Evidence Based Library and Information Practice

Research Article

Interiors, Affect, and Use: How Does an Academic Library's Learning Commons Support Students' Needs?

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Abstract

Objective – This study sought to identify the learning needs, satisfaction levels, and preferences of students using an academic library's learning commons. A particular focus was understanding whether the socio-collaborative environment facilitated by the learning commons was aligned with the institutional objectives of supporting intensive study and scholarly work.

Methods – A mixed methods sequential explanatory study design was used, in which quantitative findings were supplemented by qualitative findings. Data for the study were drawn from 59 hours of observations documenting behaviors of 9,249 individuals, as well as survey responses from 302 students. Three semi-structured focus groups with 10 students were held to discuss and clarify findings.

Results – Behavior mapping and survey data showed that students were largely satisfied with the learning commons and that it was considered a supportive environment for them to complete their stated tasks. Incongruity was observed between the learning commons' intended and actual use; although 75% of spaces were designated for collaboration, 50% of survey respondents identified independent work as their primary task and 76% of individuals were observed working independently. In focus group discussions, students praised the space for its vibrant ambiance and facilitation of social connections, but acknowledged that more serious study required retreat into quieter spaces found elsewhere in the library.

Conclusion – The learning commons is an important and desirable space for students, providing a safe and community-oriented environment that is located in the center of campus. While students deemed the atmosphere successful for fostering social relationships and creating an overall sense of belonging, care needs to be taken to maintain a proper balance between quiet and collaborative spaces. The methods used in this study underscore the importance of gathering data from multiple sources, offering guidance to other libraries seeking to create, re-envision, and assess their learning spaces.

Introduction

When Foster and Gibbons (2007) completed their seminal ethnographic study of students at the University of Rochester's River Campus, they uncovered a rich dataset of undergraduates' work processes that could be used to improve their library's physical spaces and services. Their report concluded by providing a broad appeal for user-centered design based on evidence interpreted in a "relevant context":

> We are designing technology, spaces, and services for an academic library, not a summer camp, a fitness center, or an airport. Students may want to eat in the library, socialize in the library, and sleep in the library, and we may want to make that possible. But they can do those things elsewhere. There are somethings they can only do in the library; those things must have priority. (Foster & Gibbons, 2007, p. 82)

Since that time, libraries have transitioned away from building collection-oriented spaces in favor of the more user-oriented learning commons, intended for collaborative social learning and overseen by a blend of campus partners offering broad student services (Bailey & Tierney, 2008). This model has become so common that Bennett (2015, p. 215) proclaimed, "No one now plans an academic library without a learning commons."

In December 2016, the University of Nebraska-Lincoln (UNL), a large public university in the Midwest, opened the doors to the Adele Hall Learning Commons (LC), transforming approximately 30,000 square feet of the main library's ground floor from shelving space for over 300,000 books to seating and group study rooms for nearly 500 students. Immediately becoming a bustling hub of activity located well-within the "heart" of campus, the LC borrowed heavily from what has since come to be known as the archetypal learning commons design, an open-concept, mixed-use environment, with a fireplace and coffee shop in its center. While the space's popularity was one indicator of the positive impact of the project having been consecutively voted students' favorite study spot in its first two years (UNL Libraries, 2018), it was uncertain how successful the project was in meeting the university's goal that it "accommodate and promote intensive study and scholarly work" (Fedderson, 2014).

In order to understand the LC's success as an informal learning space, this study sought to answer three foundational research questions that aimed to 1) identify the student populations using the LC, 2) understand what students use it for, and 3) evaluate its interiors, atmosphere, and services according to the stated needs of the students. Secondary data informed study design and primary data was gathered through surveys, behaviour mapping, and focus group conversations. The research findings contribute to a broader understanding of the impact of library learning spaces on learning behaviour, and how student-centered spaces and their usage can influence the academic success of students. Thus, this research enables others to better anticipate the needs of their users when designing similar spaces, to evaluate the efficacy of their own library's learning commons, and to assess how well their learning commons are fulfilling their intended purpose as a learning space.

Literature Review

In 2009, Bennett (p. 190), a prominent voice in the literature surrounding physical library spaces, outlined four millennia of library building designs culminating in the current "learning-centered paradigm" that situates academic libraries prominently in two of four identified stages of students' intentional learning. More recently, Bennett (2015, p. 220) provided a concise conceptual framework for integrating learning into library space design to help "ensure that the *things* of learning, the affordances we create, such as the learning commons - actually foster learning in a way that we might assess."

While learning commons might be commonplace, meaningful evaluation according to Bennett's recommendations present a challenge. For example, during interviews with 41 lead architects, head librarians, and library consultants for 22 recent library renovation projects, Head (2016, p.14) discovered that none of those involved had established success metrics during planning stages. Most interviewees referenced using pre- and post-project occupancy levels as an indication of positive impact and overarching goal, with one library consultant asserting "We knew doubling the amount of seats in the new building would have an immediate impact on student success" (Head, 2016, p. 14). In-depth post-occupancy evaluations were broadly viewed as too complicated, with one lead architect explaining:

> Unless you're trying to write a paper and need some data, we don't look at these measures. We always say we'd love to do more assessments, but the reality is they take more time and effort and by then you've already moved on to the next project. (Head, 2016, p. 25)

Despite such complications, a small body of assessment research has steadily accumulated over the past decade. Empirical studies examining library learning spaces have largely been case studies relying on a combination of qualitative and quantitative methods, often employing ethnographic and anthropological tools and techniques for studying students' behaviors (Andrews, Wright, & Raskin, 2016; Archambault & Justice, 2017; Asher, 2017; Thomas, Van Horne, Jacobson, & Anson, 2015; Trembach, Blodgett, Epperson, & Floersch, 2019). Many of these studies operated under the unconfirmed assumption of a relationship between learning commons' users' satisfaction and learning outcomes. This assumption was not rigorously investigated until recently, when Woo, Serenko, and Chu (2019) identified a strong positive association between these factors. The authors tested a model tying satisfaction, information literacy instruction, and expectation disconfirmation theory (EDT) to the Chi Wah Learning Commons environment at the University of Hong Kong, concluding that student satisfaction was indeed an appropriate measure of evaluation by stating: "psychological outcomes affected behavioral outcomes, which in turn produced a number of benefits. This shows that students' cognitive changes could

alter their behaviors, resulting in positive consequences, which is the goal of the Learning Commons" (Woo, Serenko, & Chu, 2019, p. 416).

A frequent theme found in research about learning commons is a documented tension between users' stated and observed desires for quiet and the collaborative activities emphasized by the built environment (Archambault & Justice, 2017; Asher, 2017; Jaskowiak, Garman, Frazier, & Spires, 2019; James, 2013; Walton & Cunningham, 2016; Whitchurch, 2009). Some authors cite an inevitable evolution in learning behaviors as rationale for defending the learning commons' collaborative environs. In opposition to Yoo-Lee, Lee, and Velez's (2013, p. 499) own findings, in which 58 of 100 students surveyed said there were no *dis*advantages to having quiet spaces in a library, the authors asserted that "Libraries need to understand the learning style of new generations and provide spaces like information commons or learning commons to reinforce the social aspects of learning...to create a dynamic, comfortable, and collaborative environment." Similarly, despite staff's ample anecdotal evidence to the contrary, Whitchurch (2009, p. 71) was so comfortable in the assumption that the commons must "provide a space for the new generation of college students and the manner in which they study" that he elected not to include individual users in his assessment. In another study conducted at the University of Iowa, a week of observational data revealed that students used the group spaces for independent study 47% of the time; however the authors discarded the finding remarking that "this shift in pedagogies may not have yet permeated into students' study habits" (Thomas et al., 2015, p. 808).

In contrast, many authors do seem to consider students' preference for quiet as evidence that there is an overall imbalance between individual and collaborative study spaces, particularly pertaining to libraries. While looking at libraries and student's feelings of "homeness", Mehta

and Cox (2019, p. 27) remarked that individual study spaces were "highly valued" and that "academic atmospheres" should be prioritized. Oliveira (2016, p. 356) summarized 12 recent studies showing strong evidence of students' preference for quiet study spaces, reflecting that "quietness is still highly valued by students and that individual study spaces (communal or isolated) are still being heavily used in academic libraries today." James (2013, p. 6) documented that 78% of 6,846 users were working independently in a library's "Collaborative Learning Center" and as such suggested that a name change more reflective of actual use might be in order.

Aims

The past decade has brought us closer to understanding how and why today's students use library spaces, however still very little is known about how successful the learning commons model is, both for the students who inhabit these spaces and for the libraries in which they are built (Asher, 2017; Head, 2016). The learning commons model is nearly synonymous with collaborative learning space, yet numerous studies have recorded students' use of the spaces as more reflective of traditional academic library atmospheres. Therefore, a key aim of this study is to explicitly investigate this prevalent schism between solitary and collaborative study, and how a learning commons contributes to the student learning experience, guided by the following research questions:

1) What populations of students are using the learning commons?
2) What are students using the learning commons for?
3) What are the needs and preferences of the students using the learning commons, according to a) atmosphere and environment, b) workspace features, and c) help and learning services?

Methods

A mixed methods sequential explanatory study design was used, in which qualitative data was collected subsequently to quantitative, with the goal of more robustly understanding students' behaviors and needs within the LC (Creswell, Plano Clark, Gutmann, & Hanson, 2003, p. 178). This approach was selected so that the primarily quantitative findings could be refined and explained via follow-up interviews that were conducted with a purposefully selected subset of students (McCrudden & Sparks, 2018). Additionally, the "robust methodology seeking multiple data sets to establish a clear evidence-based assessment" employed in this study adheres to Deed and Alterator's (2017, p. 56) conceptual model for including the lived experience when conducting occupancy assessments of informal learning spaces.

This study was guided by Nitecki and Simpson's (2016) theoretical framework regarding library spaces, which asserts that the individual student is influenced by different layers of the environment, from the higher education context (e.g., culture and policies) to physical design (e.g., furnishings and materials), which impact individual behaviors and cognitive functions (e.g., study habits, attention, and motivation). The relationship between affect and emotion is apparent between the built environment and cognitive functioning (Amedeo, Golledge, & Stimson, 2008; Cranz & Pavlides, 2013; Woo, Serenko, & Chu, 2019), suggesting that when physical and psychological needs are satisfied, learners are more productive, focused, and able to learn. Thus, for the learning commons model to fulfill its learning-centered mission, it must satisfy the multifaceted needs of its learners.

Quantitative Data Collection and Analysis

In January 2018, quantitative data was gathered through observation and an online survey distributed to students inhabiting the LC. Field data collection was carried out under supervision by a team of four undergraduate student research assistants from UNL's College of Architecture. All research assistants were trained in study procedures and design, and received certification for conducting human subjects research. The University's Human Research and Protection Program reviewed and approved all instruments and procedures for this study.

Fifty-nine hours of field observations were documented using a visual traffic sweep technique similar to that of Given and Archibald (2015), capturing the behaviors of 9,249 individuals in the LC. Five distinct seating layouts in the LC were identified using AutoCAD software, showing zone boundaries, square footage, layout, and seating capacity. Ensuring a representative sample of students' behaviours in a learning commons is complex, as space use differs dramatically throughout the day, week, and semester (Asher, 2017, p. 72). As such, we identified hour-long data collection periods over a span of three weeks, in which research assistants would "sweep" the entire LC to capture students' behaviors at peak, mid, and low-level occupancy rates. Research assistants were instructed in unobtrusive observation techniques, in which the observer does not intentionally make their presence known to those being observed (Given & Leckie, 2003). Observers used a paper-based template to physically document the locations of individuals, sizes of active collaborations, and if furniture had been rearranged. Inter-reliability testing was conducted to ensure behavior mapping was consistently carried out. To delineate findings from the data, behavior maps were overlaid to visually identify activity patterns and space use (Figure 1) and numeric count data was transferred into a spreadsheet for quantitative analysis.

The survey instrument (Appendix A) was self-developed based on Bennett's (2015) conceptual model of student learning needs and Post-Occupancy Evaluation best practices (Preiser, Rabinowitz, & White, 2015). The instrument
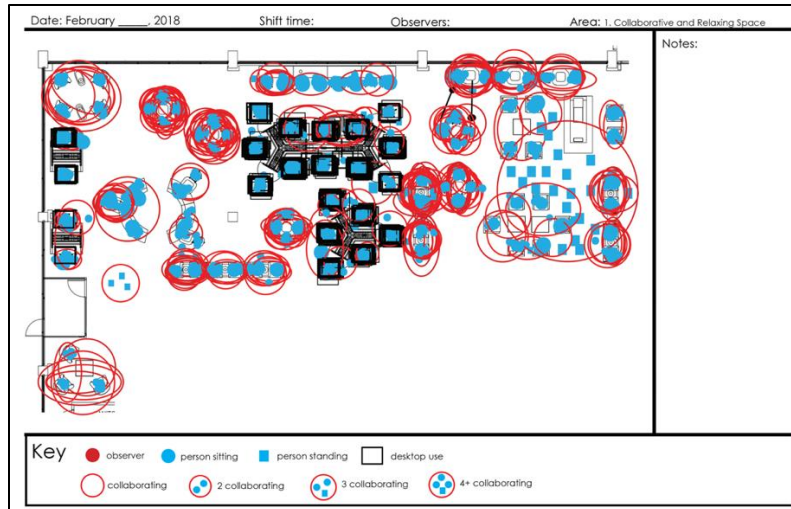
Figure 1

Example overlay of Zone 1 behavior observations of 2,774 individuals during 59 mid-morning visual sweeps.

included 16 7-point Likert-type scale items asking students to assess the physical design aspects (spatial design, furniture layout, and indoor environmental quality), technology, services, and their own productivity within the LC. An additional six items gathered demographic data, including gender identity, major, age, and race. The instrument was developed iteratively. It was piloted with six students and a panel of faculty librarians prior to dissemination to secure content validity of the items, to establish clarity and comprehension, and to verify the time required for completion.

The web-based cross-sectional survey data were gathered using random probability sampling (Hall, 2008). The LC was divided into five discrete zones based on institutionally designated use (Figure 2). Minimum survey quotas were set for each zone based on total seating capacity.

To be eligible, survey participants needed to be current students and at least 19 years of age, due to Nebraska's age of majority designation (Nebraska Legislature, 2018). Employing the same hour-long schedules used for the observations, research assistants recruited participants by approaching individuals in each zone and asking them to complete a survey, making them aware that participants could be entered into a drawing for 1 of 3 $50 gift cards. If an individual agreed and met the criteria for participation, they were immediately asked to complete an online survey using a tablet provided by the recruiter. If an individual dissented, the assistant noted the occurrence and location before moving on. Using this method, survey data was gathered from 356 students. After non-eligible participants and incompletes were removed, there was a total of 302 fully completed surveys.

For data analysis, responses were considered for the LC as a whole ($N = 302$) and then tested for between-group differences of respondents grouped according to zone location in the LC: 1) collaborative and relaxing space ($n = 95$), 2) collaborative space with mobile furniture ($n = 77$), 3) quiet reading room ($n = 37$), 4) quiet study room ($n = 15$), and 5) reservable group study rooms ($n = 78$). The survey data was analyzed using univariate statistical procedures and item responses and demographic trends were examined using cross-tabulation and frequency counts.

Figure 2
Floor plan of the learning commons showing furnishing and zones included in this study.

Qualitative Data Collection and Analysis

The survey included 1 open-response item intended to gather limited qualitative data through asking students for their input on any aspect of the LC (*n* = 110). After preliminary analyses of survey and observation data were conducted, three areas were identified as needing supplementary discussion; a semi-structured focus group format was identified as being the most time sensitive method for obtaining this insight. Survey respondents were not identifiable, therefore a convenience sample was used in which students seated in the LC were randomly approached and asked if they would be willing to participate in the hour-long focus group. A representative sample of the overall LC population was sought during

recruitment, to reflect diversity of gender identity, major, and age, again with 19 being the minimum age of participation. In total, 10 students (3 male and 7 female, comprised of 6 undergraduates and 4 graduates from a range of disciplines) participated in a series of 3 semi-structured, 1-hour focus groups, held in a private study room at the LC.

During the focus groups participants were prompted to discuss a series of open questions that were emailed in advance (Appendix B). The questions focused on students' study patterns, perceptions and opinions of physical and environmental features at the LC, and the efficacy of the learning commons model including personal use of help services. The focus groups had 1 moderator, 1 note-taker,

were audio-recorded, and all participants received a $20 gift card for their time. Thematic analysis was conducted, both on the survey's open-response item, and on the notes and audio recordings taken during the focus group sessions (Liamputtong, 2011).

Results

RQ1) What Population of Students are Using the Learning Commons?

The results left no doubt that the LC is a popular space for students. Throughout the 59 hours of observational data, 9,249 individuals were identified in the LC, with an average actual occupancy of 48.5% of 323 total seats. If using perceived occupancy, as preferred by other studies (Foster & Gibbons, 2007; James, 2013; Khoo, Rozaklis, Hall, & Kusunoki, 2016) in which spaces are considered at capacity with only 50% occupancy, the average total building perceived occupancy rate increases dramatically to over 89%, which is consistent with other studies on learning commons (Archambault & Justice, 2017; Cha & Kim, 2015; Jaskowiak et al., 2019).

Survey data illuminated the demographics of the students using the LC (Table 1). Participation largely reflected university demographics, with the majority of respondents being white (72.2%), domestic (88.08%), undergraduate (94.7%), and between 19 and 24 (95.36%) years of age. College enrollment of survey respondents was also reflective of overall university enrollment, with the greatest percentage of responses coming from students enrolled in the colleges of Arts & Sciences (28.15%) and Business (24.5%).

Survey data reflected a gender dynamic reported in similar studies (Khoo et al., 2016; Thomas et al., 2015), with females returning a larger number of surveys (63.25%) than males (35.76%). This is in contrast to the total student population, in which 51.8% of 26,079 enrolled students are male and 48.2% female (Office of Institutional Effectiveness and Analytics, 2018).

RQ2) What are Students Using the Learning Commons For?

The LC was built to emphasize collaborative social interaction, consequently the dedicated quiet study space comprises less than a quarter of the total seating capacity. Coursework was the key focus for nearly three quarters of survey respondents (74.9%), who reported being nearly equally divided between working independently (49.9%) or collaborating with a group (50.1%). The observational data indicates that while many students were inhabiting tables with at least one other individual, active collaborations in which students were either talking or focusing on a shared document were infrequently observed. Of the 9,249 total LC inhabitants documented during the 59 hours of observations, only 23.9% of individuals were observed actively collaborating.

The LC was constructed with five distinct design typologies aiming to support a diverse array of uses and activities. While not overtly defined, the grid layout results in a unique environment for each corner, with group study rooms placed throughout the core. Descriptive analyses of the survey items shows that 89.4% of respondents were moderately to extremely satisfied with the LC according to a 7-point scale (M = 6.27, SD = 0.70), and 83.5% of students reported that choice of space supported their overall productivity needs from very to extremely well on a 5-point scale (M = 4.19, SD = 0.77).

A two-way contingency table analysis of stated task and zone location revealed a significant relationship and relatively strong effect size, Pearson χ^2(4, N = 302) = 55.61, p < .001, Cramer's V = .43

According to both observational and survey data, students' behaviours and stated tasks differed by zone location. The survey results aligned with expectations (Table 2); the majority of students in zones designated for collaboration indicated that they were working collaboratively (Zones 2 and 5) and the majority of students in

zones designated for quiet study were working independently (Zones 3 and 4). Despite Zone 1 being designed to support more collaborative activities, the majority of students (61.2%) reported working independently within this space.

Table 1
Survey Sample Demographics, *N* = 302

Demographic Category		*n*	%
Class standing	Freshman	71	23.51
	Sophomore	91	30.13
	Junior	71	23.51
	Senior	53	17.55
	Graduate	15	4.97
	No response	1	.33
Gender	Female	191	63.25
	Male	108	35.76
	No response	3	.99
Age	19-20	185	61.26
	21-24	103	34.11
	25-30	11	3.64
	31-34	2	.66
	No response	1	.33
Major [a]	Agricultural Sciences	27	8.94
	Architecture	14	4.64
	Arts & Sciences	85	28.15
	Business	74	24.5
	College of Nursing	2	.66
	Education & Human Sciences	48	15.89
	Engineering	30	9.93
	Fine & Performing Arts	9	2.98
	Journalism	13	4.30
	Public Affairs	5	1.66
	Undeclared	12	3.97
	Unsure	3	.99
International student	Yes	36	11.92
	No	266	88.08

[a] Participants are allowed to select multiple majors, thus the sum exceeds sample size; percent calculated by number of respondents.

Table 1
Survey Respondents' Stated Tasks According to Zone Location, *N* = 302 [a]

		Zone 1 Collaborative & relaxing space		Zone 2 Collaborative space with mobile furniture		Zone 3 Quiet reading room		Zone 4 Quiet study room		Zone 5 Group study rooms		Total	
		n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Independent tasks	Coursework alone	56	48.3	29	32.6	28	66.7	9	52.9	14	16.9	136	39.2
	Non-coursework alone	7	6.0	3	3.4	5	11.9	1	5.9	2	2.4	18	5.2
	Relaxing alone	8	6.9	1	1.1	3	7.1	3	17.7	4	4.8	19	6.0
	Total	71	61.2	33	37.1	36	85.7	13	76.5	20	24.1	173	49.9
Group tasks	Coursework with a group	30	25.9	37	41.6	6	14.3	3	17.7	48	57.8	124	35.7
	Non-coursework with a group	3	2.6	6	6.7	0	0	1	5.9	11	13.3	21	6.1
	Socializing	12	10.3	13	14.6	0	0	0	0	4	4.8	29	8.4
	Total	45	38.8	56	63.0	6	14.3	4	23.5	63	75.9	174	50.1
Total		116		89		42		17		83		347	

[a] Participants were allowed to select multiple tasks, 3.7% selected > 1 task; percent calculated on number of respondents. Row and column totals might exceed 100% due to rounding.

Observational data revealed that less than a quarter of total individuals were seated in groups of two or more (Table 3). Zone 5's group study rooms were the only zone in which a majority of students (77.6%) were observed in groups that were actively engaging in shared tasks such as conversing or sharing documents.

RQ3) What are the Needs and Preferences of the Students in the Learning Commons?

Atmosphere and Environment

When asked to identify their most important environmental needs for productivity that day, findings aligned with Cha and Kim's (2015) study. Most students overwhelmingly identified amount of spaces (56.6%) and noise level (49.7%) as their top choices (Figure 3).

In focus group conversations, nearly all of the students referenced using the LC for less intensive work, during which social distractions were more welcome. The four graduate students stated that they only used the LC for academic work when in need of a group study room or

Table 2

Independent versus Collaborative Activities Observed by Zone over 59 Total Observations [a]

Size	Zone 1 Collaborative & relaxing space		Zone 2 Collaborative space with mobile furniture		Zone 3 Quiet reading room		Zone 4 Quiet study room		Zone 5 Group study rooms		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
1	2252	81.2	1850	80.4	2355	97.8	237	98.3	342	22.4	7036	76.1
2	406	14.6	308	13.4	40	1.7	4	1.7	550	36.0	1308	14.4
3	84	3.0	99	4.3	12	0.5	0	0	318	20.8	513	5.6
4+	32	1.2	44	1.9	0	0	0	0	316	20.7	392	4.2
Total	2774		2301		2407		241		1526		9249	

[a] Greatest percentage of collaboration size per zone in bold. Row and column totals might exceed 100% due to rounding.
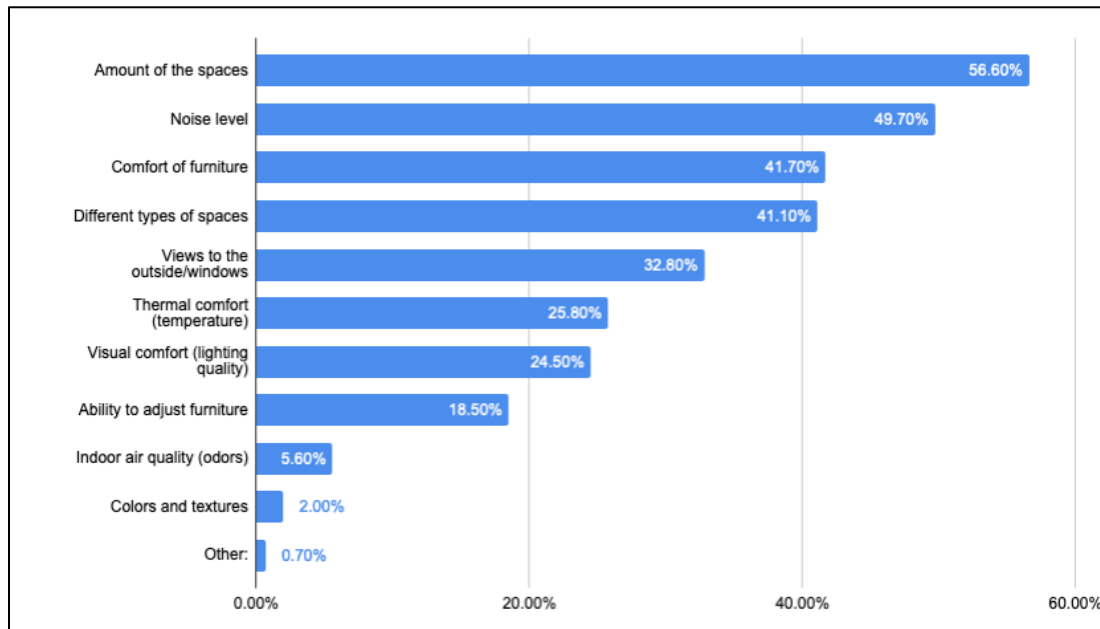
Figure 3

Top environmental needs of students according to survey results (*N* = 302).

when other campus buildings were closed and would otherwise move to quieter locations within the main library. Of the survey respondents, 10.2% were somewhat to extremely dissatisfied with noise, and all focus group participants agreed when 1 student stated "I think all students have an understanding if you need a quiet place to get work done, then you need to not be in the learning commons. I think it's just understood amongst everybody." For those times when they had nowhere else to go, most focus group participants referenced using noise-blocking ear buds to help mitigate distractions in the LC. In the words of one female graduate student, "I have to use ear plugs, because otherwise I can hear everyone talking and coming in and out and everything."

Table 4
Survey Respondents' Satisfaction with Interiors, *N* = 302

Satisfaction category	Feature	*n*	Minimum	Maximum	Mean	SD
Layout	Size of workspace	302	2	7	6.14	0.94
	Different spaces	302	1	7	6.11	0.94
	Supports task	302	2	7	6.19	0.98
Furniture	Overall comfort	302	2	7	6.03	1.04
	Adjust furniture	301	1	7	5.97	1.05
	Materials/fabric	302	3	7	5.87	1.06
	Colors	302	2	7	5.99	1.14
Interiors	Wall colors	302	1	7	6.02	1.09
	Flooring materials	302	1	7	6.05	1.07
	Surface finishings	302	1	7	6.18	0.98
Environment	Temperature	301	1	7	5.89	1.19
	Air quality	302	3	7	6.08	1.01
	Lighting	301	2	7	6.18	1.01
	Views to outside	301	2	7	6.4	1.02
	Noise level	300	1	7	5.55	1.28
Amenities	Beverage/snack options	302	1	7	5.7	1.20
	Whiteboard availability	302	1	7	5.53	1.24
	WiFi connectivity	302	2	7	6.16	1.08
	Outlets/power	302	1	7	6.01	1.19
	In-house tech	302	1	7	6.02	1.05
	Printing services	302	1	7	5.86	1.23
Overall	Overall satisfaction	302	3	7	6.27	0.70

Workspace Features

Although survey items asked participants to state their satisfaction regarding wall color, flooring, workspace, layout, and furnishing, all zones except the group study rooms include multiple interior types making it difficult to identify the most and least successful interiors from survey results. Some survey respondents expressed dissatisfaction regarding each of the categories, however the overall average satisfaction rankings were high (Table 4). Comfort of furnishings received the most critical assessment, with 6.2% of respondents expressing slight to extreme dissatisfaction.

The ability to adjust workspaces within the LC was an important feature for students. Overall, most (91.4%) were satisfied with their ability to adjust the furniture, however, 23.7% of respondents in Zone 3 (quiet reading room) were slightly to extremely dissatisfied with this feature. The quiet reading room's tables and chairs are immobile, while other zones have casters aiding the rearrangement of most tables and chairs.
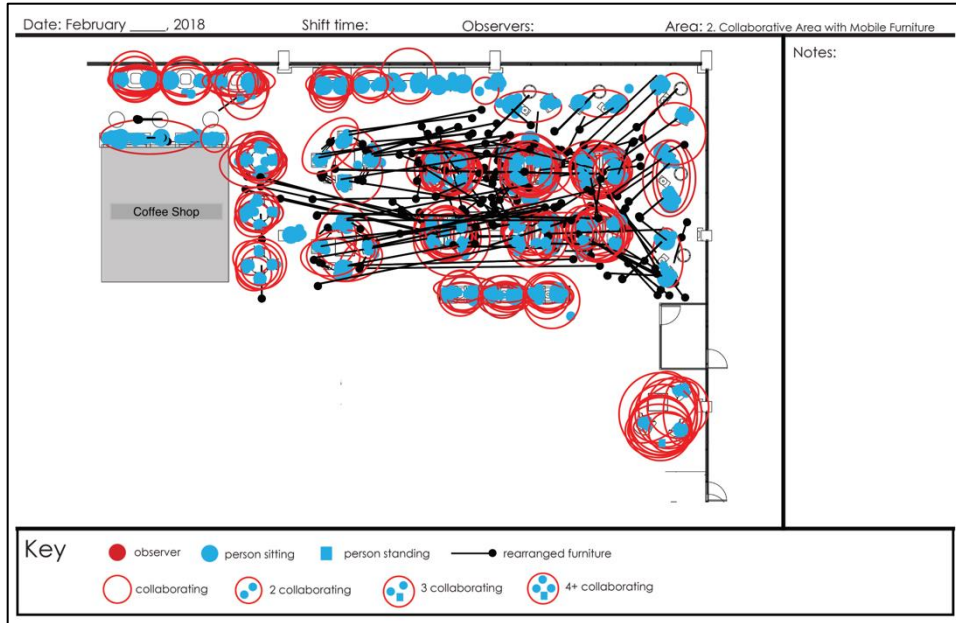
Figure 3
Zone 2: Collaborative area with mobile furniture showing furniture rearrangements throughout observations (N = 59).

When space reconfigurations were simplified via movable furniture, students took advantage of this flexibility. In Zone 2, reconfiguration of furnishings was documented throughout all 59 observations (Figure 4). Both tables and chairs were moved frequently to enable larger collaboration sizes to create a more suitable space for inhabitants. This agency was an important feature for at least one of the male undergraduate focus group students who stated, "I've moved desks and chairs and all that kind of stuff and it's very helpful. If I need a bigger table we can switch, and it works out well. I'd rather have that than them stuck in the ground."

Help and Learning Services

The LC, in adherence to the learning commons model, strives to be more than simply an unmediated space to study. A defining feature of a learning commons is the integration of a network of campus support services into the space with a multitude of objectives, including raising awareness of services, encouraging help-seeking behaviors, and providing barrier-free

access to departments and resources aimed at enhancing student success (Blummer & Kenton, 2017). At the center of the LC are two connected service desks featuring the only permanently situated building partners: a library service desk, occupied mostly by library student workers, and a technology help desk staffed by campus IT specialists. In addition to housing the Digital Learning Center for test proctoring, the LC also has a mixed-use space in which a multitude of other campus services are periodically stationed such as writing tutors, career services staff, and a tutoring service called "Study Stop." The students' awareness and use of these services were measured (Figure 5), with the understanding that this would indicate how relevant they felt the services were to their learning needs. As expected, students' awareness and use of services were higher for the permanently stationed services.

In focus group conversations, students stated they had limited experience using any of the onsite support services, with the library's service desk accounting for the lowest amount of use
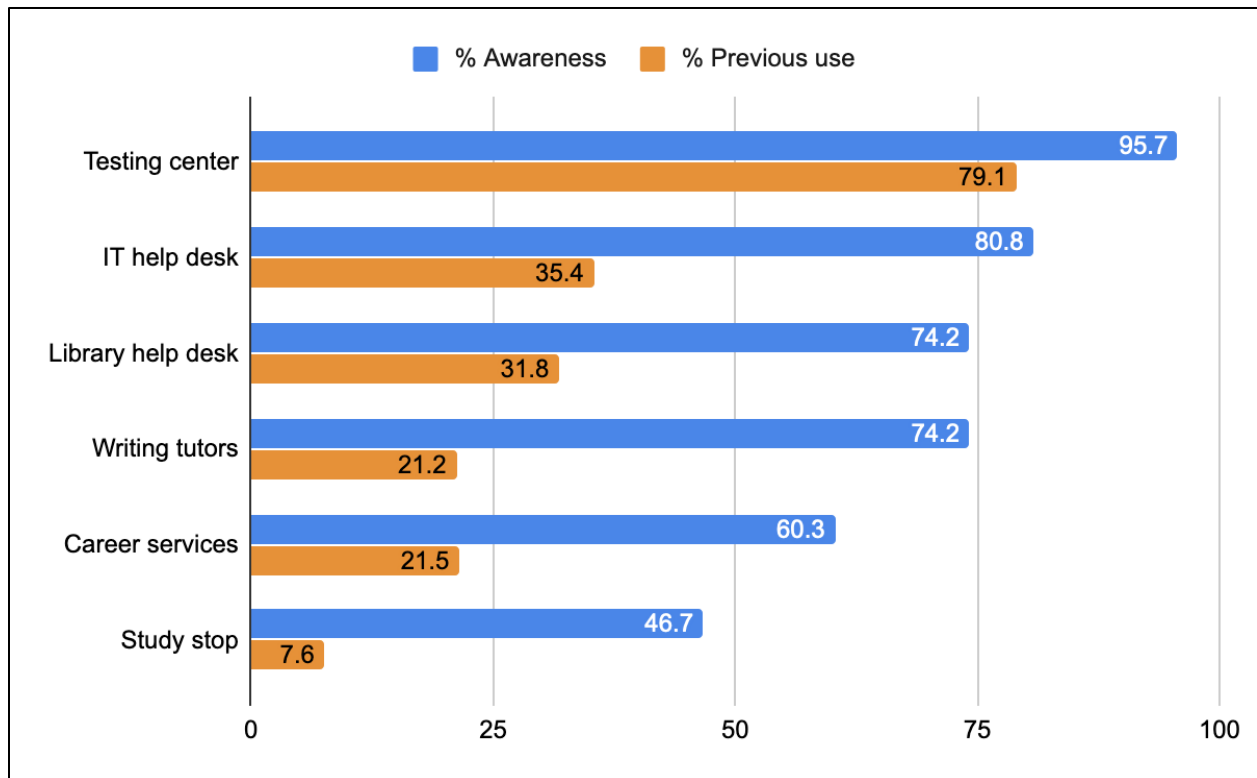
% Awareness   **% Previous use**

Testing center	95.7 / 79.1
IT help desk	80.8 / 35.4
Library help desk	74.2 / 31.8
Writing tutors	74.2 / 21.2
Career services	60.3 / 21.5
Study stop	46.7 / 7.6

Figure 4

Students' awareness and previous use of service desks according to survey respondents (*N* = 302).

and familiarity among participants. One female undergraduate student who reported using the LC an average of 15 hours a week admitted, "I actually have no idea what [the library help desk] is." Another female undergraduate was enthusiastic regarding services she had received from the library help desk, but her interactions had only involved directional or operations-related requests: "I have used the [the library help desk] because I just have general questions about the layout...[or] like a marker runs out, and then temperature in the rooms, and then bringing down the blinds." A male undergraduate student who was aware of the help desk but had never used it explained his reluctance to ask for research help by saying, "I would go ask for help from my professor, but I would not ask anybody here." When asked to clarify, the student continued:

I would say maybe part of the reason I don't go to the [library help desk] people is

because it is also another undergrad student sitting there, looking very disinterested with their job. Not that I wouldn't look disinterested, but I feel like it's just another person that wouldn't really understand my problem like a professor would. So I might have to sit there and explain it to them. It would just be a lot more work talking to someone else who's sitting at that desk.

When asked to identify the three most important amenities or services for their learning needs (Figure 6), few students selected any of the service desks. Rather, WiFi, power outlets, and food options received the highest scores, suggesting that the space itself and not the service desks is a key draw to the LC. The physical proximity to the library and its collections was a top need for nearly a quarter of survey respondents (23.8%).
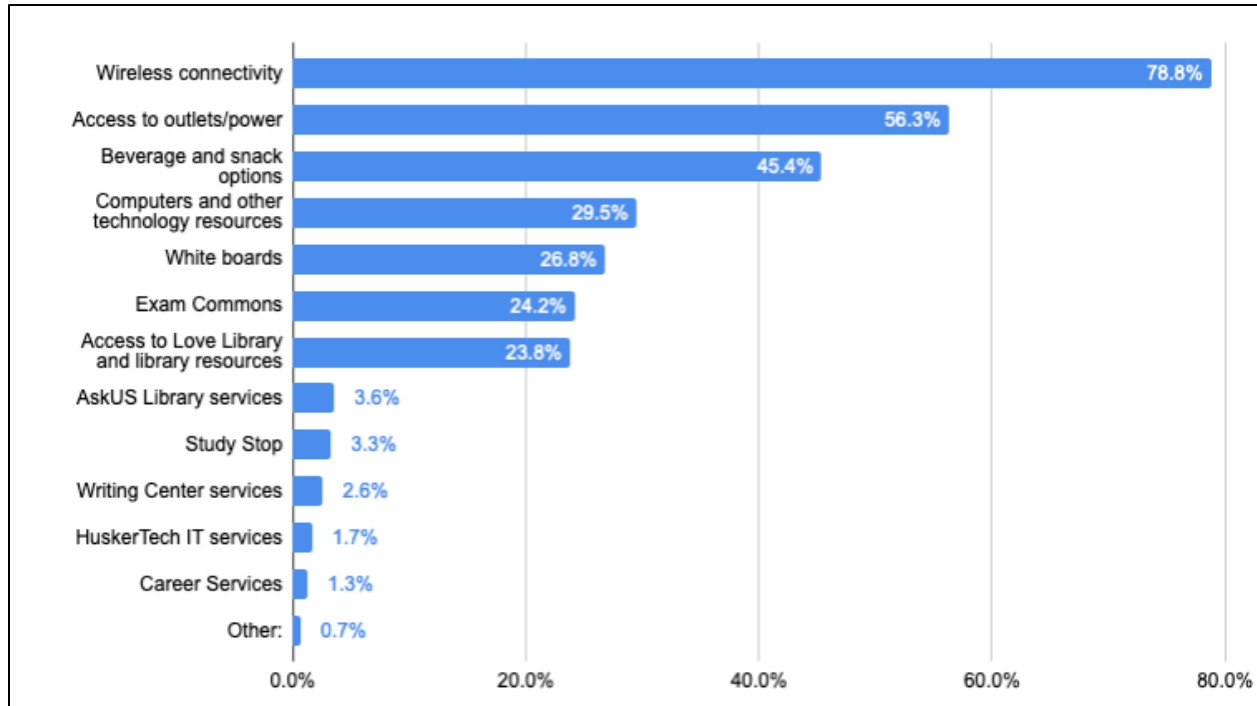
Figure 5
Student's top services (N = 302).

Discussion

The collaborative nature of a learning commons disrupts the traditional image of the quiet confines of academic library spaces. For many campuses, this has been a welcome opportunity to create a centralized communal space that has the overwhelming approval of the academic community (Head, 2017). For many libraries, this has resulted in the funding of long overdue aesthetic updates, dramatically increased gate counts, and changes in perceptions of what the library's relationship to campus is (Blummer & Kenton, 2017). For some, the popularity of active learning pedagogies results in a disruptive and costly imbalance between quiet and social spaces in the learning commons (Andrews, Wright, & Raskin, 2016; James, 2013). The many positive effects of a learning commons should not be taken to mean that quiet atmospheres are no longer relevant to twenty-first century learners.

While this study's findings detect an imbalance between the original intent of the designers and the needs of the eventual inhabitants, our students expressed overwhelming satisfaction with the LC. This satisfaction is largely attributable to the flexibility of the design, as well as the library's willingness to allow the users to dictate the environment and establish the desirable balance between quiet and collaborative. Unlike some learning commons, the LC includes a large quiet reading room (Zone 3) and quiet study rooms (Zone 4), resulting in approximately one quarter of seating being officially reserved for quiet study. These quiet spaces showed the highest average occupancy rates, and were identified as being intentionally sought out by students at significantly higher rates than the more social spaces. When LC inhabitants needed additional quiet study spaces, they were afforded the agency necessary to create this in Zone 1. This flexibility and student-centered approach has

translated into the LC's overall popularity amongst all students; the LC is not necessarily favored by any one discipline or user type. This contrasts with Asher's (2017) discovery that humanities students accounted for only 1% of learning commons, with the key difference between the two sites being the amount of formally designated quiet study space.

Libraries hoping to create a learning commons or redesign existing spaces should be very careful to identify and protect this proper balance between quiet and collaborative. While visibly active students filling academic library spaces does help to provide evidence of a library's importance to a modern campus, students still need quiet spaces with minimal distractions to focus on their academic work. If other locations within the library exist to which students needing these spaces can retreat, emphasizing socio-collaborative environments can be a focal point. If, however, truly quiet spaces are being subsumed in the process, the ability to support the full spectrum of learning needs will be at risk.

Students' underuse of the help services in the LC needs to be better understood, not only locally but in the broader context of the learning commons model. A previous study examining gate count records confirmed that while foot traffic at the main library increased by 80% immediately following the opening of the LC, there was no discernible increase in help services (Allison, DeFrain, Hitt, & Tyler, 2019, p. 309). Great effort and careful consideration goes into identifying and staffing the service desks to be aligned with students' needs. While there are numerous psychosocial reasons attributable to students' reluctance to seek help (Black, 2016), academic libraries can still play a role in not only encouraging but increasing user engagement. As found by others (Asher, 2017; Thomas et. al, 2015), most survey respondents expressed an awareness of the different help services available in the LC, yet only one third had voluntarily used any of them. The testing center is the University's designated space for

year-round proctored exams, making it understandable that nearly 80% of survey respondents had used the center before. With a prominent shared service desk situated in the middle of the LC that is staffed during all hours of operation, underuse cannot be attributed to poor visibility. When paired with the focus group students' limited understanding of the purpose of the library's service desk and their reluctance to ask a peer for help, identifying where the library's services can be most impactful needs to be more thoroughly investigated.

Limitations

A limitation for this study was the minimum age of participation for both survey and focus groups. The university is located in 1 of only 2 states in which the age of majority is 19, meaning that any research involving younger participants would require parental consent. It is unknown what percentage of students who use the LC are 18 or younger, but this age range comprised 17.5% of total enrollment for Fall 2017 (Office of Institutional Effectiveness and Analytics, 2018, p. 67). Turn-down data captured by our research team showed that only 12 (3.4%) of the 356 students approached were ineligible to participate due to being below the age of majority. It is unknowable, therefore, what effect the responses from this age group would have had on aggregate survey data.

An additional limitation was the small window during which the observational and survey data were collected. The ebb and flow of semester patterns and the perpetual shift in visitors cannot be precisely monitored or captured in a three-week time period. Data collection occurred towards the middle of the Spring semester, greatly curbing generalizability of findings.

Finally, this study considered only those using and inhabiting the spaces of the LC. The most dramatic impact of this limitation is that participants were most likely students with positive views of the learning commons, as

evidenced by the high overall satisfaction rates. Broadening the scope of the study to identify and include the students who do not feel well-served by the learning commons would be an important step towards more critically understanding the benefits and challenges afforded by this space.

Further Research

The amount of data gathered throughout this study was substantial, and there are a multitude of remaining research questions that should be explored. This manuscript focused only on a small number of questions that were felt to be the most essential to initially answer. The intent is to continue the investigation through additional, more complex analyses, with a particular focus on understanding students' satisfaction, tasks, and preferences according to various demographic variables, such as age, class standing, and major.

How the learning commons model contributes to students' relationship with academic libraries more broadly is also of great interest. Given that the learning commons aesthetic is being emulated in campus spaces outside of academic libraries (Walton & Matthews, 2013), continuing to investigate the variant needs of learners in these spaces across campuses could reveal the essential features and aspects of libraries' spaces that will ensure their continued success. Deed and Alterator (2017) outlined a model of participatory analysis for such a complex comparative study; this will inform the next stage of this study in which four additional informal learning spaces located in close proximity to the LC will be considered in order to assist with identifying the "things" that students can only accomplish in a library, as proposed by Foster and Gibbons (2007, p. 82).

Conclusion

Understanding the learning needs of students in a learning commons is a complex, multifaceted task. Through combining multiple data points,

this study identified why the learning commons is such a popular space and which features are especially attractive for students. The combination of unobtrusive observation, surveying student preferences, and discussing patterns and findings in focus groups revealed enlightening insights that were critical to understanding the value of the learning commons. The results underscore the importance of enabling students to personally decide the appropriate balance between quiet and collaborative spaces, in addition to identifying the functions considered most essential for students' needs fulfillment. Proper evaluation of informal learning spaces does require considerable time and effort; however, it should become standard practice in academic libraries because it plays such an essential role in illuminating patron needs and increasing understanding of how to better engage with them.

Acknowledgements

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Appendix A
Survey Instrument

Q1. What are you primarily here for today? (Click ALL that apply)
1. I'm working on coursework alone
2. I'm working on coursework with a group
3. I'm working on non-course related activities alone
4. I'm working on non-course related activities with a group
5. I'm mostly socializing
6. I'm mostly relaxing
7. Something else: _____

Q2. Why did you choose this particular location in the Learning Commons? (Click ALL that apply)
1. It was the only available space
2. I specifically wanted a seat in this area
3. It was the first available space I saw
4. Someone else chose it
5. Something else: _____

Q3. How long are you planning on staying during today's visit?
1. Less than 30 minutes
2. 30 minutes to less than 1 hour
3. 1 to less than 2 hours
4. 2 to less than 3 hours
5. more than 3 hours

Q4. On average, how often have you come to the Learning Commons this semester?
1. 7 days a week
2. 4 - 6 days a week
3. 2 - 3 days a week
4. 1 day a week
5. Less than 1 day a week
6. This is my first visit

Q5. Refer to the map to answer the following: How familiar are you with the following features of the different zones in the Learning Commons?

	Before this survey, I was aware of this		I have used this zone before	
	Yes	No	Yes	No
Zones 1 & 2 are intended for collaborative work and social interaction	○	○	○	○
Zones 3 & 4 are intended for individual quiet study	○	○	○	○
Zone 5 is intended for groups of two or more students	○	○	○	○

Q6. How familiar are you with the following services in the Learning Commons?

	Before this survey, I was aware of this service			I've used this service before		
	Yes	No	I'm not sure	Yes	No	I'm not sure
Library help	○	○	○	○	○	○
IT help	○	○	○	○	○	○
Writing Center help	○	○	○	○	○	○
Exam Commons/ testing center	○	○	○	○	○	○
Career Services	○	○	○	○	○	○
Study Stop academic support	○	○	○	○	○	○

Q7. Thinking about the space you are currently in, how satisfied are you regarding the layout of each of the following:

	Extremely satisfied	Moderately satisfied	Slightly satisfied	Neither satisfied nor dissatisfied	Slightly dissatisfied	Moderately dissatisfied	Extremely dissatisfied
Size of my personal workspace	○	○	○	○	○	○	○
Different types of spaces available for use	○	○	○	○	○	○	○
How well the layout supports my task for today	○	○	○	○	○	○	○

Q8. Thinking about the space you are currently in, how satisfied are you regarding the following aspects related to the furniture?

	Extremely satisfied	Moderately satisfied	Slightly satisfied	Neither satisfied nor dissatisfied	Slightly dissatisfied	Moderately dissatisfied	Extremely dissatisfied
Overall comfort	◯	◯	◯	◯	◯	◯	◯
Ability to adjust the furniture to meet my needs	◯	◯	◯	◯	◯	◯	◯
Material/fabric	◯	◯	◯	◯	◯	◯	◯
Colors	◯	◯	◯	◯	◯	◯	◯

Q9. Thinking about the space you are currently in, how satisfied are you regarding the following features of the interiors?

	Extremely satisfied	Moderately satisfied	Slightly satisfied	Neither satisfied nor dissatisfied	Slightly dissatisfied	Moderately dissatisfied	Extremely dissatisfied
Wall colors	◯	◯	◯	◯	◯	◯	◯
Flooring materials	◯	◯	◯	◯	◯	◯	◯
Workspace surface finishes(e.g., desktop, table)	◯	◯	◯	◯	◯	◯	◯

Q10. Thinking about the space you are currently in, how satisfied are you regarding each aspect of your surrounding environment?

	Extremely satisfied	Moderately satisfied	Slightly satisfied	Neither satisfied nor dissatisfied	Slightly dissatisfied	Moderately dissatisfied	Extremely dissatisfied
Temperature	○	○	○	○	○	○	○
Air quality (e.g., stuffy/stale air, cleanliness, odors)	○	○	○	○	○	○	○
Lighting	○	○	○	○	○	○	○
Views to the outside/windows	○	○	○	○	○	○	○
Noise level	○	○	○	○	○	○	○

Q11. Thinking about the Learning Commons in general, how satisfied are you regarding each of the following amenities?

	Extremely satisfied	Moderately satisfied	Slightly satisfied	Neither satisfied nor dissatisfied	Slightly dissatisfied	Moderately dissatisfied	Extremely dissatisfied
Beverage and snack options	○	○	○	○	○	○	○
White board availability	○	○	○	○	○	○	○
Wireless connectivity	○	○	○	○	○	○	○
Access to outlets/power	○	○	○	○	○	○	○
Computers and other technology resources	○	○	○	○	○	○	○

Print, scan, and copy services	○	○	○	○	○	○	○

Q12. From the list below, drag the top 3 most important environmental factors contributing to your productivity today in the Learning Commons into the box below:

Top 3 most important environmental factors
1. Amount of the spaces
2. Different types of spaces
3. Comfort of furniture
4. Ability to adjust furniture
5. Colors and textures
6. Thermal comfort (temperature)
7. Indoor air quality (odors)
8. Visual comfort (lighting quality)
9. Views to the outside/windows
10. Noise level
11. Other:

Q13. From the list below, drag the top 3 most important services or amenities contributing to your productivity today in the Learning Commons into the box below:

Top 3 most important services or amenities
1. Access to the library and library resources
2. Computers and other technology resources
3. White boards
4. Beverage and snack options
5. Wireless connectivity
6. Access to outlets/power
7. Library help services
8. IT help services
9. Writing Center services
10. Exam Commons
11. Career Services
12. Study Stop
13. Other:

Q14. How well does your choice of space in the Learning Commons support your ability to get your job done today?

1. Extremely well
2. Very well
3. Moderately well
4. Slightly well
5. Not well at all

Q15. Overall, how satisfied are you with the Learning Commons?
1. Extremely satisfied
2. Moderately satisfied
3. Slightly satisfied
4. Neither satisfied nor dissatisfied
5. Slightly dissatisfied
6. Moderately dissatisfied
7. Extremely dissatisfied

Q16. Finally, do you have any comments, suggestions, or feedback you would like to share with us about the Learning Commons?

Appendix B
Focus group questions and prompts

1. Talk about your life as a student here:
   a. What is your major? Do you live on or off-campus? How many classes are you taking? Do you work? How much time do you spend studying?
   b. Is there a place in your college life—outside of the classroom—where most of your academic learning occurs, e.g., library, dorm, home, coffee house, online? Why is this your "go-to learning place"?

2. What do you like best about the general layout of the Learning Commons? How does it help you do your job? What more would you like to see in the design? If you had that, what would that allow you to do?

3. Tell us about individual work at the Learning Commons. How does the physical layout impact individual work? How would any improvements in design help with individual work? Which design and environmental factors interfere with individual work?

4. Tell us about the level of collaboration. Is it easy to collaborate with others when you work at the Learning Commons? Which design and environmental factors interfere with group work?

5. How important do you feel a Learning Commons is for today's college students? How important is the LC to you in regard to successful assignment completion, study habits, performance in courses, learning and acquisition of knowledge, or educational goals?

6. Do you use any of the services available at the LC? Why or why not? Are there other services that might be more helpful? When you are studying or working on assignments, how do you most often get help?

7. Finally, are there any additional comments or observations you would like to make about the Learning Commons?