area of sitting reading areas is 4508 sf2, The area of book shelves is 38781.36 sf2, Open reading areas with seats between book shelves, Circulation space, Adjacent to public corridor, book shelves are neatly arranged in a row, No cues for wayfinding
Finish Materials	Floor: Dark gray carpet Wall: Paint Ceiling: Acoustic ceiling tile
Furniture	Total 34 sets of carrel desks with office chairs, 12 sets of public office tables and 22 sets of individual tables
Lighting	Direct light & linear troffer with len, Direct suspended linear fluorescent / LED light fixture
Sensory Design	Simple aesthetics, repetitive floor finishing materials and painted walls, Simple light without change, Computers available, Natural light from 6 windows on the wall with good view

Image

First Level   Second Level   Third Level

Fourth Level

Reading Areas. Some learning spaces make the researcher confused at the UCO library; for example, the library does not define the specific name for this learning space, but it is next to book stacks and display single furniture for individual study (see Table 9). Also it was arranged in the open group study area, which shows that this study zone should belong to reading areas (RA). Even though it is not perfect for all the standards of a reading area, it meets a reading function. Identifying each zone of learning spaces is easy for the researcher to investigate and collect data for the study. Another periodicals reading place is next to the corridor, and it is located in another group study zone as well. People passing the hallway and intense group discussions might disturb readers. Accordingly, the reading areas should be quiet. The rest of the reading areas are either randomly scattered around certain corners or not precisely located. A good ideal of the reading area is observed in the third floor in which a set of reading zones are between book stacks with soft couches and coffee tables. Students leisurely enjoy reading outside the class. The researcher encourages the library to extend areas of reading spaces so as to meet student's reading needs such as flexible and comfortable furniture, suitable artificial light, comfortable daylight use, and friendly atmosphere. Actually, the UCO library does not offer many specific places for reading; merely 8% of the entire learning spaces are suitable for reading.

Observations of the Number of Students in Learning Spaces

During the three periods (beginning, mid-term, and final week of two semesters) designated for observation from morning to midnight, the data was collected about the number of students who were using the different types of spaces, as the main purpose of the research was to identify what types of learning spaces students prefer and value.

It is important to note that the UCO library offers 99 sets of tables and chairs and 13 sets of sofas and coffee tables for servicing public groups /together study, 8 group private/together

study rooms, 30 sets of tables with chairs for individual public/alone study, 166 individual study

carrels, 4 sets of single tables with 4 office chairs for individual private/alone study, and 68

computer workstations. In fact, there is a total of 34 sets furniture to service students.

The usage frequency for each type of learning spaces and average of number of students

is shown in Table 10.

Table 10

Observation of number of students in learning spaces

Period / Location	Final Week (December 2018)					Beginning (January 2019)					Mid-Term (March 2019)				
	7:30-12:00	12:01-18:00	18:01-21:00	21:01-2:00	Total	7:30-12:00	12:01-18:00	18:01-21:00	21:01-2:00	Total	7:30-12:00	12:01-18:00	18:01-21:00	21:01-2:00	Total
Public/Together (PUT)	83	182	218	195	678	38	39	40	37	154	61	74	79	58	272
Private/Together (PT)	12	34	22	23	91	5	6	6	7	24	1	18	20	17	56
Public/Alone (PUA)	27	51	32	31	141	16	12	7	6	41	11	17	16	15	59
Private/Alone (PA)	24	52	44	62	182	13	13	21	4	51	21	20	13	12	66
Learning Commons (Computer Workstation CW)	26	63	46	50	185	22	17	22	18	79	17	19	17	22	75
Reading Areas (RA)	6	20	14	11	51	4	1	2	1	8	3	3	2	2	10

Table 10 shows different periods each learning space was being utilized by students. The

beginning of the semester was marked by a lower usage rate of each learning space; however,

finals week had peak attendance, and the difference of the usage rate is also revealed in each

time of each period of the semester in the learning spaces. The usage rate of evening time (18:01

to 21:00) was the highest, while the morning time (7:30 to 12:00) usage rate was the lowest,

whether it was finals week, beginning of the term, or mid-term. In these learning spaces, the

most sought after space was public/together (PUT) study areas. As shown in Table 10, PUT

study areas were the most frequently used of all spaces, although in the beginning of the term,

PUT study areas still had a higher usage rate than other learning spaces. Furthermore, in the final

week, almost 58% of students who were observed were using that space during evening times of

the final week in which this data was collected. Significantly, over 47% students were using the

computer workstations of the learning commons. The fourth most sought out study area was

slightly less than the third. Even though the busy final week evening was supposed to be the

busiest time, the reading areas had the lowest attendance (4%). The third most sought out

learning area was public/alone (PA) study areas (12%), closed computer workstations (CW), and

Private/together (PT) study area with 6% of the usage rate.

The results obtained from collected data clearly demonstrate that the students observed

preferred the PUT study areas where they can study collaboratively. The public/together study

areas dedicated for group work and socialization were utilized by 50% of students inside the

learning spaces of the library. The public/together study areas occupied most areas of learning

spaces, but this did not mean that this was the space that students valued the most because of the

uneven spatial distribution in the entire learning spaces. Thus, the library should think about

reorganizing and balancing these spaces to better accommodate the students who use them.

The computer workstations were mainly distributed on the first level so that they might

be easy for students' use. The area of computer workstation is not as large as the PUT study

areas, but their utilization rate were not less than the PUT study area. In the beginning of the

week, the utilization rate of the computer workstations was 22%; the utilization rate of the final

week was 14%, which was the same as that of the mid-term. Because the reading areas are the

smallest spaces for students' reading and studying at the UCO Library, they could not

accommodate a lot of users, but in the final week, the reading areas were busier than the

beginning week and the mid-term.

   As shown in Table 10, the overall grouping for destinations related to space was

definitely the public/together study areas, especially during the final week. The second most

popular learning spaces were the learning commons (computer workstations), and the third most

popular were the private/alone study areas. The usage rate of public/together study areas was

sharply higher than the second sought out areas; other areas have similar number of students'

attendance. PT study areas were only enclosed spaces for student private together study. Based

on several observations, students preferred those enclosed rooms, which were almost full in the

afternoons and evenings of the mid-term and final week.

Survey Findings

   In this section, the results obtained from the survey data collection method will be

presented and discussed. A total of 146 samples were used to analyze students' satisfaction

levels with and expectations about the existing learning spaces of the UCO Chambers Library.

Frequency and Purpose of Library Use
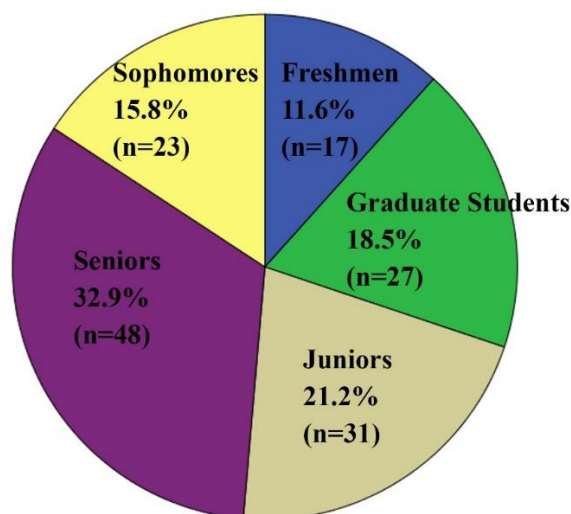
Figure 18. Classification of survey participants
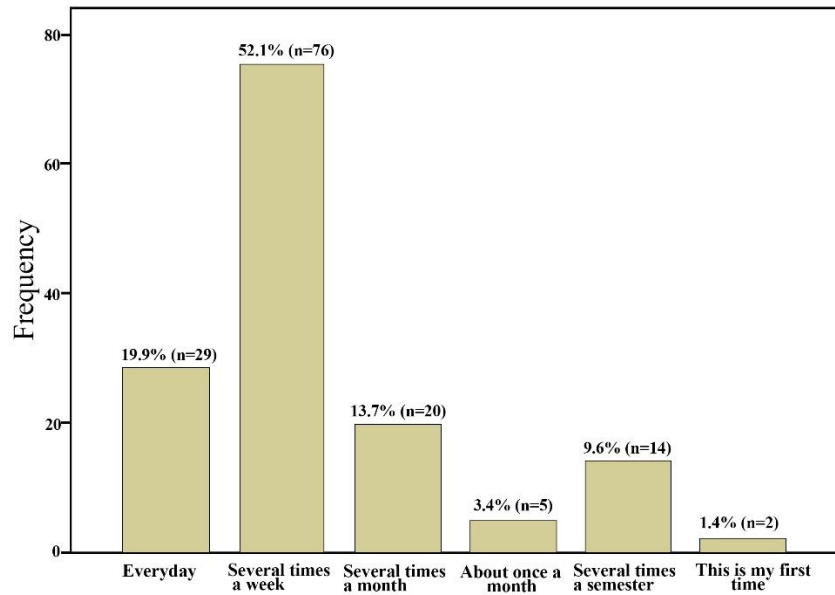
Figure 19. Frequency of library use
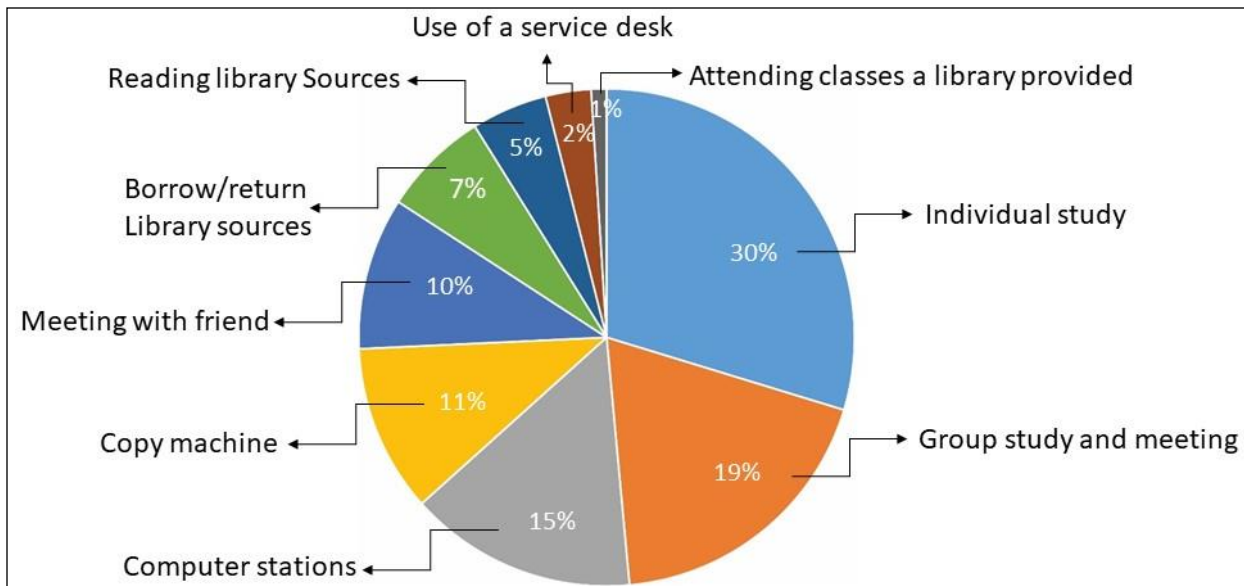
Figure 20. Purpose of library use

The researcher randomly selected students in the library and handed out 174 paper

surveys to participants. A total of 160 people participated in the survey. Eventually, of the

students who answered the questionnaire, 146 were used (see Figure 18), 32.9% of them (n=48)

were seniors, 21.2% were juniors (n=31), 18.5% were graduate students (n=27), 15.8% were

sophomores (n=23), and 11.6% were freshmen (n=17). Most respondents frequently used the

UCO Chambers Library as shown in Figure 19. As shown in Figure 20, the major purposes of

visiting to a library were for individual study (30%), group study and meeting (19%), and use of

computer stations (15%). Students also used the library for copy machine (11%), meeting with

friends (10%), borrow/return library sources (7%), reading library sources (5%), use of a service

desk (3%), and attending classes a library provided (1%).

Preferred Learning Spaces

The respondents chose one or two learning spaces which they frequently used for

different types of activities, such as individual study, collaboration and communication,

socialization, entertainment, reading library materials, searching information, and

printing/copying materials. As shown in Table 11, students preferred both individual study areas

and group study areas, especially private/alone study areas (Type 4) and public/together study

Table 11.

Finding about preferred learning spaces for different types of activities

Activities	Type of the Learning Space						
	Group Study Areas		Individual Study Areas		Learning Commons	Reading Areas	None/Never Used
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	
Individual Study	50 (24%)	12 (6%)	38 (19%)	67 (33%)	22 (10%)	12 (6%)	5 (2%)
Collaboration & Communication (Group Study, Group Work)	75 (42%)	52 (29%)	17 (10%)	6 (3%)	11 (6%)	4 (2%)	15 (8%)
Socialization (Meeting with Friends & Other Students)	79 (45%)	26 (15%)	12 (7%)	9 (5%)	14 (8%)	8 (5%)	27 (15%)
Entertainment (Playing Games/Hearing Music/Watching Movies, etc.)	29 (17%)	14 (8%)	19 (11%)	29 (17%)	20 (12%)	8 (4%)	54 (31%)
Reading Library Materials	21 (13%)	5 (3%)	29 (17%)	33 (20%)	11 (7%)	22 (13%)	45 (27%)
Search for Information	30 (18%)	11 (7%)	18 (11%)	29 (17%)	34 (20%)	5 (3%)	40 (24%)
Print/Copy Materials	32 (22%)	5 (3%)	3 (2%)	8 (6%)	44 (30%)	4 (3%)	50 (34%)

Note: Type1 (Public/Together) / Type 2 (Private/Together) /Type 3 (Public/Alone) / Type 4 (Private/Alone)

areas (Type 1) for their individual study work. However, they frequently used group study areas (both Type 1 and 2) for collaboration, communication, and socialization. In other words, learning spaces were frequently used by students for their individual study, group meeting and study, and socializing with other students.

Students preferred individual study areas (both Type 3 and 4) in addition to reading areas for reading library sources. For searching information and printing or copying materials, they used learning commons. One interesting finding was that students more frequently used public/together study areas (Type 1) and private/alone study areas (Type 4) for playing games, hearing music, or watching movies than the learning commons. The findings also showed that many students never used learning spaces for several activities such as entertainment, reading materials, searching information and printing/copying materials.

Satisfaction with the Overall Physical Environment Features of Learning Spaces

As shown in Figure 21, the overall physical environment features of the UCO library learning spaces reached the satisfaction level (M > 5). The index of the highest satisfaction level is "space planning and layout" (M=5.76, SD=1.08), whereas the one of the lowest satisfaction level is "aesthetics" (M=5.40, SD=1.36). These findings indicated that the majority of students are somewhat satisfied with overall space layout, wayfinding cues, furniture, lighting, finish materials, aesthetics features, and technologies of the existing learning spaces.

Even though students were somewhat satisfied the overall physical environment of learning spaces, a large percentage of respondents answered that some features did not reach their satisfaction level (see Table 12). For instance, more than 20% of students (gray color on the table) were not satisfied with aesthetics (27.4%), finish materials (24.8%), the type, size, and arrangement of furniture (24.1%), and technology (21.2%) of learning spaces. In addition,

although the lighting has an important influence on student learning and studying, 18.6% of

students responded that they were not satisfied with the illuminance level, lighting control and

type of lighting in learning spaces.

Figure 21. Satisfaction level with the physical environment features of learning spaces (n=146)

Even though students were somewhat satisfied the overall physical environment of

learning spaces, a large percentage of respondents answered that some features did not reach

their satisfaction level (see Table 12). For instance, more than 20% of students (gray color on the

table) were not satisfied with aesthetics (27.4%), finish materials (24.8%), the type, size, and

arrangement of furniture (24.1%), and technology (21.2%) of learning spaces. In addition,

although the lighting has an important influence on student learning and studying, 18.6% of

students responded that they were not satisfied with the illuminance level, lighting control and

type of lighting in learning spaces.

Table 12

A valid percentage of the satisfaction level with the physical environment features of learning spaces (n=146)

Physical Environment Features	Satisfied Level Valid Percentage (%)						
	Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied
Space Planning and Layout	0.0	1.4	4.1	6.2	15.2	51.7	21.4
Wayfinding	0.0	1.4	7.7	8.4	18.9	36.4	27.3
Furniture (Type/Size/Arrangement)	0.7	3.4	9.0	11.0	11.7	36.6	27.6
Lighting (Illuminance/Control/Type)	0.7	2.1	6.2	9.6	11.0	37.0	33.6
Finish Material (Floor/Wall/Ceiling)	0.0	0.7	4.8	19.3	11.0	37.2	26.9
Aesthetics (Color/Shape/Plants/Art installation)	0.7	1.4	7.5	17.8	17.1	30.8	24.7
Technologies (Touch screen/TV/ Multimedia)	0.0	3.5	6.4	11.3	15.6	36.2	27.0

Satisfaction with the Physical Environment Features of Different Types of Learning Spaces

As shown in Figure 22, regardless of types of learning spaces, students were somewhat satisfied with sound and visual privacy, location, furniture arrangement and size, lighting level, equipment and supplies and aesthetics features of learning spaces. However, satisfaction levels with sound and visual privacy and aesthetics features were lower than those of other categories. Students especially showed the lowest satisfaction level with the sound privacy (M=4.9, SD=1.62) of learning commons. This result was supported by findings related to a valid percentage of the satisfaction level with different types of learning spaces (see Table 13): 41.5% of respondents were not satisfied with sound privacy of learning commons. Another interesting finding was that students showed a lower satisfaction level with furniture arrangement and size as well as equipment and supplies of reading areas, compared to other learning spaces.
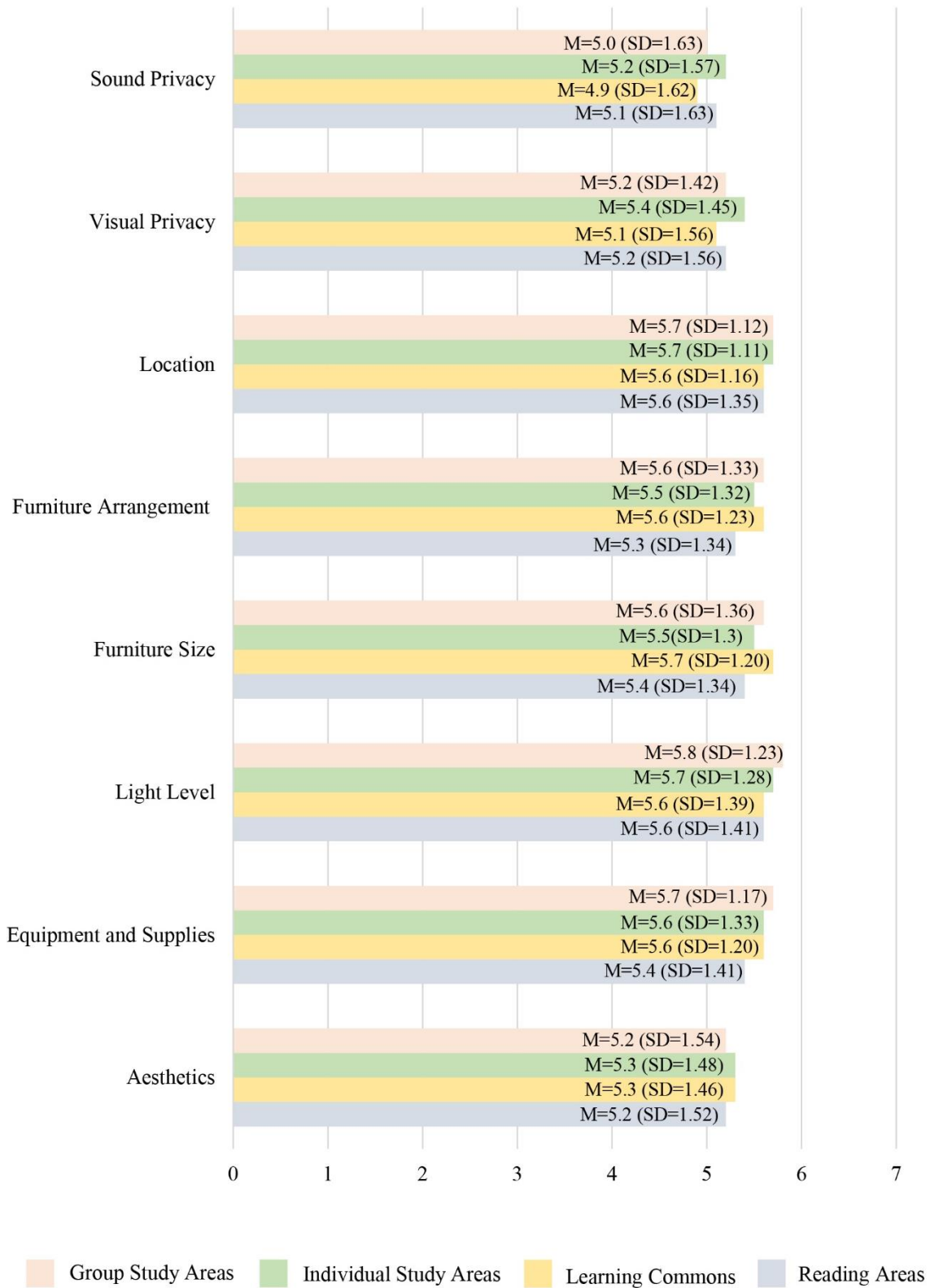
Figure 22. Satisfaction with the physical environment feature of different types of learning spaces (n=146)

Table 13

A valid percentage of the satisfaction level with different types of learning spaces (n=146)

Learning Spaces	Features	Satisfied Level Valid Percentage (%)						
		Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied
Group Study Areas	**Sound Privacy**	3.5	6.4	7.8	16.3	17.0	31.2	17.7
	Visual Privacy	1.4	4.3	6.4	17.0	24.1	29.8	17.0
	Location	0.0	0.0	2.9	18.2	8.0	46.0	24.8
	Furniture Arrangement (Clearance/Flexibility)	0.7	2.8	4.3	12.1	17.0	36.2	27.0
	Furniture Size (Table/Desk/Seating)	1.4	1.4	6.4	10.6	13.5	39.0	27.7
	Light Level (The amount of light)	0.0	2.8	2.8	10.6	12.1	40.4	31.2
	Equipment and Supplies (Movable white board/TV/Charging plug)	0.7	0.7	2.1	12.9	20.7	36.4	26.4
	Aesthetics (Color/Shape/Plant/Art installation)	2.9	2.9	7.2	18.7	12.9	33.1	22.3
Individual Study Areas	**Sound Privacy**	2.2	5.9	8.1	13.2	14.0	36.8	19.9
	Visual Privacy	1.5	3.7	4.4	18.4	12.5	35.3	24.3
	Location			3.7	14.8	12.6	44.4	24.4
	Furniture Arrangement	0.7	2.2	5.9	13.2	14.7	40.4	22.8
	Furniture Size	0.7	0.0	8.9	13.3	15.6	37.0	24.4
	Light Level		2.2	5.9	10.3	9.6	41.2	30.9
	Equipment and Supplies	0.8	0.8	8.3	12.0	12.0	39.1	27.1
	Aesthetics	0.7	3.7	8.1	20.6	8.1	35.3	23.5
Learning Commons	**Sound Privacy**	3.4	5.9	10.2	22.0	12.7	29.7	16.1
	Visual Privacy	4.3	2.6	6.9	21.6	15.5	31.9	17.2
	Location	0.0	0.8	3.3	17.2	13.1	41.8	23.8
	Furniture Arrangement	0.0	1.7	4.2	15.8	16.7	37.5	24.2
	Furniture Size	0.0	1.7	4.2	13.4	12.6	43.7	24.4
	Light Level	1.6	1.6	5.7	11.5	10.7	39.3	29.5
	Equipment and Supplies	0.0	1.7	3.4	13.7	17.1	38.5	25.6
	Aesthetics	2.5	1.7	5.0	21.0	14.3	31.9	23.5
Reading Areas	**Sound Privacy**	4.4	2.7	7.1	20.4	16.8	24.8	23.9
	Visual Privacy	3.6	3.6	3.6	20.5	18.8	26.8	23.2
	Location	1.8	0.9	3.5	17.5	13.2	36.0	27.2
	Furniture Arrangement	0.9	3.5	2.6	21.9	14.9	37.7	18.4
	Furniture Size	0.9	1.7	6.1	20.0	13.0	38.3	20.0
	Light Level	1.7	1.7	3.4	19.0	9.5	34.5	30.2
	Equipment and Supplies	0.9	2.7	6.3	19.8	9.9	36.9	23.4
	Aesthetics	2.6	1.7	8.6	24.1	13.8	26.7	22.4

The finding shown in Table 13 with gray color indicated that high percentages of students were not satisfied with three major categories: sound privacy, visual privacy, and aesthetics: 1) sound privacy (34%), visual privacy (29.1%), and aesthetics (31.7%) of group study areas; 2) sound privacy (29.4%), visual privacy (28%), and aesthetics (33.1%) of individual study areas; 3) sound privacy (41.5%), visual privacy (35.4%), and aesthetics (30.2%) of learning commons; and 4) sound privacy (34.6%), visual privacy (31.3%), and aesthetics (37%) of reading areas. These categories should be carefully handled when suggesting design alternatives.

Even though the satisfaction level with reading areas' light level has a high mean value (M=5.6. SD=1.41), 26% of respondents said that the amount of light did not meet their satisfaction level, thus the library should offer more various options of lights for these areas; one example of this would be task lights. Indeed, the equipment and supplies are important parts for conveniently enhancing student studies. However, the highest index of respondents (29.7%) answered that equipment and supplies of reading areas did not meet their satisfaction level.

Expectations on Furnishing, Lighting, Finish Materials, and Aesthetics of Learning Spaces

The researcher collected data about students' expectations about the existing furniture, lighting, finish materials, and aesthetic features of learning spaces. As shown in Figure 23, even though these physical environment features met students' expectations, special features did not exceed students' expectations (< M=5). The attributes that showed the lowest expectation level was access to nature (M=4.2, SD=1.69), followed by access to daylight (M=4.4, SD=1.58) and furniture design style (M=4.4, SD=1.45). Seating functions (i.e. height and tilt adjustment, charging plug option, M=4.5, SD=1.48) and finish materials (i.e. material type, color, pattern, and texture, M=4.5, SD=1.40) were slightly lower in terms of the expectation average value than other attributes.

Figure 23. Expectations on furnishing, lighting, finish materials, and aesthetic features of learning spaces (n=146)

Table 14.

A valid percentage of the expectation level with furnishing, lighting, finish materials, and aesthetic features of learning spaces (n=146)

Attributes	Expectations Level Valid Percentage (%)						
	Far Short of Expectations	Moderately Below Expectations	Slightly Below Expectations	Meet Expectations	Slightly Above Expectations	Moderately Above Expectations	Far Exceeds Expectations
Table/Desk Mobility and Flexibility (Easy to Move for Group or Individual Study and Learning)	0.7	1.4	7.9	48.9	11.5	20.1	9.4
Table/Desk Size (Height/Length/Width)	0.7	2.1	8.5	41.5	13.4	22.5	11.3
Table/Desk Type (Carrel/Square/Circle)	0.7	2.2	5.8	46.8	8.6	26.6	9.4
Table/Desk Functions (Height and Size Adjustment/Charging Plug Option)	0.7	2.1	7.7	44.4	12.0	21.8	11.3
Table Finish Materials (Type/Color/Texture)	0.7	2.1	8.5	47.5	13.5	17.0	10.6
Seating Size (Seat and Back Height/Seat Width and Depth)	0.7	2.8	13.4	40.1	14.1	14.8	14.1
Seating Mobility	0.0	2.2	10.2	41.6	12.4	21.9	11.7
Seating Type (Sofa/Chair/Stool/ Booth Seat)	1.4	3.5	13.4	31.7	11.3	24.6	14.1
Seating Functions (Height and Tilt Adjustment/Charging Plug Option)	1.4	4.9	16.2	35.9	12.7	14.8	14.1
Seating Finish Materials (Type/Color/Pattern/ Texture)	0.0	7.9	8.6	44.6	12.9	12.9	12.9
Furniture Design Style	2.9	5.7	10.7	42.1	12.1	16.4	10.0
Ambient Lighting Level (The Amount of Light)	2.9	.7	7.2	43.2	15.8	12.2	18.0
Task Lighting Level (The Amount of Light)	1.4	1.4	13.7	38.8	13.7	13.7	17.3
Lighting Control (On and Off)	0.8	5.4	10.9	42.6	11.6	14.7	14.0
Access to Daylight	2.9	8.0	13.8	38.4	8.7	13.8	14.5
Floor Finish Materials (Type/Color/Pattern/ Texture)	0.0	4.3	7.2	49.3	11.6	13.8	13.8
Wall Finish Materials (Type/Color/Pattern/ Texture)	0.7	3.6	9.4	50.4	10.8	12.2	12.9
Ceiling Finish Materials (Type/Color/Pattern)	0.0	6.5	4.3	55.1	8.7	11.6	13.8
Access to Nature (Plants/Outside View)	5.0	12.1	17.9	30.7	9.3	12.1	12.9
Art Installation	2.2	4.4	9.6	34.6	14.0	19.1	16.2

According to Table 14, large percentages of respondents (gray color on the table) said

some attributes did not meet their expectations: access to nature (35%), access to daylight

(24.7%), seating functions (22.5%), and furniture design style (19.3%). Students mentioned the

library needed to add more green plants and windows for access outside view and daylighting.

They wanted more adjustable and comfortable chairs. In addition, more than 16% of students

said that lighting control (17.1%), task lighting level (16.5%), seating finish materials (16.5%),

and seating size (16.9%) also did not met their expectations. Students did not prefer automatic

on/off lights and the dark color scheme of the seating material. The lack of lighting options was

another important issue. Seating type was one of attributes that showed the highest expectation

level (M=4.8, SD=1.47), but 18.3% of students said this attribute was below their expectations

and wanted more seating options such as bean bags and stools. The art installation did not show a

low expectation level, but many students were not fully satisfied with the how the art gallery was

arranged inside the library.

Table 15 shows the survey findings related to visual and tactile design attributes of the

existing learning spaces in the UCO Chambers library.

Table 15.

Visual and tactile sensory design attributes and survey findings

Categories	Attributes	Survey Questions	Findings
The Sense of Sight	Color & Shape	Aesthetics about Color (Finish Materials of Floor, Ceiling, and Wall)	Aesthetics factor of physical environment features (M=5.4, SD=1.36), 27.4% of respondents think Aesthetics did not reach their satisfactions level. The mean index of aesthetics of each learning space is over 5, but a high number of respondents think aesthetics of learning spaces did not meet their satisfactions level, the lowest level is reading areas (37%), the second lower space is individual study areas (33%), the third lower learning space is group study areas (32%).
		Table Finish Materials (Color, Type)	The expectation level of table finish materials (M=4.7, SD=1.27), Merely 11.3% of respondents think table finish materials did not meet their expectations level.

		Seating Finish Materials (Color, Type)	According to survey, seating finish materials (M=4.5, SD=1.40), 16.5% of respondents said seating finish materials did not meet their expectations level, but some students mentioned patterns of the chairs are dark, meanwhile they suggested change brighter color to them.
		Floor, Ceiling, and Wall of Finish Materials (Color, Type)	Floor finish materials (M=4.6, SD=1.32), wall finish materials (M=4.6, SD=1.33), and ceiling finish materials (M=4.6, SD=1.34). 14% of respondents think wall finish materials have low expectations level, and students suggested painting the wall green to simulate nature better than white wall.
		Type of Furniture	Type of furniture factors of physical environment features (M=5.5, SD=1.26), 24.1% of respondents said furniture type of the physical environment features has low satisfactions level.
	Lighting	Lighting (Illuminance, Control, Type)	Lighting illuminance, control, and type of physical environment features (M=5.7, SD=1.35), 19% of respondents think Lighting illuminance, control, and type did not meet their satisfactions level.
		Light Level (the amount of Light)	The light level of group study areas (M=5.8, SD=1.23), the light level of individual study areas (M=5.7, SD=1.28), the light level of learning commons (M=5.6, SD=1.39), the light level of reading areas (M=5.57, SD=1.41). The reading areas have lowest satisfactions level for light level with 26% of respondents selecting this option. The learning commons were selected at 20.4%. In the "open-ended questions" students suggested light can be brighter in learning spaces.
		Ambient Lighting Level	The ambient lighting level of learning spaces (M=4.8, SD=1.43), 11% of respondents think ambient lighting level has low expectations level in learning spaces, and some students mentioned the lighting is too dark on third and fourth floor.
		Task Lighting Level	The task lighting level of learning spaces (M=4.7, SD=1.44), and it was selected as low expectations level by 16.5%. Students suggested more task light, especially table lamps.
		Access to Daylight	The access to daylight of learning spaces (M=4.4, SD=1.58). 25% of respondents said access to daylight that is low expectations level, and students suggested learning spaces of UCO Library need to add more windows and more natural light in the "open-ended" questions.
	Visual Connections with Nature	Aesthetics about Plants	The lowest satisfaction level (27.4%, n=146) selected was about plants in the aesthetics of physical environment features (M=5.4, SD=1.36).
		Access to Nature (Plants, Outside View)	The lowest expectation level (35%, n=146) selected was about access to nature of learning spaces (M=4.2, SD=1.69), meanwhile, in the "open-ended question" participants mentioned the UCO Library need to add green plants and more windows on higher levels for outside view, even some students mentioned they wish more areas were exposed to outside.
	Visual Texture & Tactile Texture	Floor, Ceiling, and Wall of Finish Materials (Pattern, Texture)	This finding as same index as floor, ceiling, and wall of finish materials (type, color). Floor finish materials (M=4.6, SD=1.32), wall finish materials (M=4.6, SD=1.33), and ceiling finish materials (M=4.6, SD=1.34). 14% of respondents think wall finish materials have low expectation level, and students suggested painting the wall green to simulate nature better than a white wall.
		Table Finish Materials (Texture)	This finding as same index as table finish materials (color, type)
The Sense of Touch		Seating Finish Materials (Texture)	This finding as same index as seating finish materials (Color, Type)
	Technology of Touching	Haptic technologies (Touch Screen, TV, Multimedia)	Technologies (touch screen, TV, multimedia) of physical environment features in the learning spaces (M=5.55, SD=1.35). 21.2% of respondents said technologies negatively reflect satisfaction level.

Students' Suggestions about Furnishing, Lighting, Finish Materials, and Aesthetics of Learning Spaces

Although students who participated in the survey were satisfied with the overall physical environment features of learning spaces, and the majority of respondents (90.3%) agreed that the overall learning space enhanced their learning outcomes, several features of learning spaces did not satisfy students and meet their expectations. The researcher included open-ended questions in the survey to get students' opinions and suggestions about learning spaces.

74 respondents of 146 students answered the qualitative open-ended questions on the survey. Mostly respondents suggested that the library's furniture (tables and chairs) need to be updated. They generally agree that the furniture is uncomfortable, outdated, and lacks ergonomics, and the fabric of the chairs is bland as well. A student said: "some of the chairs are too tall for the tables / cubicles and this ends up hurting / straining your neck." That means that as basic study tools, facilities that do not meet students' needs might influence their morale, study time, and efficiency. Some respondents suggested the library needs to add more comfortable chairs, couches, bean bags and standing desks. Many respondents think the lighting is not bright enough for studying; some respondents even said: "the ambient lighting at the library makes my eyes tired sometimes." Meanwhile, occupancy sensor lights that turn on and off automatically are inconvenient for students doing long study sessions, and they also suggested the library needs more task lighting such as table lamps and floor lamps and more natural lighting from windows to enjoy outside views. The respondents said: "more natural light would be more inviting than the inside lights, and adding more windows would help with a sitting area for studying." "I wish we could have more lamps on / next to tables so we could have more light." The respondents pointed out that the library's finish materials need to be changed such as wall and ceiling color; the student said white walls do not feel relaxing, on the contrary,

large areas of white walls can make lighting seem harsh. Other students suggested adding more

green plants, art installations, decoration, and enhanced aesthetic features to beautify the

environment for their studying and learning. Some respondents suggested the library needs to

add more power supplies such as outlets and power plugs in learning spaces for the convenience

of students using their own devices, and they recommended to provide more computers,

especially Mac, and headphones as well.

These qualitative open-ended questions reflected students' suggestions for their physical

environment of learning spaces and facilities of learning spaces. Furnishing, lighting, finish

materials, and aesthetic features are all crucial factors that not only provide facilities for students

learning and studying, but also create a beneficial learning atmosphere for students. Eventually,

participants' suggestions would become a good guideline to help the researcher renovate the

UCO Library.

CHAPTER FIVE: DESIGN SUGGESTIONS

This section introduced design alternatives of the UCO Library. The design concept is based on the literature review, physical environment observations, and survey findings of sensory design; meanwhile, the researcher utilized the UCO main color palette and its logo as the design concept to support these design alternatives. The design suggestions for learning spaces that were not utilized sufficiently are group study areas, individual study areas, learning commons (computer workstations), and reading areas. Also related to sensory design aspects that were not clearly represented were furniture, lighting, aesthetics, finish materials, and technologies.

Group Study Areas *(Public/Together and Private/Together)*

Group study areas are the largest open areas for seated study in the existing UCO Library from the first to the fourth floor. Therefore, these spaces were the loudest areas. The result of the physical environment observations and findings of survey clearly showed that group study areas are one of the most sought out areas, and they have the most number of students to study there. Hence, the researcher would keep their function and locations in the design alternatives but would re-organize the furniture and space layout, apply finish materials and lighting, and add suitable technology to assist student's learning. The group study areas included public/together (PUT) and private/together (PT) areas. The researcher kept PUT study areas as the main group of study areas for collaborative work on the first and the fourth floors with flexible furniture, various furniture arrangements, and useful technologies.

Group study areas with students for collaborative work should be remodeled by adding multiple and flexible furniture. PUT study areas have more than two different types of furniture such as circular tables, rectangular tables, stools, and adjustable chairs; meanwhile, some tables

Figure 24. 3D rendering of public/together study area for group work on fourth level

Figure 25. Details of public/together study area for group work on fourth level

have outlets and USB ports. Students pointed out in the survey's "open-ended questions" that the

library needs to add standing tables; thus the researcher arranged two sets of standing tables that

can hold 6 people with high seats on the PUT study areas, and each group has multiple glass

boards for recording during collaborative work. Meanwhile these 'glass walls' can be used for

visual privacy as well. A casual seating booth against the wall is made of special materials. The

surface of the material is connected to a kinetic framework, to produce dynamic movement.

When learning on it, it will form a different shape and be accompanied by different colors and

light (Pohl, & Loke, 2012) (see Figure 24 and 25).

Figure 26. 3D rendering of public/together study area for group work on fourth level

Circular tables provide good collaboration for group work, and each group is equipped

with a movable white board. Green hues have calming and stress reducing effects (Jalil, Yunus

& Said, 2012); triangular shapes represent energetic and dynamic emotions and make people feel

stable and balanced (Ching & Binggeli, 2012). As shown in Figure 26 and 27, there are sets of

triangular glass dividers which separate each group zone; according to survey findings, students

were not satisfied with visual privacy (29.1%) of group study areas. These folding dividers offer

visual privacy and can be used like white boards. Furthermore, acoustic panels suspended

vertically from the ceiling absorbs sound in open areas, so these interesting elements brought more joy for the study atmosphere. The researcher suggested offering technology to help students focus on their studies such as multimedia moveable TV that enables students to conveniently share their information or prepare a presentation.
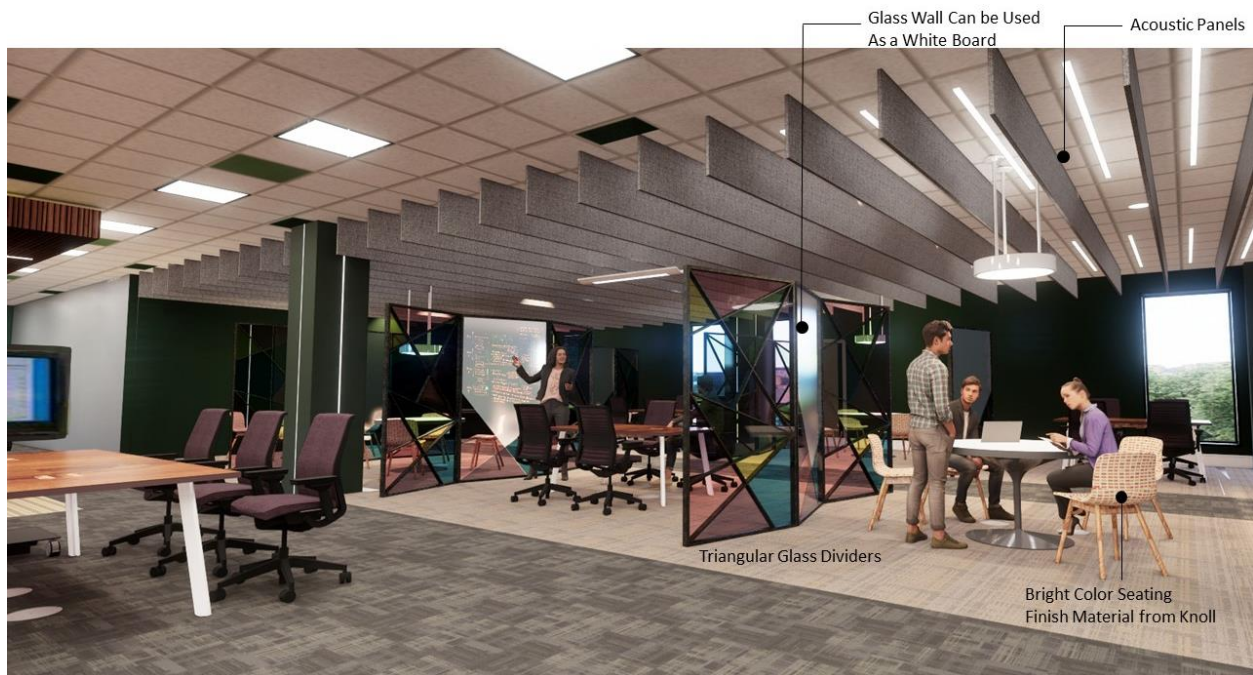
Figure 27. Details of public/together study area for group work on fourth level

Based on the findings of survey about sensory design, 16.5% of respondents think seating finish materials have a low satisfaction level, and some students mentioned the chair cover patterns were "dark" and "hideous"; therefore, the researcher selected bright and positive colors, soft and warm textiles for seats covering in Knoll textiles (Knoll, n.d.) while imparting fresh tones, textures, and temperatures to be incorporated with the entire design. Many students reported that the light is not bright enough for the general environment. Acuity Brands suggest the selection of CPX LED flat panel that has low-glare ambient lighting available in a 2'x2' configuration on the Acoustic Ceiling Tiles (ACT) to produce ample and soft lighting for students to carry out their group work without harsh light. Also, the flat panel gives the open

spaces as well as the general areas brightness and comfort (Lithonia Lighting, n.d.a.). When the

new LED light fixtures were installed using 2'x2' acoustic ceiling as ambient lighting, the entire

learning space became bright and vivacious. The researcher also selected "Seem 4 LED"

suspended direct LED luminaire (Focal Point, n.d.) as localized lighting to focus on each group's

work area to increase the lighting level of particular tasks.

 As shown in Figure 28 and 29, the PT study zones are enclosed spaces for

private/together work areas for group work. The researcher kept their location on the third floor,

but to further meet the students' needs and enhance the aesthetics of the physical environment,

Figure 28. 3D rendering of private/together study area for group work on third level

the researcher extended areas of each room and added more rooms for students' needs. In fact,

physical observations of the environment indicated that some rooms did not have enough space

to fit furniture, and these rooms were almost full in the afternoons and evenings for students to

use. Also, these areas had mostly the same aesthetic features as other existing learning spaces.
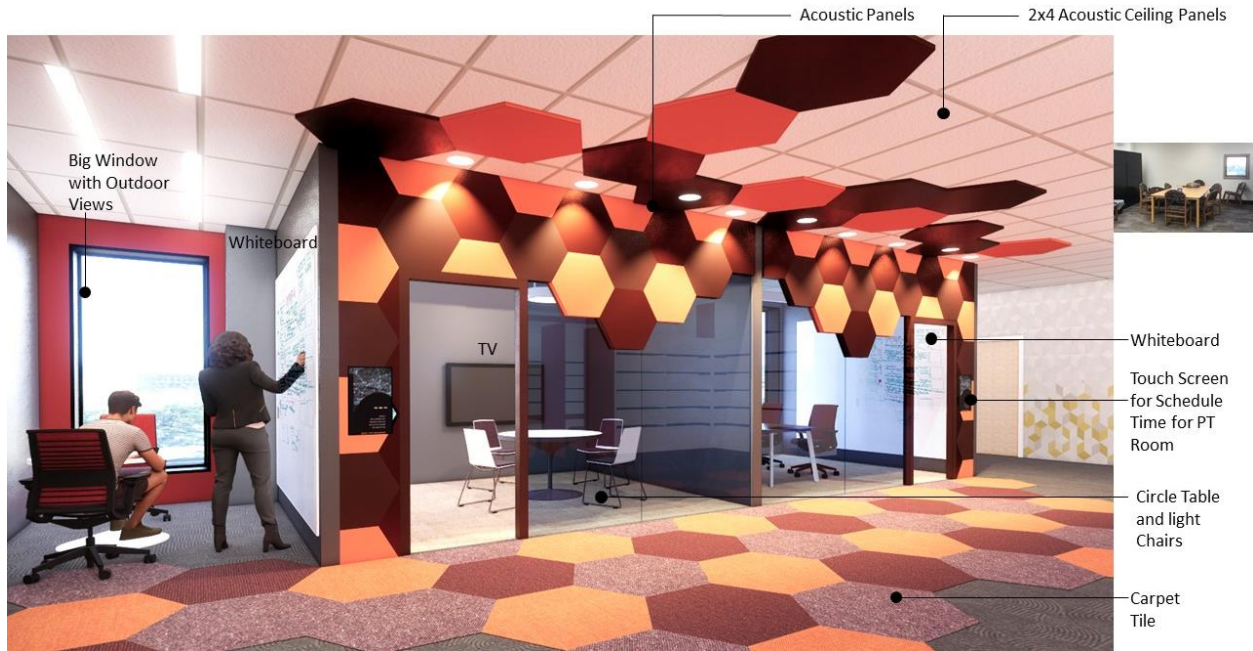
Figure 29. Details of private/together study area for group work on third level

Consequently, the researcher readjusted each area to ensure that each room could have a window

with natural light, and decorated their facades with acoustic geometrical shapes. These brown

hue colors promote students' relaxation and reduce fatigue (Kaplan, n.d.; Magagula, 2018).

Under these design suggestions, students can enjoy an outside view and relax during studying.

To avoid noise transmission between rooms, acoustic panels, as main finish materials, were used

on the PT study areas with sound privacy. Students can talk and use a laptop on the multimedia

screen to present information or videos to aid in studying while the view through the glass wall

helps the enclosed room feel open. Each room can accommodate four to six people using flexible

furniture that can use rectangular or circular tables for students to have more options. The room

provides power outlets and USB ports. Both light armchairs and adjustable chairs would be

perfect for the table sizes. The white board is convenient for students' discussion; even outside

the room students can still use it for their collaborative work. Touch screens are installed outside

the door that allow students to schedule time for the PT room.

In the enclosed PT study rooms, the "Narrow Wrap Decorative Indoor Linear Design" light flexure is good for use with narrow ceiling areas, and has "no flickering and quiet operation without interfering with other home electronics" (Lithonia Lighting, n.d.b). The "Seem® 4 LED Asymmetric Flush Lens" constitutes the ambient light on this floor in the learning spaces, so its linear design lamp has a delicate and fashionable appearance and provides uninterrupted illumination with visual comfort (Focal Point, n.d.c). Although some students are in the open area, they can still keep their eyes from getting tired and concentrate on their learning.

Individual Study Areas *(Public/Alone and Private/Alone)*

Public/Alone (PUA) and Private/Alone (PA) study areas are for individual study. PA areas provide solo spaces for a quiet private space, and PUA study areas for accompanying other students' social connection while working alone. Even though these existing functions provide
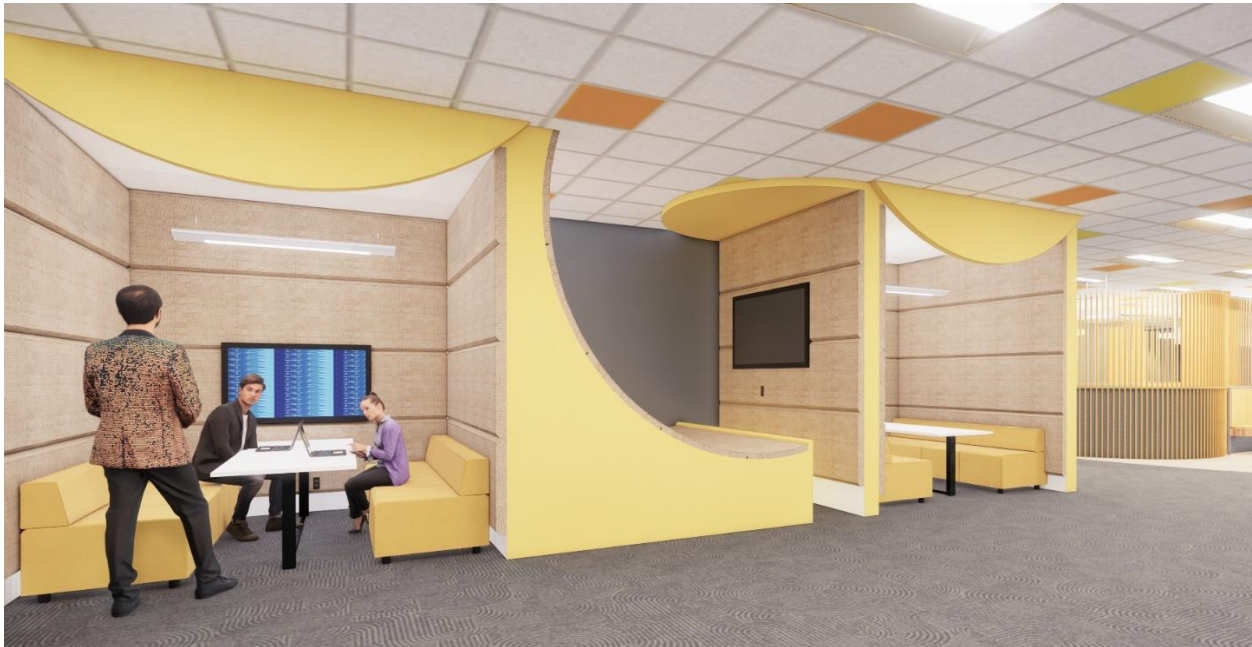
Figure 30. 3D rendering public/alone study area for individual study on second level

student's individual study at the UCO Library, students' surveys and physical environment observations reflected that students were not satisfied with many features such as aesthetics,

lighting level, and visual and sound privacy. Therefore, individual study areas met study function

while they need to enhance the perception of sensory design to service students' needs.
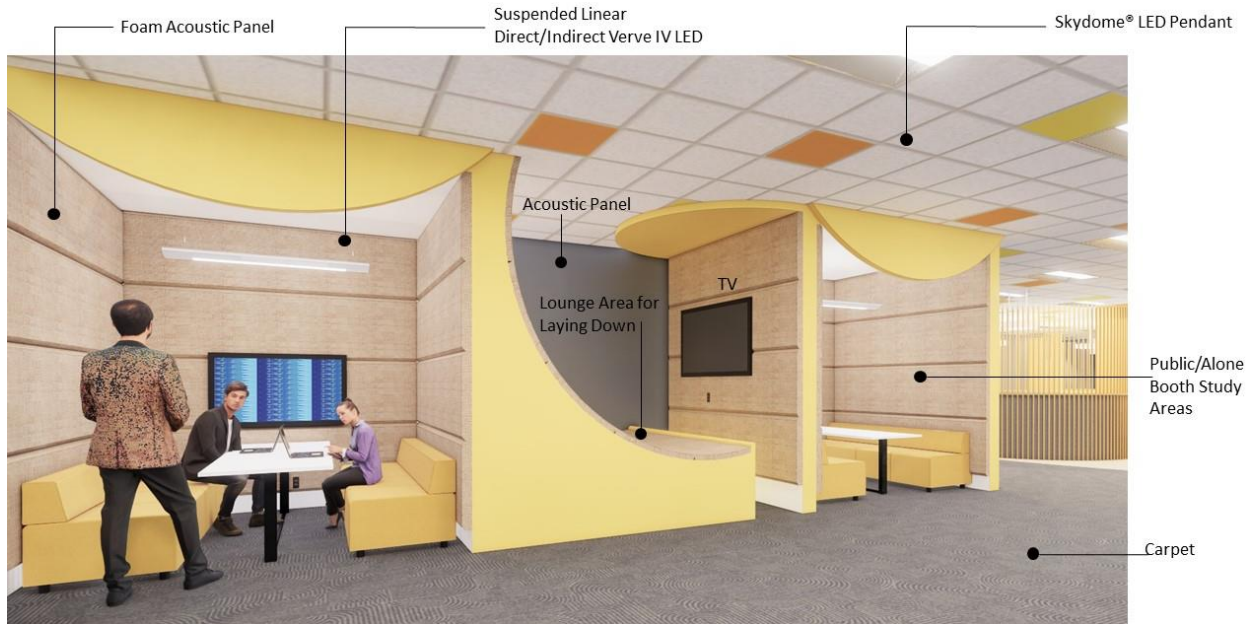
Figure 31. Details of public/alone study area for individual study on second level

Figure 32. 3D rendering of public/alone study area for individual study on second level

Figure 33. Details of public/alone study area for individual study on second level

Some PUA study areas have unclear functions in the existing learning spaces, so students

are confused about finding study zones they need. As shown in Figure 30 and 31, the yellow

color lets students feel more positive. The sets of the yellow arc-shape connect solo booth rooms

Figure 34. 3D rendering of public/alone study area for individual study on second level

together; students can sit on the benches to talk about their group work and also can lay down to

watch programs using electronic devices combined with the TV. Each booth has acoustic tile to

decorate walls and avoid sound interference. The suspended linear direct/indirect Verve IV LED

task light is used in each booth room; it has a soft light source that is perfect for educational

facilities (Focal Point, n.d.e). Another PUA study area design suggestion is a semi-circular
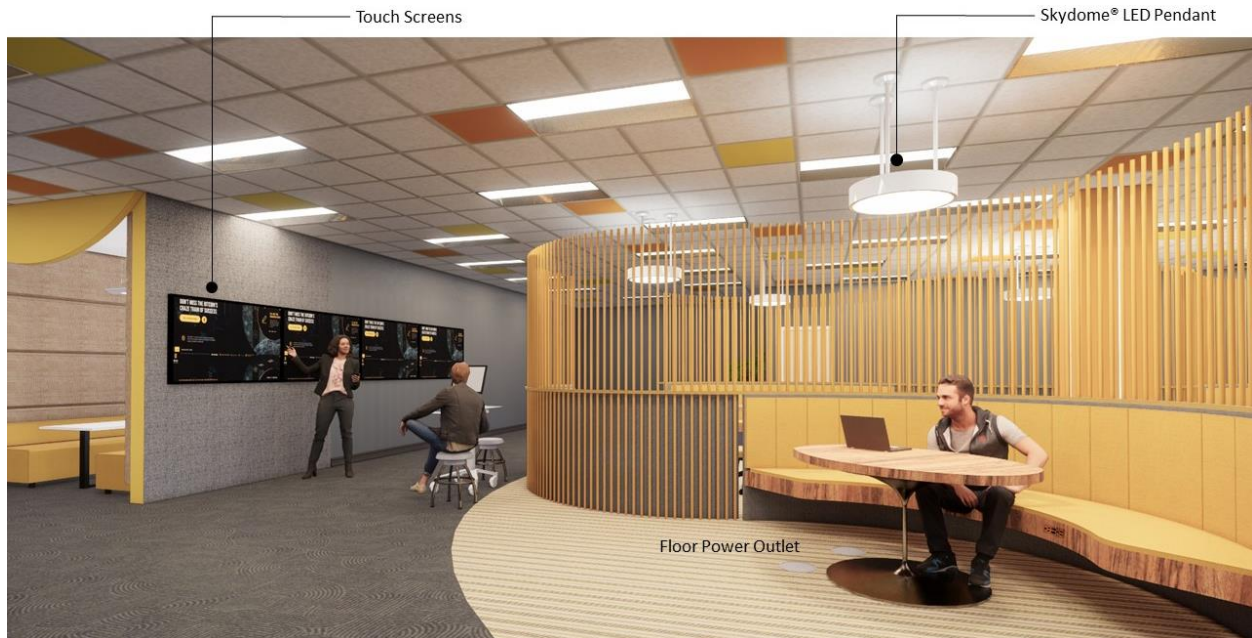
Figure 35. Details of public/alone study area for individual study on second level

working area (see Figure 32 and 33). Students sit on the wood pole surrounding the semi-

enclosed learning area providing excellent visual privacy for the open public space. The space

focuses on both individual and social connection work. Thus, both flexible options let students

choose their study needs. This design offers more fun for studying instead of monotonous,

simple furniture arrangements. As shown in Figure 34 and 35, some students are using a touch

screen to present their presentation on the west side wall. Technology applications appear in

every learning area to meet students' needs. Ambient lighting used 2'x4' recessed Amica LED

luminaire which has sweeping curves and classic lines; the center ribbed diffuser masks LED

brightness while creating good illumination (Focal Point, n.d.a). Each solo learning zone has a

Skydome pendant mount LED round dome luminaire, which has a "shallow 4.5" deep housing. In

fact, maintaining a low profile is a good choice for open public learning spaces such as school or meeting areas (Focal Point, n.d.d).

The private/alone (PA) study area is a completely silent place where students do their work alone. The most prominent feature of this area is studying alone. To further improve the functions of private alone study spaces, the researcher tried to reorganize the existing space layout and furniture arrangement because existing PA study areas had issues of underutilized spaces that were inconveniently located. Hence, the researcher unified those scattered desks into one area, compared to existing locations, which saved a lot of time to find individual seats (see Figure 36 and 37). Meanwhile, glass walls meet private study needs while they also function like white boards.

Figure 36. 3D rendering of private/alone study area for individual study on third level
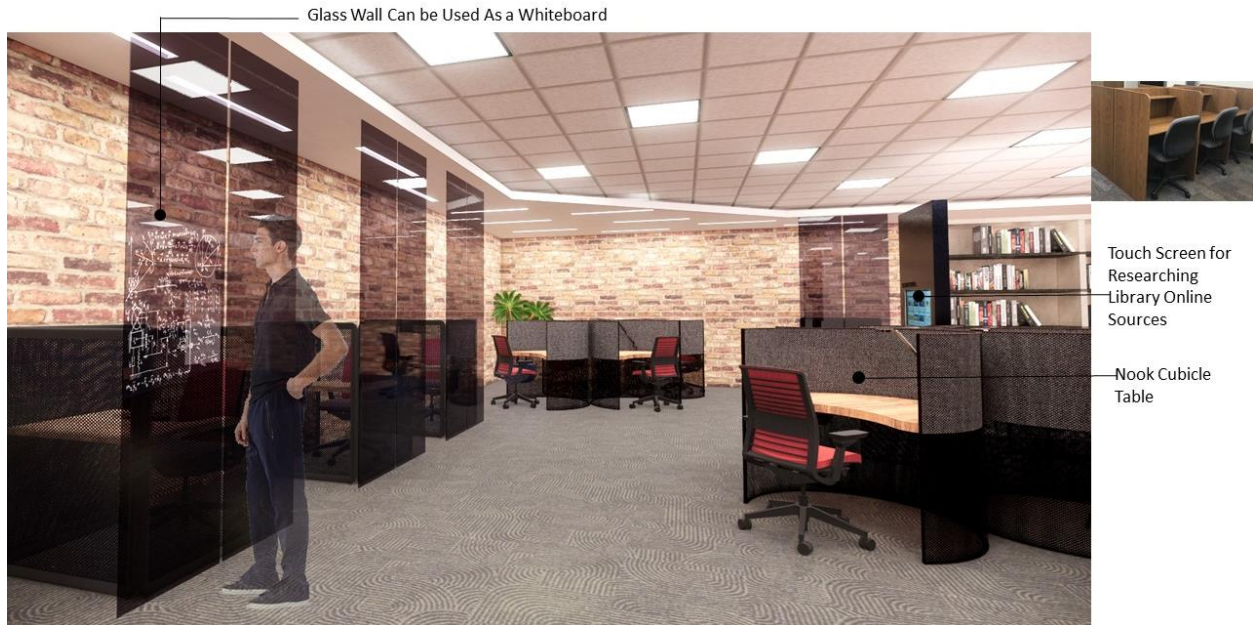
Figure 37. Details of private/alone study area for individual study on third level

For furniture selection, the researcher chose Lagunitas Focus Nook cubicle tables to

replace existing carrels for private/alone study spaces (see Figure 38), because the new form of

the nook cubicle is a spacious breathable piece of furniture with knit pattern or fabric

Figure 38. Lagunitas focus nook cubicle tables (Steelcase, n.d.)

construction and freestanding rather than a narrow enclosed box. It also meets "traditional work

posture —optimizing space within the open plan with high screens" (Steelcase, n.d.). Task

lighting is also important for individual study areas, especially for those in secluded spaces

where cubicle walls or other barriers could block light. However, when the researcher observed

the facilities of the learning spaces, there was almost no task lighting for students to use;

therefore, the dash mini LED task lighting would be used perfectly in the private alone study

areas where students can have enough light sources to carry out their independent studies without

dim light affecting their study mood.

<div align="center">

Learning Commons *(Computer Workstations)*

</div>

According to the literature review, learning commons have many different function areas,

including the computer workstations. The computer workstations, indeed, are one of the most

important learning spaces for students' to use at the UCO Library; thus, the researcher focused

on redesigning the computer workstations of the learning commons as an important part of the

design alternatives.
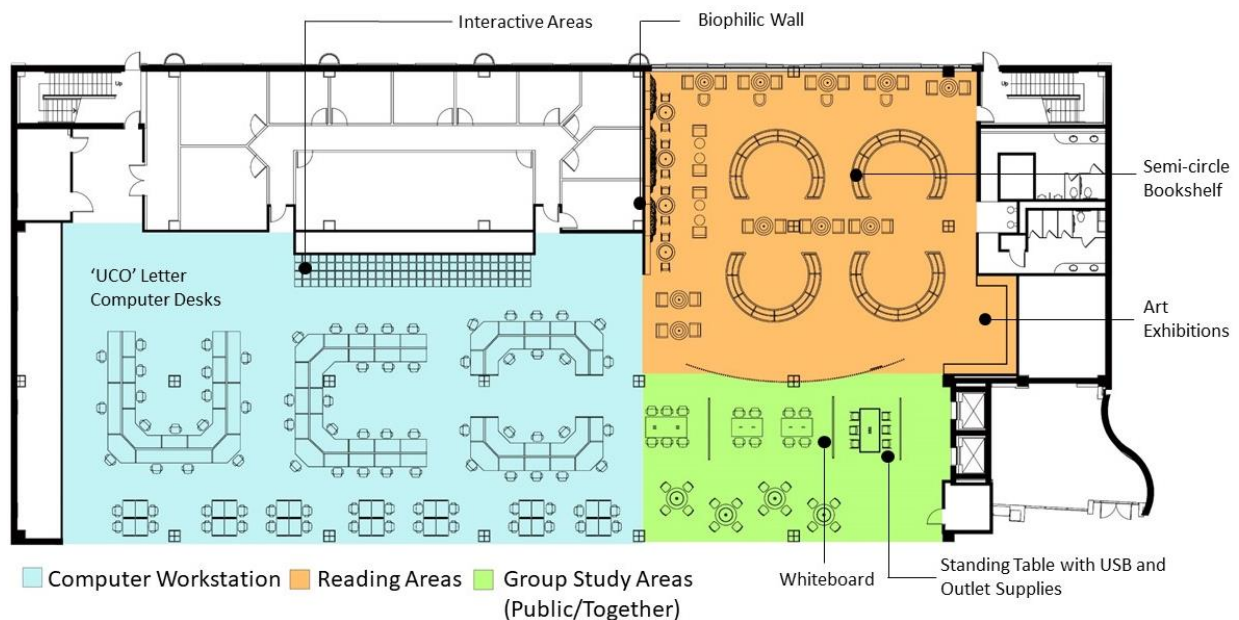
Figure 39. 'UCO' letter tables in the computer workstation area of learning commons on first
level next to public/together study area and reading area

The researcher relocated the computer workstations to be further away from the windows to minimize the sunlight reflection on the computer screens and made this location close to innovation studios; in other words, integrating technology was applied to an area where students could meet to discuss their projects and communicate via technology (see Figure 40 and 41).

Figure 40. 3D rendering of computer workstation of learning commons on first level

Figure 41. Details of computer workstation of learning commons on first level

The arrangement of the computer tables were designed to form the letters UCO (see Figure 39), and these rectangular shapes create feelings of courage, discipline, and strength. Students sit around them to complete individual computer work with visual privacy. Figure 42 and 43 show, an interactive wall in the computer workstation area, which is "the medium of the iris diaphragm that responds to the quantity of light present in front of it and creates spectacular effects" (Aulive nv, 2007).
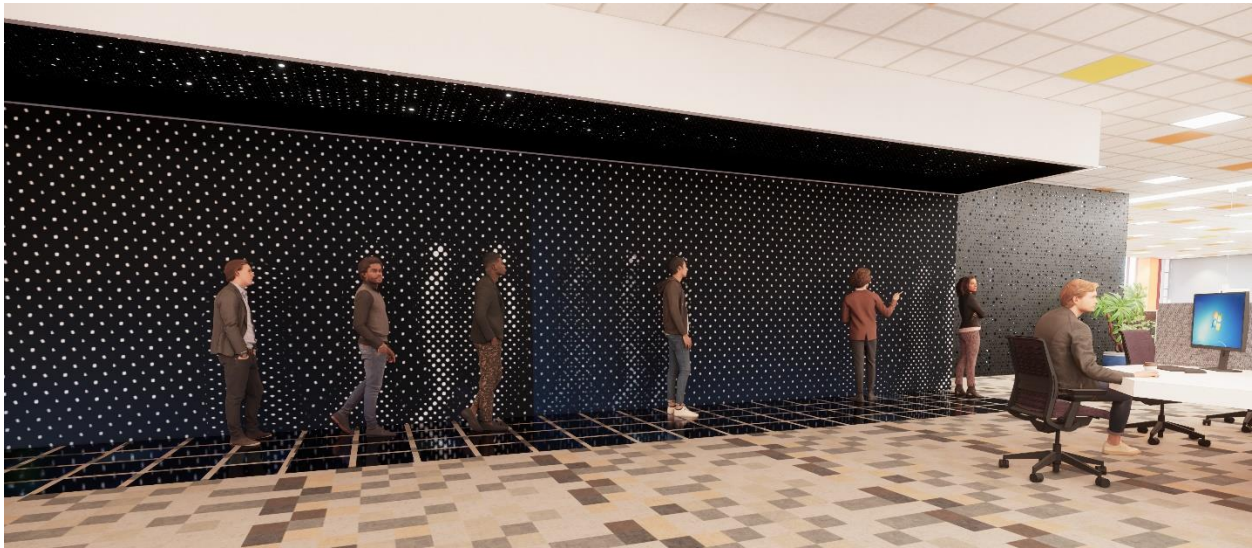
Figure 42. 3D rendering of computer workstation of learning commons on first level
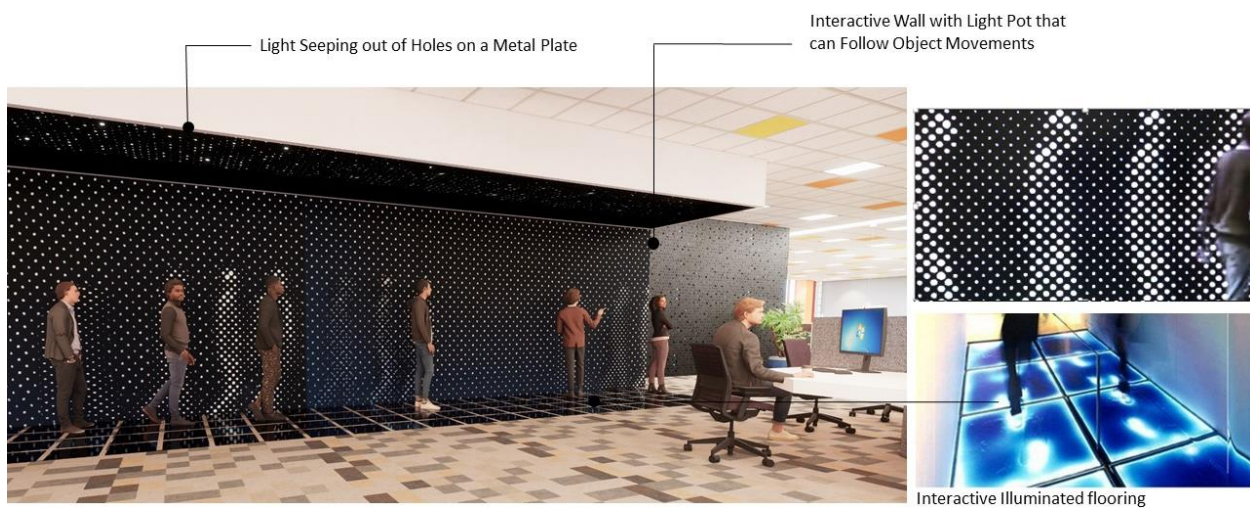
Figure 43. Details of computer workstation of learning commons on first level

When people walk by this wall, it can display people's shape, light can follow object

movements, and interactive illuminated flooring can record footprints when walking across the

Light Fader. This silent interactive wall brings more fun and joy to a currently monotonous area.

The blue color makes students feel calm and facilitates learning, and the blue color is depicted in

the technology as a sober medium (Desantis Breindel, 2019). Several multiple option seats

behind the 'UCO' shape were created where students can bring their own electrical devices to do

computer work or use the library's computer to work, search for materials, and entertain

themselves. One of the computer workstation areas is for listening to music and using several

instruments.

Reading Area *(Reading Area and Bookshelf)*

The reading area includes spaces for students to read, study, consult, and check out

different resources. Because of the weight of the concentration of many books and bookshelves,

the design concept kept these existing areas as they are, but the researcher renovated their shape

and reorganized their arrangement to extend functional uses in order to enhance the overall

visual beauty. According to *Hale Library Furniture* (2017), the height of each fully-assembled,

single-sided book shelf is 84 inches high, 36 inches wide, and 11 by 3/4 inches deep. The

researcher kept ergonomics requirement while extending space to add furniture for individual

studying or reading with soft upholstery seats, adjustable task lighting, configured outlets and

USB ports. A robot helps students look for and reach books alongside the bookshelves (see

Figure 44 and 45). Between book shelves, there is enough space to accommodate other

individual study tables such as Nook cubicle tables with adjustable chairs and cozy armchairs;

this furniture is very convenient for students' use when they search for materials or study

individual. The touch screens were installed on the side of each bookshelf not only to save

spaces to search for information but to reflect the development trend of the modern library (see

figure 46). The recessed asymmetric Seem® 4 LED luminaires were integrated with the ceiling in
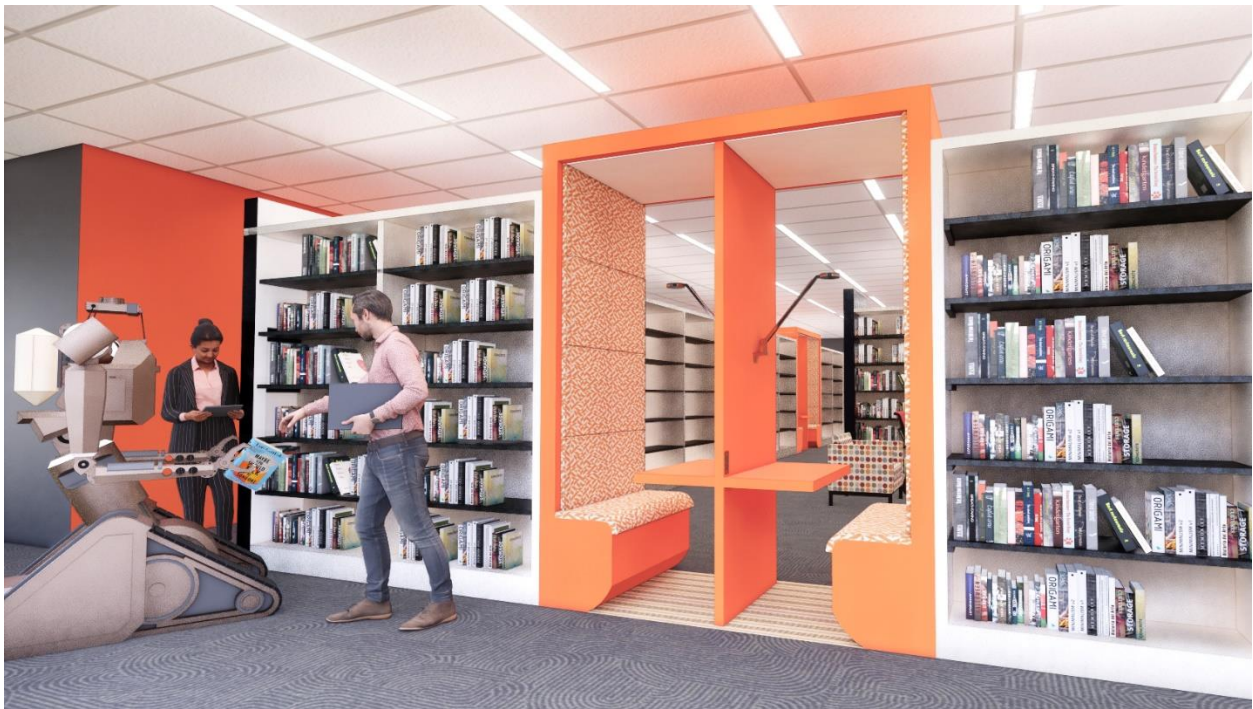
Figure 44. 3D rendering of reading areas on third level
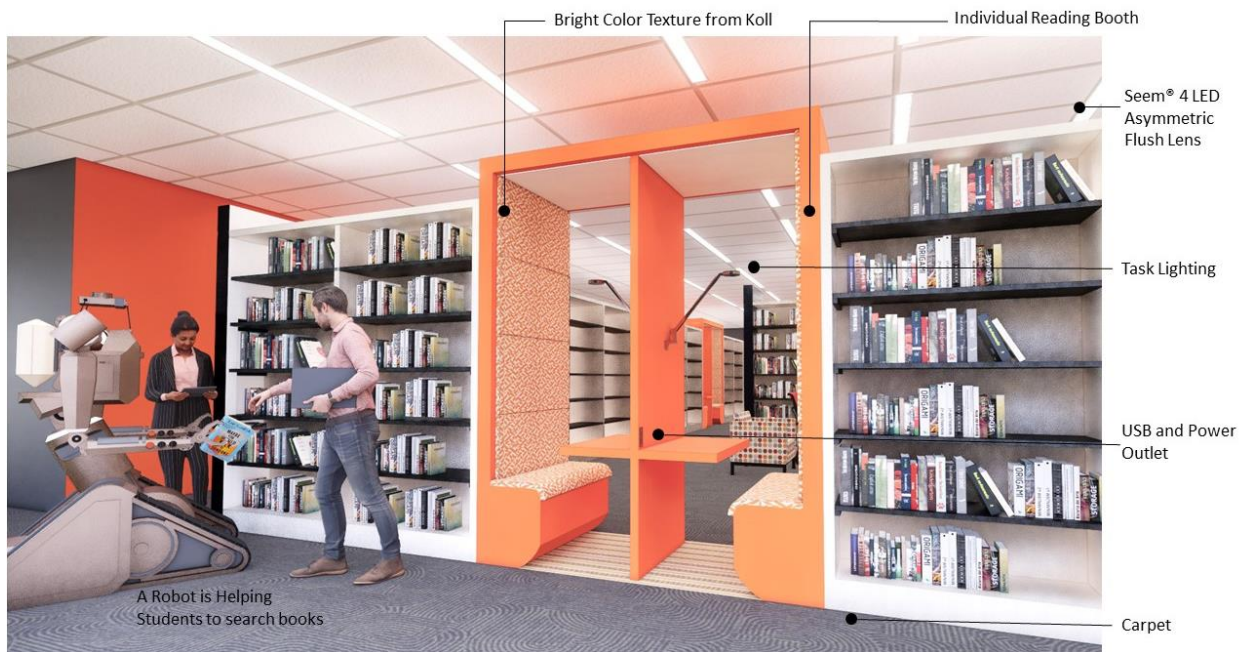
Figure 45. Details of reading areas on third level

a variety of mounting styles for a clean, unobtrusive aesthetic atmosphere. The concealed LEDs

provide a comfortable visual perception (Focal Point, n.d.b), and help users look for books on the

shelves without visual unrest. The dash mini LED task lights were applied to the individual study

areas to adjust the light brightness for users' needs.
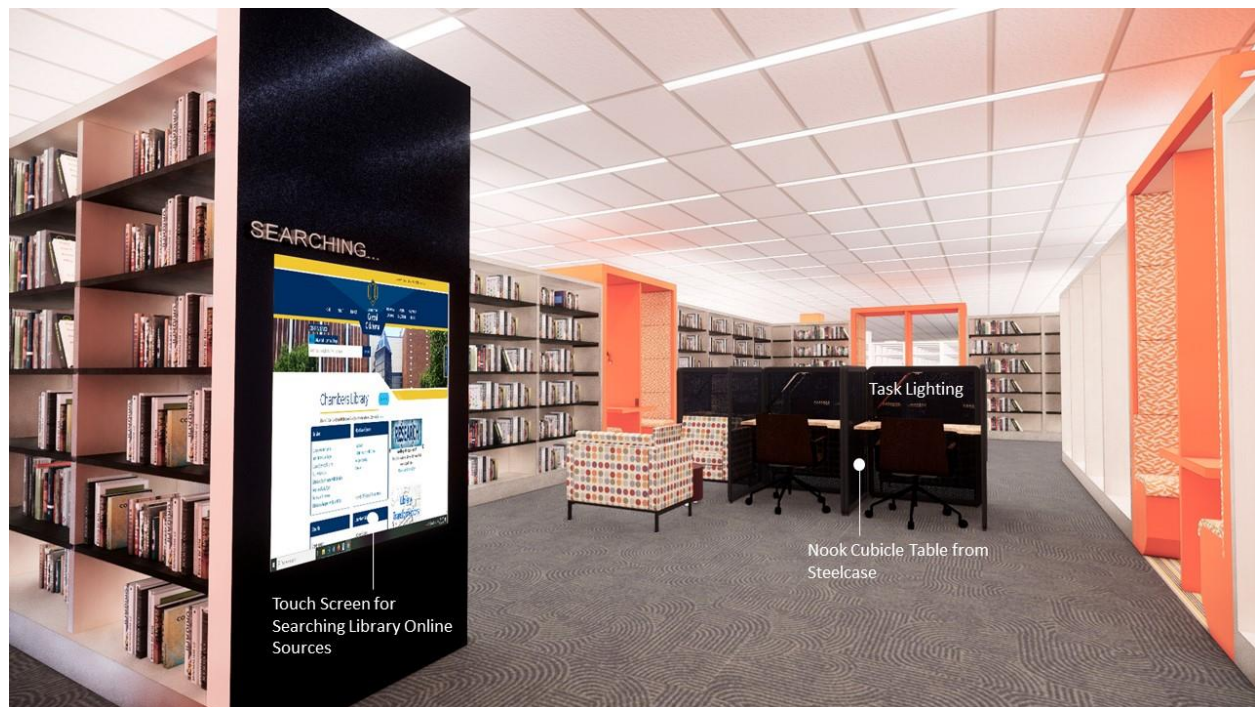
Figure 46. 3D rendering of reading areas on third level

The data from the survey reflected access to daylight with low expectations level because

of two issues: 1) limited daylight was not well used in the right environment; and 2) some of the

windows are too small to filter daylight. Therefore, the researcher suggested extending some

small windows to allow as much natural light as possible inside the learning spaces; for instance,

a transparent glass wall replaced the small windows on the north side of the first floor. This large

glass window brings sufficient sunlight and beautiful outdoor views to the new reading area

(existing area is computer workstation) where students sit on cozy armchairs to relax while

Figure 47. 3D rendering of reading areas on first level
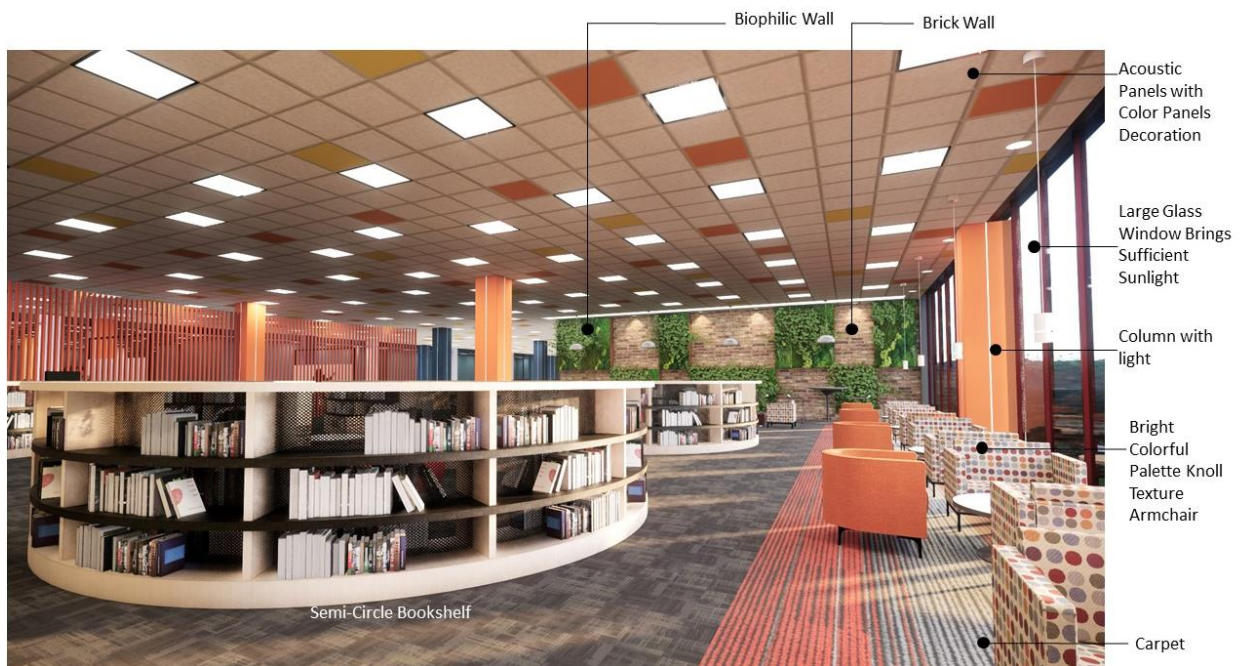
Figure 48. Details of reading areas on first level

reading newspapers or periodicals or meeting with their friends (see Figure 47 and 48).

"Daylight and plant life always work well together" (Demaria, 2018). As shown in Figure 49,

biophilic elements create a wall on the reading area that sufficiently improve cognitive functions

and creativity, and reduce the students' stress. Who does not want to study in such a relaxing

environment?

Figure 49. 3D rendering of reading areas on first level

CHAPTER SIX: CONCLUSIONS

In this study, the researcher attempted to explore via survey responses what students were satisfied with and the expected features of physical environment in the learning spaces. The researcher also investigated how the facilities of the learning spaces served students and how often users came to the library by observing the physical environment.

Discussion of Findings

The results of survey findings conducted at the Chambers Library of the University of Central Oklahoma indicated that students were satisfied with the learning spaces such as group study areas, individual study areas, learning commons, and reading areas. Overall, the learning spaces met their expectations about the features of physical environment such as furnishing, lighting, finish materials, and aesthetics. However, there were a number of students who expressed their not satisfaction with certain characteristics of the learning spaces at the library, and many students provided their suggestions for learning spaces as well. Within the environment, the researcher observed functional flaws in the facilities and deficiencies in a sensory design approach in the physical environment of the learning spaces. Under the influence of many factors, the researcher combined literature review, observations, and survey questionnaires to develop proposed design to illustrate efficient solutions to address these issues. Taking into consideration the aim of this study, the researcher focused on utilizing sensory design theories as a foundation to remodel the physical environment of the learning spaces to make them attractive and aesthetically pleasing to the eyes and hands of the users.

There are six separate learning spaces distributed from the first to the fourth floor. These learning spaces include the private/together study areas, public/together study areas for group work, private/alone study areas, public/alone study areas for individual study, computer

workstations of learning commons, and reading areas. Each learning space has its own function,

so students could be free to choose their needs; for instance, two or more students having group

work have two options: enclosed rooms (private/together) or opened public areas

(public/together) for their collaborative work. Students also can choose public/alone areas for

individuals who would like to study with other students while working alone; another

private/alone area for students is the individually dedicated space that enables users to

concentrate on their private studies. Nevertheless, it is clear that each learning space has similar

characteristics in the type of furniture, furniture arrangement, finish materials, light fixtures, and

so on. As a result, these factors would lead to a focus on functional facilities while ignoring the

importance of sensory designs in the interior physical environment of the learning spaces. These

design alternatives, which apply visual and tactile design features, presented some suggestions to

clearly embody the regional characteristics and further clearly display the function of each space.

In the modern academic library, using efficient tables and chairs is not the only key for

having a comfortable environment. The researcher explored more consideration of how visual

and tactile applications could be better used in the learning spaces so that they do not appear

identical and monotonous. The findings indicated that 27.4% of respondents were not satisfied

with the aesthetic features of the physical environment in the learning spaces, including color,

shape, plants, and art installation. Therefore, the researcher considered visual and tactile design

elements to improve these features. According to literature review, the colors blue, yellow, red,

green, brown, and orange help students obtain positive effects in their learning, and different

geometric shapes suggested special meanings such as straight lines, squares, rectangles, and

triangular shapes to express a sense of strength, courage, security, stability, and balance. After

these sensory design elements were applied to design alternatives such as finish materials, types

of furniture, furniture arrangement, and space layout, each learning space became more distinct, so they strengthened their functional expression. The arrangement of plants in the learning spaces was another important suggestion of design alternatives because natural views can create positive feelings in the environment. According to the findings, it was indicated that 35% of respondents did not experience access to nature and daylight in the learning spaces. Thus, the researcher created a plant wall in the design alternatives to establish a visual connection with nature in the reading area; meanwhile, outdoor scenery was conveyed to the interior environment via a large window which provided a comfortable and healthy physical environment in the learning spaces.

Even though the findings indicated students were happy with the style, type, size, and function of tables and chairs, 23% of respondents were fully satisfied with many seating functions and did not indicate a high expectation level of seating size. Participants also mentioned that some of the chairs were too high with a low table, which caused discomfort to their necks. Thus, the researcher selected adjustable chairs with casters for group and individual study areas. These chairs can adjust their height to fit tables, and could be flexibly moved to meet collaborative work needs. Beside adjustable chairs, some lightweight chairs like the Bolia and Jenny, Millbrae armchair (Steelcase, n.d.) also supported multiple functional needs in the learning spaces. At the same time, the researcher selected soft and bright color texture on finish materials of the furniture while imparting fresh tones, textures, and temperatures to be incorporated with the entire design.

The design alternatives applied a variety of tufted textured loop carpet (Interface, n.d.) for flooring materials that provide a quiet environment to focus on learning. Meanwhile, the researcher also kept using 2'x2' and 2'x4' acoustic ceiling tiles as ceiling finish materials to

reduce noise in the public learning spaces, but rearranged different color panels into them that

would be appropriate to the entire design style. The researcher also attempted to create more

enthusiasm in learning spaces by changing the color of finish materials. In the "open-ended

questions," the students mentioned lighting was not bright enough in the learning spaces, and the

findings indicated that 16.5% of respondents were not happy with task lighting, so the researcher

suggested applying various luminaries in the learning spaces. For instance, 2'x2' CPX LED flat

panel, 2'x4' recessed Amica LED luminaire, and Seem® 4 LED Asymmetric Flush Lens (Focal

Point, n.d.a, n.d.b) were suggested as options for lighting. These types of ambient lighting not

only provided ample lighting without glare for learners but also accommodated different learning

needs. The dash mini LED task lights were applied to the individual study areas since it is easy

to adjust the light brightness for users' needs. These light fixtures were selected from the

manufacturer that professionally provides positive lighting effects for learning. They also

achieved comfort visual perception, reduced visual fatigue, and beautified the entire

environment.

        The findings, in addition, indicated that 21.2% of respondents were not satisfied with

technology, including touch screens, TVs, and multimedia gadgets; also, based on researcher

observations, there were few technologies used in the learning activities. Therefore, the

researcher suggested applying haptic technology to be used in learning. For instance, the sensor

light wall can display people's shape with light when people walk by this wall, and interactive

illuminated flooring can record footprints after walking across the Light Fader. The movable

media screen was another useful technology product that was beneficial in collaborative work, in

that students can use it to give a presentation or share their information for group work. In the

public/alone areas for individual study, the wall-mounted TV also helped students to carry out

learning activities. A robot helped students to look for and reach books alongside the bookshelves. This technology was applied in the learning spaces not only to assist learning but also to modernize the spaces.

Through visual and tactile design theory, these design alternatives presented some insights and ideas for the next academic library to apply. As the learning spaces of the academic library are about serious study and learning, what might be discovered is unique learning spaces from the perspective of vision and touch. Currently, the UCO Library has added some new furniture and is also exploring different ways to meet the needs of students in the learning spaces, which is a very optimistic beginning.

Limitations and Future Research

This study excluded the print center, the information desk, and the classrooms of learning commons to collect data and to suggest design ideas. These areas can be considered as important learning spaces for student's learning so that the researcher needs to consider these areas in the future research. In addition, the future research may consider adding more sensory design approaches such as hearing and smell senses.

Although these design alternatives were suggested based on applications of the sensory design theory, a series of case studies, and findings of the observation and survey, the final design suggestions with the application of visual and tactile design features need to be evaluated whether or not they meet the needs of students in the future research. The researcher will develop the Virtual Reality (VR) tool to conduct the post-survey about students' satisfaction levels about the design suggestions of this research by allowing participants walk through the virtual environments of the learning spaces which applied visual and tactile sensory design features.

Implications

This study will contribute to designing academic libraries using sensory design features for improved learning spaces and enhance students' learning outcomes. The UCO Library, as a case study, can be used as an example for other researchers, institutions, or designers who are interested in developing the study topics and designing academic libraries and learning spaces. The survey questionnaire and observation checklists which were used in this study will be able to provide other researchers with basic knowledge and guidance for organizing and collecting data. These data collection tools can be modified to apply to different types of academic libraries to explore students' needs, satisfaction, and expectations Because learning is the power of the continuous advancement of human civilization, more people are now paying attention to the importance of learning spaces. The sensory design theory, hence, can be applied to the learning spaces where the students' needs are met and their success is achieved.

References

AGATI Furniture. (2017). Choosing the right furniture for you library [PDF file]. Retrieved

from https://www.agati.com/wp-content/uploads/2018/01/Agati-Furniture-Book-2017.pdf

Al-Ayash, A, A, A. (2015). The influence of colour on learning in University libraries [PDF

file]. *School of Built Environment Department of Architecture and Interior Architecture.*

Retrieved from

https://pdfs.semanticscholar.org/c5e7/cb2fa257ae7c756945ee47451e5535ed6ded.pdf

Amara, M. (2013). Space planning, design 102: Implementing your plan. *Demco.* Retrieved from

https://ideas.demco.com/blog/space-planning-design-102-implementing-your-plan/

Amelar, S. (2019). Taking down the walls. *Gensler.* Retrieved from

https://www.gensler.com/research-insight/publications/dialogue/30/taking-down-the-

walls

Andrews, C., & Wright, S. E. (2015). Library learning space: Investigating libraries and

investing in student feedback. *Journal of Library Administration, 56*(6)*, 647-672.*

Array Interactive (Producer). (2013). *Creating a next generation library* [YouTube]. Retrieved

from https://www.youtube.com/watch?v=WksFwU2VkhU

Aulive nv (Producer). (2007). *Aperture facade installation* [YouTube]. Retrieved from

https://www.youtube.com/watch?v=QWUEPBXyj2E&feature=emb_title

Barclay, D, A. (2007). Creating an academic library for the twenty-first century. *InterScience, 139,*

103-115. doi:10.1002/he.271

Branz Ltd. (2007). Designing quality learning spaces: lighting [PDF file]. *Ministry of Education.*

Retrieved from https://www.education.govt.nz/assets/Documents/Primary-

Secondary/Property/Design/Flexible-learning-spaces/BranzLightingDesignGuide.pdf

Breffeilh, R. (n.d). Technology and the senses: Multi-sensory design in the digital age [PDF file]. Retrieved from https://www.huichawaii.org/assets/breffeilh%2C-rebecca--technology- and-the-senses.pdf

Broz, D. (2011). The college library is ready for its close-up. *GenslerOn Cities.* Retrieved from http://www.gensleron.com/cities/2011/10/3/the-college-library-is-ready-for-its-close- up.html

Chang, B., Xu, R., & Watt, T. (2018). The impact of colors on learning. *Adult Education Research Conference.* Retrieved from https://newprairiepress.org/aerc/2018/papers/30/

Chen, Y. T., & Chuang, M. C. (2014). The study of tactile feeling and it's expressing vocabulary. *International Journal of Industrial Ergonomics, 44*, 675-684.

Child, S., Matthews, G., & Walton, G. (2013). Space in the university library – an introduction. *Loughborough University Institutional Repository,* 1-8.

Ching, F. D. K., & Binggeli, C. (2012). Design vocabulary. In *Interior Design Illustrated* (Vol. 3rd ed). Hoboken: Wiley. Retrieved from https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=442145&site=ehost -live

Christensen, E. (n.d). Natural patterns. Retrieved from https://ecstep.com/natural-patterns/#top

Clements-Croome, D. J., Keeling, T., Luck, R., & Pointer, P. (2012). How the sensory experience of buildings can contribute to wellbeing and productivity. *ResearchGate.* Retrieved from https://www.researchgate.net/profile/D_Clements-Croome

Dahlgren, A, C. (2009). Public library space needs: A planning outline / 2009 [PDF file]. *Wisconsin Department of Public Instruction.* Retrieved from https://dpi.wi.gov/sites/default/files/imce/pld/pdf/plspace.pdf

Demaria, F. (2018). Biophilia and interior design: Creating multi-sensorial experience. Retrieved from https://www.terramai.com/blog/biophilia-interior-design-create-multi-sensorial-experience/

Deruy, E. (2017). Virtual reality and smoothie bars: What's in at bay area university libraries? *East Bay Time*. Retrieved from https://www.eastbaytimes.com/2017/07/10/virtual-reality-and-smoothie-bars-the-modern-university-library/

Desantis Breindel. (2019). Technology brand colors: Red, bright, and blue. Retrieved from https://www.desantisbreindel.com/insights/b2b-tech-brand-colors/

Designing Libraries. (2013). A social hub of information, technology and services. *Designing Libraries C.I.C*. Retrieved from http://designinglibraries.org.uk/index.asp?PageID=444

Deziel, C. (n.d.). What is the difference between visual texture and tactile texture in design? *Hunker*. Retrieved from https://www.hunker.com/13412625/what-is-the-difference-between-visual-texture-and-tactile-texture-in-design

Djkopas. (2018). From traditional school library to learning commons: Why this evolution is necessary for today's students. *Dancker*. Retrieved from https://www.dancker.com/blog/from-school-library-to-learning-commons-why-this-evolution-is-necessary-for-todays-students/

Donoff, E. (2015). A new addition to Staten Island's Stapleton Library creates a 21st-century gathering place while reinvigorating the local community. *Architectural Lighting*. Retrieved from https://www.archlighting.com/projects/second-edition_o

Enabling Devices. (n.d.). Sensory products. Retrieved from https://enablingdevices.com/product-category/sensory/

FG Library & Learning. (2019). Sensory storywall. Retrieved from

      https://www.fglibrary.co.uk/furniture/sensory-storywall

Focal Point. (n.d.a). "Amica 2x4." *Focal Point.* Retrieved from

      https://www.focalpointlights.com/BIMlibrary

Focal Point. (n.d.b). "Seem 4 LED." Retrieved from

      https://www.focalpointlights.com/products/linear/seem-4-led-fsm4ls

Focal Point. (n.d.c). "Seem 4 LED Asymmetric Flush. Retrieved from

      https://www.focalpointlights.com/BIMlibrary

Focal Point. (n.d.d). "Skydome® LED 2', 3', 4' - Pendant." *Focal Point.* Retrieved from

      https://www.focalpointlights.com/BIMlibrary

Focal Point. (n.d.e). "Verve IV LED." *Focal Point.* Retrieved from

      https://www.focalpointlights.com/BIMlibrary

Franz, R. (2016). Library as learning commons: 3 key zones. *Ideas Inspiration from Demco.*

      Retrieved from https://ideas.demco.com/blog/library-learning-commons/

Gallace, A., & Spence, C. (2010). The science of interpersonal touch: An overview.

      Neuroscience and Biobehavioral Reviews, 34. 246–259.

Gensler, A. Rosenstein., K. Tompkin, G., Cubbison, E., Dobelle, E., Knight,L.,… Tavenner, D.

      (2016). A high-performance place for learning. *Gensler.* Retrieved from

      https://www.gensler.com/research-insight/gensler-research-institute/a-high-performance-

      place-for-learning

Haller, K (2017). Colour in interior design. *ScienceDirect*. Retrieved from

      https://www.sciencedirect.com/science/article/pii/B978008101270300014X?via%3Dihub

Hale Library Furniture. (2017). Price list [PDF file]. Retrieved from http://halemfg.com/wp-

      content/uploads/2017/08/Library-Price-List-2017.pdf

Hickson, K. (2014). What is the function of libraries in our new "wired" world? *GenslerOn*

      Cities. Retrieved from http://www.gensleron.com/cities/2014/8/29/what-is-the-function-

      of-libraries-in-our-new-wired-world.html

Hofstra University Library. (2018). Where to study in Axinn library. Retrieved from

      http://libguides.hofstra.edu/studyspaces/quiet

Interface. (n.d.). Retrieved from https://www.interface.com/US/en-US/homepage?r=1learn

Jabi, W., Borcea, C., Passerini, K., & Hall, T. W. (2008). Early experiences with

      interdisciplinary design studios. *ResearchGate.* Retrieved from

      https://www.researchgate.net/publication/228917107_Early_Experiences_with_Interdisci

      plinary_Design_Studios

Jackson, K. (2018). Biophilic design is bringing nature into the office. *Azure*. Retrieved from

      https://www.azuremagazine.com/article/biophilic-design-nature-office/

Jalil, N, A., Yunus, R, M., & Said, N, S. (2012). Environmental colour impact upon human

      behaviour: A review. *SciVerse ScienceDirect, 35,* 54-62.

Jantz, R, C. (2012). Innovation in academic libraries: An analysis of university librarians'

      perspective. *Library & Information Science Research, 34,* 3-12.

Kaplan. (n.d.). Using color to enhance learning and influence mood. Retrieved from

      https://www.kaplanco.com/ii/using-color-to-enhance-learning

Katerina, M. (2012). Natural light in learning environments (Master's thesis). Retrieved from

      https://www.academia.edu/2018655/Natural_light_in_learning_environments

Knoll. (n.d). Retrieved from https://www.knoll.com/shop/knolltextiles/upholstery

Kowalczyk, P. (2018). Library of the future: 8 technologies we would love to see. *Ebook Friendly.* Retrieved from https://ebookfriendly.com/library-future-technologies/

Kreij, K. V. (2010). Sensory intensification in architecture (Master's thesis). *Scribd.* Retrieved from https://www.scribd.com/document/54867117/Sensory-Intensification-in-Architecture-by-Kamiel-Van-Kreij

Lacović, D. (2014). Students' information behavior and the role of academic library. *Libellarium*, *7*(1), 119-139.

Learn Through Experience, (2018). The power of context: Learning through your senses. Retrieved from http://learnthroughexperience.org/blog/power-of-context-learning-through-senses/

Lehman, M. L. (n.d.). How sensory design can help responsive architecture be more effective. *Maria Lorena Lehman Mll Design Lab.* Retrieved from https://marialorenalehman.com/post/how-sensory-design-can-help-responsive-architecture-be-more-effective

Leone, C. W. (2008). Come to your senses. *IIDA,* Retrieved from http://www.iida.org/content.cfm/come-to-your-senses

Library of the Future. (n.d.). Haptic technology. *American Library Association*. Retrieved from http://www.ala.org/tools/future/trends/haptic

Lithonia Lighting. (n.d.a). "Contractor Select CPX LED Flat Panel." *AcuityBrands.* Retrieved from https://www.acuitybrands.com/products/detail/855690/lithonia lighting/contractor-select-cpx-led-flat-panel/most-popular-and-readily-available-configurations-for-your-everyday-lighting-needs

Lithonia Lighting. (n.d.b). "Narrow Wrap." *AcuityBrands.* Retrieved from

https://lithonia.acuitybrands.com/products/detail/47229/lithonia-lighting/narrow-

wrap/decorative-indoor-linear-design

Lupton, E. & Lipps, A. (2018). Why sensory design? *CooperHewitt.* Retrieved from

https://www.cooperhewitt.org/2018/04/03/why-sensory-design/

Lux, V., Snyder, R. J., & Boff, C. (2016). Why users come to the library: A case study and non-

library units. *The Journal of Academic Librarianship, 42,* 109-117.

Magagula, S. (2018). 6 tools to optimize classrooms: Learning through the senses. *Healing*

Places. Retrieved from https://www.healingplaces.nl/single-post/2018/04/03/6-Tools-To-

Optimize-Classrooms-Learning-Through-the-Senses

Malman, D. (2005). Lighting for libraries [PDF file]. Libris Design. Retrieved from

https://hosting.iar.unicamp.br/lab/luz/ld/Arquitetural/diversos/Lighting%20for%20Librari

es.pdf

Mathur, P., Singhal, M., & Bhardwaj, S. (2014). Haptic - A tactile feedback technology an

overview [PDF file]. *College of Computing Sciences and Information Technology.*

Retrieved from http://tmu.ac.in/college-of-computing-sciences-and-it/wp-

content/uploads/sites/17/2016/10/T420.pdf

McKinley, H. (2019). Children interacting with high-tech tables at libraries. Retrieved from

https://www.thegazette.com/subject/news/children-interacting-with-high-tech-tables-at-

libraries-20140614

McMullen, S., & Williams, R. (2008). US academic libraries: Today's learning commons model

[PDF file]. *OECD.* Retrieved from https://www.oecd.org/unitedstates/40051347.pdf

Medgar Evers College Library of the City University of New York. (2017). Retrieved from

http://arcdog.com/portfolio/medgar-evers-college-library-of-the-city-university-of-new-

york/

Mei, X.Y. (2014). To create a happy reading at library. *Qual Quant, 48,* 1143-1147.

doi:10.1007/s11135-013-9917-2.

Metcalf, K. D. (1970). Library Lighting [PDF file]. *The association of research libraries.*

Retrieved from https://files.eric.ed.gov/fulltext/ED053762.pdf

Montgomery, S. E. (2014). Library space assessment: User learning behaviors in the library. *The

Journal of Academic Librarianship, 40,* 70-75.

Moody Monday. (2015). Texture variations in interior design. Retrieved from

https://www.moodymonday.co.uk/2015/06/texture-variations-in-interior-design/

Nova Southeastern University. (n.d.). Pick a place to study — Individual study.

Studyhttps://nsufl.libguides.com/c.php?g=112209&p=2807779

Oblinger, D, G. (2006). Learning space. *EDUCAUSE.* Retrieved from

https://www.educause.edu/research-and-publications/books/learning-spaces

O'Kelly, M., Scott-Webbe, L., Garrision, J., & Meyer, K. (2017). Can a library building's design

cue new behaviors? A Case Study. *portal: Libraries and the Academy,* 17*(4),* 843-862*.*

doi:10.1353/pla.2017.0049.

Oliveira, S, M. (2016). Space preference at james white library: What students really want. *The

Journal of Academic Librarianship, 42,* 355-367.

Perera, N., & Swaris, N. (2017). Good reading light: Visual comfort perception and daylight

integration in library spaces. *ResearchGate.* Retrieved from

https://www.researchgate.net/publication/321719388_Good_Reading_Light_Visual_Com

fort_Perception_and_Daylight_Integration_in_Library_Spaces

Planer (n.d.). Touch screen display solutions from desktop monitors to video walls. (2019).

Retrieved from https://www.planar.com/products/touch-displays/

Plummer, S. (2017). Library week offers students fun activities to enjoy before finals. *OSU

Institute of Technology.* Retrieved from https://osuit.edu/news/library-week-offers-

students-fun-activities-enjoy-finals.php

Pohl, I. M., & Loke, L. (2012). Engaging the sense of touch in interactive architecture.

ResearchGate, doi:10.1145/2414536.2414611

Postscapes. (2015). Google's project jacquard brings touch to textiles. Retrieved from

https://www.postscapes.com/googles-project-jacquard-brings-touch-to-textiles

The Psychology of Color: How do colors influence learning? (2019). Retrieved from

https://www.shiftelearning.com/blog/how-do-colors-influence-learning

Reddy, J. V. (2015). Evaluation of library furniture and anthropometric characteristics of St.

Mary's students for ergonomics design of table and chair. I*nternational Journal of

Research Studies in Science, Engineering and Technology*, 2(5), 27-32.

Rewi, A. J. (n.d.). Tactile technology. *IIDA.* Retrieved from

http://www.iida.org/content.cfm/tactile-technology

Robinson, D. H. (2012). Illuminating the effects of dynamic lighting on student learning. *SAGE

Open.* Retrieved from https://doi.org/10.1177/2158244012445585

Roca, M. L. (2003). Interior designing that celebrates the five senses. *Harrington College of

Design.* Retrieved from http://www.harrington.edu/Student-Life/Blog/August-

2013/Interior-Design-Focusing-On-The-5-Senses

Ross, T, A. (2009). Design multi-sensory learning environments for students who are challenged by sensory experiences [PDF file]. Retrieved from https://www.op.ac.nz/assets/Uploads/590b536c46/04-166-AllanRoss-11-09.pdf

Salvador, M. G. S., Sanchez, M. G., & Awat, V. (2013). Factors affecting the learning behaviors of students. Retrieved from https://www.academia.edu/18084545/FACTORS_AFFECTING_THE_LEARNING_BE HAVIORS_OF_STUDENTS

Smore. (n.d.). Element of Art: TEXTURE. Retrieved from https://www.smore.com/9xm5-elements-of-art-texture

Sonneveld, M. H., Ludden, G. D. S., & Schifferstein, H. N. J. (2008). Multi sensory design in education. *ResearchGate.* Retrieved from https://www.researchgate.net/publication/286043976_Multi_sensory_design_in_educatio n

Steelcase – Libraries. (n.d.). Learning spaces – Libraries. Retrieved from https://www.steelcase.com/eu-en/discover/information/education-professionals/active-learning-spaces-libraries/

Sufar, S., Talib, A., & Hambali, H. (2012). Towards a better design: Physical interior environment of public libraries in peninsular Malaysia. *SciVerse ScienceDirect, 42,* 131-143.

Sullivan, M. (2011). How to create the 21st-century school library of your dreams. *Smith System.* Retrieved from https://smithsystem.com/resource-library/article-library/divine-design-create-21st-century-school-library-dreams/#

Sullivan-Windle, B. (2013). Students' perceptions of factors influencing effective library use.

    Australian Academic & Research Libraries, 24(2), 95-104.

    doi:10.1080/00048623.1993.10754821

Thaler, M. (2013). Confronting the library paradox. Retrieved from

    http://www.gensleron.com/cities/2013/8/19/confronting-the-library-paradox.html

Thaler, M., Burke-Vigeland, M., Hickson, K., Broz, D., Anderson, A., Barber, C., … Wightman,

    S. (2014). Future of the academic library. *Gensler.* Retrieved from

    https://www.gensler.com/research-insight/gensler-research-institute/future-of-the-

    academic-library

Tubik Studio. (2017). Knock design into shape. Psychology of shapes. Retrieved from

    https://uxplanet.org/knock-design-into-shape-psychology-of-shapes-6e43c6e59955

Turner, A. Welch, B. & Reynolds, S. (2013). Learning spaces in academic libraries – A review

    of the evolving trends. *Australian Academic & Research Libraries*, *44*(4), 226-234.

    doi:10.1080/00048623.2013.857383

Wastiels, L., Schifferstein, Hendrik N. J., Wouters, I., & Heylighen, A. (2013). Touching

    materials visually: About the dominance of vision in building material assessment.

    Original Article, 7(2).

What you need to know about sensory design. (2016). Retrieved from https://medium.com/syfte-

    blog/what-you-need-to-know-about-sensory-design-f4d02f4633ce

Zeiger, M. (2017a). A library is reimagined as a luminous cultural hub. *Architectural Lighting.*

    Retrieved from https://www.archlighting.com/projects/53rd-street-library-new-york-

    public-library-new-york_o

Zeiger, M. (2017b). Smythe library renovation, Tonbridge school, Kent, England. *Architectural*

   Lighting. Retrieved from https://www.archlighting.com/projects/smythe-library-

   renovation-tonbridge-school-kent-england_o

APPENDIX 1: SURVEY QUESTIONNAIRE

SECTION ONE

1. You are:

☐ Freshman   ☐ Sophomore   ☐ Junior   ☐ Senior

☐ Graduate Student   ☐ Other [   ]

2. On average, **how often** do you use the UCO Chambers Library?

☐ Everyday   ☐ Several times a week   ☐ Several times a month

☐ About once a month   ☐ Several times a semester   ☐ This is my first visit

3. **What do you usually do** when you visit the UCO Chambers Library? (Select Top Three)

☐ Borrow/Return library sources   ☐ Use of the copy machine   ☐ Use of the computer station

☐ Attend library programs/classes ☐ Group meeting/study   ☐ Individual study

☐ Meet friends   ☐ Read library sources   ☐ Use of the Service Desk

☐ Others [   ]

4. Overall, **Learning Spaces*** of the UCO Chambers Library enhance my **learning outcomes** (quantity and quality of learning/studying output)?

Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree	N/A
☐	☐	☐	☐	☐	☐	☐	☐

*The learning spaces includes group study areas, individual study areas, reading areas, and learning commons (computer stations, multimedia zones). Please check pictures on the separate pages.

SECTION 2: The Physical Environments of Learning Spaces in the UCO Chambers Library

5. How **satisfied** are you with each of the following **physical environment features** of the overall **Learning Spaces*** in the UCO Chambers Library?

	Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied	Don't know or N/A
Space planning & Layout	☐	☐	☐	☐	☐	☐	☐	☐
Finding a way & a destination	☐	☐	☐	☐	☐	☐	☐	☐
Furniture (type/size/arrangement)	☐	☐	☐	☐	☐	☐	☐	☐
Lighting (illuminance/control/type)	☐	☐	☐	☐	☐	☐	☐	☐
Finish material (floor/wall/ceiling)	☐	☐	☐	☐	☐	☐	☐	☐
Aesthetics (color/shape/plants/art installation)	☐	☐	☐	☐	☐	☐	☐	☐
Technologies* (touch screen /TV/multimedia)	☐	☐	☐	☐	☐	☐	☐	☐

*Technologies include Touch screen for checking library floor maps / TVs of group study rooms / multimedia including electric piano, CD player, and record player.

6. Which area do you **frequently use** for the following **activities** in the UCO Chambers Library's **Learning Spaces**? (Select Top ONE or TWO learning spaces per each activity). Please check pictures on the separate pages.

	Group Study Areas **TY1**	Group Study Areas **TY2**	Individual Study Areas **TY3**	Individual Study Areas **TY4**	Learning Commons **TY5**	Reading Areas **TY6**	None/ Never Used
Individual Study	☐	☐	☐	☐	☐	☐	☐
Collaboration & Communication (group study, group work)	☐	☐	☐	☐	☐	☐	☐
Socialization (meeting with friends & other students)	☐	☐	☐	☐	☐	☐	☐
Entertainment (playing game/hearing music/watching movie, etc.)	☐	☐	☐	☐	☐	☐	☐
Reading Library Materials	☐	☐	☐	☐	☐	☐	☐
Search Information	☐	☐	☐	☐	☐	☐	☐
Print/Copy Materials	☐	☐	☐	☐	☐	☐	☐
Take Classes & Training	☐	☐	☐	☐	☐	☐	☐
Library Service *	☐	☐	☐	☐	☐	☐	☐

**Library Service includes IT service, circulation information (library materials), equipment checkout & use, library instruction.

SECTION 3: The Use of Group and Individual Learning Spaces in the UCO Chambers Library

7. How satisfied are you with each of the following features of the **Group Study Areas (both Type 1 & 2)** in the UCO Chambers Library?

	Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied	Don't know or N/A
Sound Privacy*	☐	☐	☐	☐	☐	☐	☐	☐
Visual Privacy**	☐	☐	☐	☐	☐	☐	☐	☐
Location	☐	☐	☐	☐	☐	☐	☐	☐
Furniture Arrangement (clearance***/flexibility****)	☐	☐	☐	☐	☐	☐	☐	☐
Furniture Size (table/desk/seating)	☐	☐	☐	☐	☐	☐	☐	☐
Light Level (the amount of light)	☐	☐	☐	☐	☐	☐	☐	☐
Equipment & Supplies (movable white board/TV/charging plug)	☐	☐	☐	☐	☐	☐	☐	☐
Aesthetics (color/shape/plants/art installation)	☐	☐	☐	☐	☐	☐	☐	☐

*Sound Privacy: the inability of an unintentional listener to understand another person's conversation
** Visual Privacy: being accessed visually or visual separation from general circulation and other areas
***Clearance: Between furniture and furniture have room for people going through
****Flexibility: dynamic furniture arrangement (individual-to-collaborative)

8. How satisfied are you with each of the following features of the **Individual Study Areas (both Type 3 & 4)** in the UCO Chambers Library?

	Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied	Don't know or N/A
Sound Privacy	☐	☐	☐	☐	☐	☐	☐	☐
Visual Privacy	☐	☐	☐	☐	☐	☐	☐	☐
Location	☐	☐	☐	☐	☐	☐	☐	☐
Furniture Arrangement (clearance/flexibility)	☐	☐	☐	☐	☐	☐	☐	☐
Furniture Size (table/desk/seating)	☐	☐	☐	☐	☐	☐	☐	☐
Light Level (the amount of light)	☐	☐	☐	☐	☐	☐	☐	☐
Equipment & Supplies (movable white board/TV/charging plug)	☐	☐	☐	☐	☐	☐	☐	☐
Aesthetics (color/shape/plants/art installation)	☐	☐	☐	☐	☐	☐	☐	☐

SECTION 4: The Use of Learning Commons and Reading Areas in the UCO Chambers Library

---

9. How satisfied are you with each of the following features of the **Learning Commons** (**Type 5)** in the UCO Chambers Library?

	Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied	Don't know or N/A
Sound Privacy	☐	☐	☐	☐	☐	☐	☐	☐
Visual Privacy	☐	☐	☐	☐	☐	☐	☐	☐
Location	☐	☐	☐	☐	☐	☐	☐	☐
Furniture Arrangement (clearance/flexibility)	☐	☐	☐	☐	☐	☐	☐	☐
Furniture Size (table/desk/seating)	☐	☐	☐	☐	☐	☐	☐	☐
Light Level (the amount of light)	☐	☐	☐	☐	☐	☐	☐	☐
Equipment & Supplies (movable white board/TV/charging plug)	☐	☐	☐	☐	☐	☐	☐	☐
Aesthetics (color/shape/plants/art installation)	☐	☐	☐	☐	☐	☐	☐	☐

10. How satisfied are you with each of the following features of the **Reading Areas** (**Type 6)** in the UCO Chambers Library?

	Very Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neutral	Somewhat Satisfied	Satisfied	Very Satisfied	Don't know or N/A
Sound Privacy	☐	☐	☐	☐	☐	☐	☐	☐
Visual Privacy	☐	☐	☐	☐	☐	☐	☐	☐
Location	☐	☐	☐	☐	☐	☐	☐	☐
Furniture Arrangement (clearance/flexibility)	☐	☐	☐	☐	☐	☐	☐	☐
Furniture Size (table/desk/seating)	☐	☐	☐	☐	☐	☐	☐	☐
Light Level (the amount of light)	☐	☐	☐	☐	☐	☐	☐	☐
Equipment & Supplies (movable white board/TV/charging plug)	☐	☐	☐	☐	☐	☐	☐	☐
Aesthetics (color/shape/plants/art installation)	☐	☐	☐	☐	☐	☐	☐	☐

SECTION 5: Furnishing, Lighting, Finish Materials, Aesthetics of Learning Spaces in UCO Library

---

11. Overall, at what level do the following **furniture features** of the UCO Chambers Library's **Learning Spaces** meet your expectations for studying and learning?

	Far short of Expectations	Moderately Below Expectations	Slightly Below Expectations	Meets Expectations	Slightly Above Expectations	Moderately Above Expectations	Far Exceeds Expectations	Don't know or N/A
Table/Desk Mobility & Flexibility (easy to move for group or individual study & learning)	☐	☐	☐	☐	☐	☐	☐	☐
Table/Desk Size (height/length/width)	☐	☐	☐	☐	☐	☐	☐	☐
Table/Desk Type (carrel/square/circle)	☐	☐	☐	☐	☐	☐	☐	☐
Table/Desk Functions (height & size adjustment/ charging plug option)	☐	☐	☐	☐	☐	☐	☐	☐
Table Finish Materials (type/color/texture)	☐	☐	☐	☐	☐	☐	☐	☐
Seating Size (seat & back height/ seat width & depth)	☐	☐	☐	☐	☐	☐	☐	☐
Seating Mobility	☐	☐	☐	☐	☐	☐	☐	☐
Seating Type (sofa/chair/stool/booth seat)	☐	☐	☐	☐	☐	☐	☐	☐
Seating Functions (height & tilt adjustment/ charging plug option)	☐	☐	☐	☐	☐	☐	☐	☐
Seating Finish Materials (type/color/pattern/ texture)	☐	☐	☐	☐	☐	☐	☐	☐
Furniture Design Style	☐	☐	☐	☐	☐	☐	☐	☐

12. Would you please give any suggestions about the **Furnishing** to improve the learning space environment for your learning and studying?

13. Overall, at what level do the following **Lighting, Finish Materials, and Aesthetic features** of the UCO Chambers Library's **Learning Spaces** meet your expectations for studying and learning?

	Far short of Expectations	Moderately Below Expectations	Slightly Below Expectations	Meets Expectations	Slightly Above Expectations	Moderately Above Expectations	Far Exceeds Expectations	Don't know or N/A
Ambient Lighting* **Level** (the amount of light)	☐	☐	☐	☐	☐	☐	☐	☐
Task Lighting** Level (the amount of light)	☐	☐	☐	☐	☐	☐	☐	☐
Lighting Control (on & off)	☐	☐	☐	☐	☐	☐	☐	☐
Access to Daylight	☐	☐	☐	☐	☐	☐	☐	☐
Floor Finish Material (type/color/pattern/ texture)	☐	☐	☐	☐	☐	☐	☐	☐
Wall Finish Material (type/color/pattern/ texture)	☐	☐	☐	☐	☐	☐	☐	☐
Ceiling Finish material (type/color/pattern)	☐	☐	☐	☐	☐	☐	☐	☐
Access to Nature (plants/outside view)	☐	☐	☐	☐	☐	☐	☐	☐
Art Installation	☐	☐	☐	☐	☐	☐	☐	☐

*Ambient Light: general light that provides a uniform level of illumination throughout the space
**Task Light: light on the tasks a person carries out such as reading, studying, computer work, for which a brighter light is required

14. Would you please give any suggestions about **Lighting, Finish Materials, and Aesthetic features** to improve the learning space environment for your learning and studying?

[text box]

Thank you so much for your time to complete this survey!

APPENDIX 2: VISUAL HANDOUT PHOTOS OF LEARNING SPACES FOR SURVEY

Learning Spaces

Group Study Area   Type 1 [Public / Together]

1st Level   2nd Level   3rd Level   4th Level   4th Level MAX

Group Study Area   Type 2 [Private / Together]

2nd Level   3rd Level

Individual Study Area   Type 3 [Public / Alone)

1st Level   1st Level   2nd Level
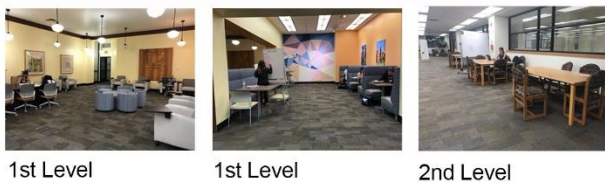
Individual Study Area   Type 4 [Private / Alone)

2nd Level   3rd Level   3rd Level   4th Level   4th Level

Learning Commoms   Type 5

1st Level   1st Level   2nd Level   3rd Level   4th Level   4th Level

Reading Area   Type 6

1st Level   1st Level   3rd Level   3rd Level   4th Level
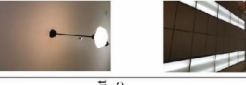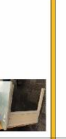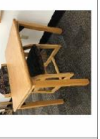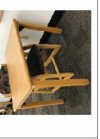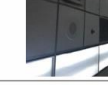
APPENDIX 3: OBSERVATION OF THE PHYSICAL ENVIRONMENT FEATURES

Observation of the Physical Environment Features

Level	Zone	Learning Spaces	Location (North/South)	Seating – Material	Seating – Shape	Seating – Size	Furniture Table/Desk – Material	Table/Desk – Shape	Table/Desk – Size	Light Fixture – Type	Light Fixture – Lamp	Floor – Material	Wall – Material	Ceiling – Material
1	A	Group Study Area (GS) / Public/Together (PUT)	South; North	Wood & Fabric	Square	1. W: 18 5/8" L: 18" H: 16" 2. W: 17 1/4" L: 17" H: 17" 3. Stool: W: 13" L: 1' 4" H: 16" 4. W: 15" L: 17" H: 16"	Wood	Rectangle Table	1. Diameter: 41" H: 25" 2. W: 32" L: 6' H: 26" 3. W: 41" L: 61" H: 25" 4. W: 5'1" 7'6" H 25" 5. W: 41" L: 61" H: 25" 6. W: 3' L: 7'6" H: 26" 7. W: 3'1" L: 41" H: 25" 8. W: 2'1" L: 31" H: 25" 9. W: 3' L: 5' H: 24"	Direct Light & Linear Troffer with Len; Indirect Suspended Linear Fluoresent / LED Fixture Light	Fluorescent; Fluoresent/ LED	Carpet	Paint & Glass Wall	Acoustic Panel & White Paint
	B	Individual Study Areas (IS) / Public / Alone (PUA)	South; North	Wood & Fabric; leather & Upholstery; Wood	Sofa; Office Chair; Stool; Small Sofa; High Back Chair	W: 27" L: 27" H: 1'4"; W: 16 1/2" L: 17" H: Can Adjust; Diameter: 22" H: 16 1/4"; W: 27 3/4" H: 16 1/4"; W: 17" H: Can Adjust	Wood	Pendant Light... Rectangle Long Table; Rectangle Long Table with Two Legs; Sofa with Table; Cricle Table	W: 18" L: 2' H: 1'8"; 4' x 8' x 24 1/2"; 4' x 26" x 2'5 3/8"; 3' x 3' x 2'5 3/8"; 29" x 3'6" x 3'3"	Pendant Light; Task Light & Direct Light & Diffiuse Light & Troffer Light	LED; Task, Halogen & Fhluorescent	Carpet	Orange Paint	White Paint & Aconstic Panel
	C	Learning Commons (LC) / Computer Workstation (CWC)	North	Fabric	Office Chair	1. W: 16 1/2" L: 17" H: Can Adjust 2. W: 15" L: 17" H: 16' 3. W: 17" L: 18" H: Can Adjust	Wood	Wood & Office Table	1. W: 2' L: 2'11" H: 25 1/2" 2. W: 1' 11 5/8" L: 3'6" H: 25" 3. W: 2'6" L: 6 H: 2'5"	Direct / Indirect Light	Fhluorescent	Carpet	Paint	Acoustic Panel
	D	Reading Areas (RA) / Reading Areas (RA) Bookshelves	North	Wood & Fabric	Square	W: 17 1/4" L: 17" H: 17"	Wood	Rectangle	W: 2'1 1/2" L: 3' 11/4" H: 25"	Direct / Indirect Light Pendant Light	Fhluorescent LED	Carpet	Paint	Acoustic Panel

Observation of the Physical Environment Features

Level	Zone	Learning Spaces		Location (North / South)	Furniture – Seating (Material / Shape / Size / Photo)			Furniture – Table/Desk (Material / Shape / Size / Photo)			Light (Type / Lamp / Photo)		Floor (Material / Photo)		Finish Materials – Wall (Material / Photo)	Finish Materials – Ceiling (Material / Photo)
2	A	Group Study Area (GS)	Private/ Together (PT)	North ✓	Fabric	office	W: 17" L: 18" H: Can Adjust	Wood	Rectangle Table	W: 41" L: 61" H: 25"	Troffer	Fluorescent	Carpet		Paint	Acoustic Panel
			Public/ Together (PUT)	South ✓	Wood & Fabric	Square	1. W: 18 5/8" L: 18" H: 16" 2. W: 17 1/4" L: 17" H: 17"	Wood	Circle	1. W: 41" L: 61" H: 25" 2. W: 41" L: 61" H: 25" 3. Diameter: 41" H: 25"						
	B	Individual Study Areas (IS)	Public / Alone (PUA)	North ✓	Wood & Fabric	Square	1. W: 18 5/8" L: 18" H: 16"	Wood	Rectangle Table	W: 41" L: 61" H: 25"	Troffer	Fluorescent	Carpet		Paint	Acoustic Panel
			Private / Alone (PA)	South ✓	Fabric	office	W: 17" L: 18" H: Can Adjust	Wood	Carrel	W: 1'10" L: 29 H: 2' 7 1/2"						
	C	Learning Commons (LC)	Computer Workstation (CWC)	South ✓	Fabric	office	W: 17" L: 18" H: Can Adjust	Wood	Carrel	W: 2' L: 5'11" H: 25 1/2"	Troffer	Fluorescent	Carpet		Paing	Acoustic Panel
	D	Reading Areas (RA)	Reading Area (RA)	South ✓	Frabic	Sofa	W: 27" L: 27" H: 14"	Wood	Rectangle Table	W: 18" L: 2' H: 18"	Troffer	Fluorescent	Carpet		Paint	Acoustic Panel
				South ✓	Fabric	Office	W: 17" L: 18" H: Can Adjust		Carrel	W: 1'10" L: 29 H: 2' 7 1/2"						
			Bookshelves (BS)	South ✓	Wood & Metal	Rectangle	W: 2 3/4" L: 2'3" H: 7'3"									

Observation of the Physical Environment Features

Level	Zone	Learning Spaces		Location (North / South)	Furniture – Seating (Material / Shape / Size / Photo)	Furniture – Table/Desk (Material / Shape / Size / Photo)	Light Fixture (Type / Lamp / Photo)	Finish Materials – Floor (Material / Photo)	Finish Materials – Wall (Material / Photo)	Finish Materials – Ceiling (Material / Photo)
3	A	Group Study Area (GS)	Private/ Together (PT)	North ✓	Fabric; office; W: 17" L: 18" H: Can Adjust	Rectangle; W: 2'1" L: 3'1" H: 25"	Troffer; Fluorescent	Carpet	White Paint	Acoustic Panel
			Public/ Together (PUT)	North ✓	Wood & Fabric; Square; 1. W: 18 5/8" L: 18" H: 16" 2. W: 17 1/4" L: 17" H: 17"	Wood; Rectangle; W: 4'1" L: 6'1' H: 25'	Troffer; Fluorescent	Carpet	White Paint	Acoustic Panel
				South ✓		Circle; Diameter: 4'1" H: 25"				
	B	Individual Study Areas (IS)	Private / Alone (PA)	North ✓	Fabric; office; W: 17" L: 18" H: Can Adjust	Wood; Rectangle; W: 29" L: 3'8 1/2" H: 25"	Troffer; Fluorescent	Carpet	Brick	White Paing
				South ✓	Wood; Carrel; W: 1'10" L: 29 H: 2'7 1/2"	Carrel; W: 1'10" L: 29 H: 2'7 1/2"				White Paing
	C	Learning Commons (LC)	Computer Workstation (CWC)	North ✓	Fabric; office; W: 17" L: 18" H: Can Adjust	Wood; Rectangle; W: 2' L: 5'11" H: 25 1/2"	Troffer; Fluorescent	Carpet	Paing	Acoustic Panel
						Office; W: 2'6" L: 6' H: 25"				
	D	Reading Areas (RA)	Reading Area (RA)	North ✓	Frabic; Sofa; W: 27" L: 2'7" H: 14"	Wood; Rectangle; W: 18" L: 2' H: 18"	Troffer	Carpet	Paint	Acoustic Panel
				South ✓	Wood & Fabric; Square; W: 18 5/8" L: 18" H: 16"	Carrel; W: 1'10" L: 29 H: 2'7 1/2" Between Contertop and Shelf H: 11"				
			Bookshelves (BS)	North ✓ South ✓	Wood & Metal; Rectangle; W: 2 3/4" L: 2'13" H: 7'3"					

Observation of the Physical Environment Features

Level	Zone	Learning Spaces		Location		Furniture									Light Fixture			Finish Materials							
						Seating				Table/Desk								floor		wall		ceiling			
				North South		Material	Shape	Size	Photo	Material	Shape	Size	Photo	Type	Lamp	Photo	Material	Photo	Material	Photo	Material	Photo			
4	A	Group Study Area (GS)	Public/ Together (PUT)	North ✓	South ✓	Wood & Fabric	Square	W: 18 5/8" L: 18" H: 16"		Wood	Rectangle	W: 41" L: 61" H: 2'5'		Troffer	Fluorescent		Carpet		Paint		Acoustic Panel				
				Max			Sofa & Chair	W: 27" L: 27" H: 14"			Cricle	Diameter: 41" H: 2'5"													
	B	Individual Study Areas (IS)	Public / Alon (PUA)	✓	✓	Wood & Fabric	Square	W: 18 5/8" L: 18" H: 16"		Wood	Cricle	Diameter: 41" H: 2'5"		Troffer	Fluorescent		Carpet		Paint		Acoustic Panel				
			Private / Alone (PA)		✓	Fabric	office	W: 17" L: 18" H: Can Adjust			Rectangle	W: 29" L: 38 1/2" H: 2'5"													
					✓		office				Carrel	W: 1'10" L: 29 H: 2' 71/2"													
	C	Learning Commons (LC)	Computer Workstation (CWC)	✓	✓	Fabric	office	W: 17" L: 18" H: Can Adjust		Wood	Carrel	W: 1'10 L: 2' 51/2" H: 2'8"		Troffer	Fluorescent		Carpet		Paing		Acoustic Panel				
											Office	W: 2'6" L: 6 H: 2'5"													
	D	Reading Area (RA)	Reading Area (RA)	✓	✓	Wood & Fabric	Square	W: 18 5/8" L: 18" H: 16"		Wood	Carrel	W: 1'10" L: 29 H: 2' 71/2"		Troffer	Fluorescent		Carpet		Paing		Acoustic Panel				
			Book Stacks (BS)		✓	Wood & Metal	Rectangle	W: 2 3/4" L: 2'13" H: 7'3"																	