

Wayfinding and the User Experience of Space Selection in Learning and Community Spaces: A Review and Guide for Next Steps

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ABSTRACT

Background. College and university users have varying needs and preferences regarding learning space usage. One such public space is the academic library, which also needs to re-evaluate services and spaces to accommodate the growing and changing user population.

Objectives. For learning spaces to enhance the user experience (UX) of their users, spaces need to be evaluated from time to time. Before evaluating a specific learning space, a broader look at the topic can help understand the problem, learn about trends, and help design research questions and goals for the next steps. This paper covers the first step, a *review* of the topic—wayfinding and the UX of space selection in academic libraries.

Methods. This investigation highlights methods used in similar studies, helps identify gaps and lessons in the literature, and its recommendations can guide library space design practice for future implementation.

Results. The findings culminate in three themes: *method varieties as beneficial* with an important lesson that purely quantitative studies or a single method alone was a limitation to understanding true user and space assessment data. The themes of *user perception* and *change and flexibility* are also important to understanding why space assessments do not transfer from place to place as paradigm shifts continue to fluctuate as users, norms, and characteristics of spaces. These behavioral characteristics and attitudes can impact how spaces are considered and used. The synthesis and findings, including a template of recommended next steps of this review, can help colleges, universities, and libraries jump-start their next steps for site evaluation.

Contributions. The results of this study will be informative to academic institutions with plans or goals for a learning space redesign.

INTRODUCTION

Library users have varying preferences and needs regarding library space usage, including but not limited to solo workspace, group workspace, noise level preferences, and seating comfort preferences. Libraries may not understand how users choose to move in, and or, around and use the library—a topic that is frequently discussed among library deans and administrators (personal communication, March 2023). I had such conversations with fellow library leadership team members at an academic library of a R2 research university with

22,000 students during 2021-2023.

At the same time, I was involved in UX design work relating to digital interfaces and services where design thinking, empathy research, and user studies are norm. As a result, I applied typical UX methods to understand the root problems with learning and library space design and conducted a formal qualitative study for space assessment. At the time, the library had never conducted a formal study on space design, which was a further reason for these strategies used in this study, which include two phases: a formal review of literature on the topic (as presented in this article) and using that knowledge to design and execute a qualitative study with surveys and interviews of users (the second phase which will be detailed in a separate article).

Given that administrators of learning spaces may not know what areas of the building are preferred or avoided and the larger conversations about space design and UX that are happening locally and across library networks, there is an increased awareness of the changing needs of users in learning spaces that need attention. Annually, the campus and library get new users, which can impact different audiences' generational and cultural norms with varying library space use preferences. The same can be applied to other information and community-related organizations including GLAMs (galleries, libraries, archives, and museums). Without assessment, the library or GLAM does not know what users need and does not know whether that need is being met now in the current space design.

Research Gap

For learning spaces to enhance the UX of its users, spaces need to be evaluated from time to time. There needs to be a fundamental understanding of whether and how current spaces are used. If there is no data or understanding of existing user preferences, it is impossible to effectively improve those spaces. Before evaluating a specific learning space, a broader look at the topic can help understand the problem, learn about trends, and help design research questions and goals for the next steps.

Overview of Study Structure

The first step is to conduct a *critical* or *systematic review* of the topic—wayfinding and the UX of space selection in academic libraries. This investigation will highlight methods used in similar studies, help identify gaps and lessons in the literature, and guide library space design practice for future implementation. The literature review captures the state of the field from 2000 to 2020¹.

The synthesis and findings of this review can help colleges, universities, and libraries jump-start their next steps for site evaluation. The results of this study will be informative to academic institutions with plans or goals for a learning space redesign. This study will also give an insight into recent space changes and the UX of the academic library and offer a template in Appendix A for the next steps in planning an assessment of learning space usage.

¹ That timeframe was used because this review was the first step in a multiple-step project. First, you review what is known, and then you build on that, design, and execute a space design. The review stopped because it was completed and then used for the next steps which were subsequently done in phases in 2021-2024.

LITERATURE REVIEW

A review was conducted to help highlight methods used in similar library space studies, identify gaps and lessons in the literature, and guide library space design practice for future implementation. To help identify key terms and understand their meaning within the context of this content analysis, the following definitions will be used:

- *Wayfinding* is a "process of finding your way to a destination in a familiar or unfamiliar setting using cues given by the environment" (Farr, Kleinschmidt, Yarlagadda, & Mangelsen, 2012).
- *UX* is a concept that "encompasses all aspects of the end-user's interaction with the company, its services, and its products" (Norman & Nielsen, 1998).
- *Design thinking*, also known as human-centered or user-centered design, is an approach and mindset with a user-focused framework to understand and create a meaningful design for the users impacted (Gibbons, 2016; UXPA, n.d.).

Problem Statement and Literature Review Protocol

The review's goal is to critically analyze the methods used in previous literature. The review will attempt to answer the following literature review research questions (RQs):

- RQ1: What research methods have been used to investigate wayfinding (spot selection) in libraries?
- RQ2: What are lessons learned from these studies?
- RQ3: What are the general theories used to explain user behavior in library space use selection?

There are various types of literature reviews and varying procedures for their sequence. This paper's review structure follows the eight common literature review steps as demonstrated in Xiao and Watson (2019):

- formulating the research problem;
- developing and validating the review protocol;
- searching the literature;
- screening for inclusion;
- assessing quality;
- extracting data;
- analyzing and synthesizing data; and
- reporting the findings.

METHOD

Literature Search and Evaluation

The literature review was modelled on prior systematic reviews (Xiao & Watson, 2019; Mandel, 2020). This review took a mixed-methods approach, using a qualitative and quantitative focus as described by Grant and Book (2009), which identified what was known and unknown, recommendations for practice, correlations between characteristics, and gaps or differences in the studies. A colleague external to this study reviewed the database and search string prior to use for validation of the search strategy and another colleague reviewed the scoring rubric, codebook, and data to address analysis and reliability measures. For example, another qualitative researcher with expertise in inductive coding reviewed the initial set of codes that came out of the initial affinity diagramming and inductive coding approach used

before I later used subsequent closed coding techniques based on the original inductive codes (as detailed later in the Analysis and Synthesis section). If the coding differed, there was discussion and an agreed upon code. This external review of the data extraction and analysis helps to address reliability measures in this study where coding meetings were used to resolve discrepancies.

The following databases were used to locate relevant literature: Library Literature and Information Full Text (H. W. Wilson), Web of Science, and Google Scholar. The search parameters for H.W. Wilson and Web of Science included: library space us* AND (academic OR university) AND (wayfinding OR assessment OR UX resulting in 69 results; academic library AND space use AND assessment resulting in 25 results. For Google Scholar, the search parameters included: (library space AND (academic OR university) AND (user experience OR UX) AND (use OR usage) AND (assessment OR measure); UX AND library space; library space AND assessment AND spot selection. Collectively, the Google Scholar searches returned in over 377,00 results. From all the searches, the title was read for each entry to determine if it would meet the inclusion criteria; if there were more than 100 entries, only the first 100 titles were read. The final output of the search strategy resulted in an initial pool of 194 sources.

Inclusion and Exclusion Criteria

Next, the titles, abstracts, and database data were reviewed with the goal to include studies that provide guidance on the methodology of conducting space assessments in academic libraries. The sources were perused for inclusion or exclusion based on predetermined criteria:

- studies written in English,
- inclusion of studies from academic libraries (although there were relevant studies conducted at public libraries that provided useful data, such as, reports that provided results of informal and non-peer reviewed space assessments: these were excluded),
- inclusion of studies published between 2000-2020, and
- had a document type of either a peer-reviewed article or a high-quality book chapter (based on year of publication, author and or editor background, number of citations, etc.).

Special attention was paid to studies that reported methods or concepts useful for conducting space assessments (qualitative, quantitative, theoretical, or a combination). Studies from countries other than the United States were considered and included if it was written in English and met the criteria. Any items exclusively about how to find materials (i.e., books) or services (i.e., tutoring) were excluded. Other reasons for exclusion included duplicated items and irrelevant search results (e.g., studies that were not related to wayfinding, library UX, or space assessments; items that were abstracts or reviews of other studies; and studies that did not have clear information or were not related to the scope of this work).

Screening for Inclusion

From the literature pool, 20 journal articles and book chapters were selected for further review. The full-text were read to further evaluate their quality and relevance to the proposed study. Backward and forward search strategies were used to help further identify and rank the literature. Ten studies were found irrelevant and removed largely because the item was one of the following: a journal introduction, an article, a book review, a study not about wayfinding or space assessment, or that the study found wayfinding or space assessment only mentioned in the abstract, keywords, or author biography rather than within the study's full text. The

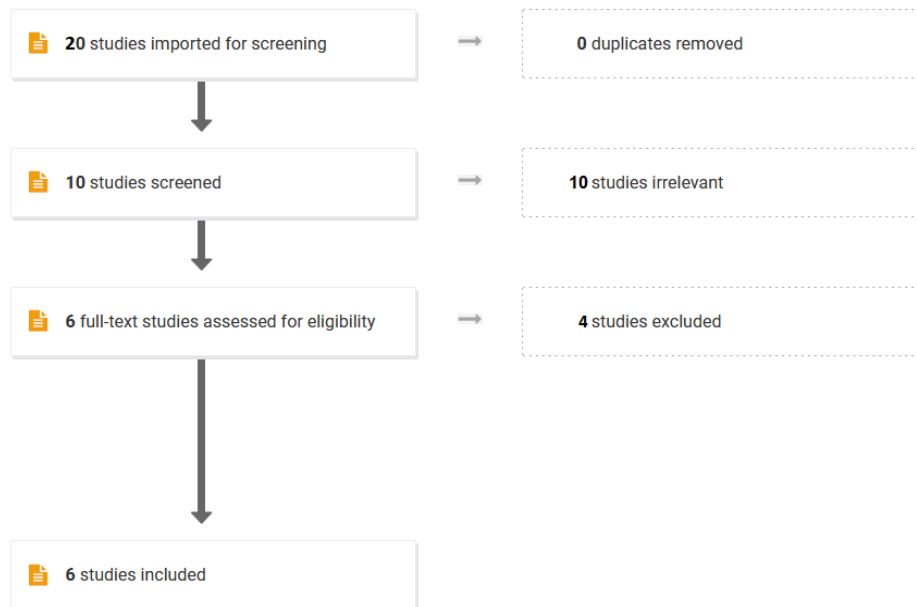


Figure 1: Snapshot of PRISMA/Covidence software extraction process

screening for inclusion, quality and eligibility assessment phases used Covidence and PRISMA software for review and extraction, as demonstrated in Figure 1.

Quality and Eligibility Assessment

The remaining ten publications were evaluated based on a scoring rubric adapted from Boote and Beile's (2005) literature review scoring rubric's categories of *coverage*, *synthesis*, *methodology*, *significance*, and *rhetoric* and used a type of ranking system. Their scoring rubric takes the categories of coverage (reasons for inclusion/exclusion), synthesis (state of the field, new perspectives), methodology (research techniques and methodologies), significance (practical or scholarly significance), and rhetoric (coherence and structure) and measures them against criterion that are ranked on a 1- 4 scale (most are 1-3, only the category of methodology can have a rating of 4). For example, the category of coverage has a criterion of “justified criteria for inclusion and exclusion from review” and potential rating of:

- did not discuss the criteria inclusion or exclusion,
- discussed the literature included and excluded, or
- justified inclusion and exclusion of literature.

Boote and Beile’s (2005) scoring rubric is based on Hart’s (1999) work (both works are largely cited) and is increasingly used to make researchers aware of literature review stages and evaluation methods for those stages. Hart is cited in Boote and Beile (2005).

Using the adapted scoring rubric categories and ranking system, study information was collected for the ten publications: publisher information (journal, relevance, ranking, editorial board, impact factors), methods and frameworks used, research questions, gaps or lessons, author background, and relevance to the proposed study. These ten studies are depicted in Table 1 in Appendix B, noting the year of publication, journal name, author names, article title, country of study, and article keywords. The use of the scoring rubric in this assessment helped to further evaluate the quality of studies and to limit the scope of this review with irrelevant studies primarily being excluded due to lack of details for coverage, research

methods, or significance (n=4). This process resulted in identifying six peer-reviewed journal articles as quality and included in this review for a detailed analysis.

Data Extraction and Analysis

All six peer-reviewed journal articles in Table 2 in Appendix B received the same procedural approach to information extraction. This approach covers the following:

- 1) article citation format;
- 2) short summary of the article in plain words;
- 3) restate the article's research question(s);
- 4) identified any theories presented;
- 5) identified any variables being evaluated/operationalized;
- 6) identified the research methodologies used;
- 7) identified any claims advanced by the article; and
- 8) identified any research gaps or limitations identified by the article.

Full references for these six articles are in Table 2.

All data extraction was completed using both low-and high-fidelity means through colour coding to highlight and identify common or differentiating themes. Cross-checking key terms and methods across the articles were also performed during the analysis. A codebook was developed iteratively as the data extraction and analysis were performed on the content of the selected articles. The information extraction approach described above (#1-8) was recorded, as well as subjects and keywords, source of the journal title, author(s), publication year and the country of the study. Other coding categories including the timeframe of each study and the methods used (surveys, tools, or framework) are shown in Table 2. Inductive coding which was a data-driven approach to derive codes from the data itself was used.

Analysis and Synthesis

In order to synthesize this data, affinity diagramming was used to formulate common themes across all extraction categories (research questions, theories, methods, variables, claims, and gaps). Affinity diagramming, also known as affinity mapping, is typically used as a UX research method to cluster and organize research findings, to sort ideas, and to brainstorm (Krause & Pernice, 2024) and helps to illustrate groupings of individual observations into higher level categories (Beyer & Holtzblatt, 1998). In practical terms, this method uses color-coding as a useful strategy to more easily find related themes among data, whether on physical or digital surfaces. Affinity diagramming and thematic analysis often complement each other, where both qualitative research methodologies code data into similar categories and themes. I regularly use both methods as a way to organize, visualize, and connect data to form a narrative with these UX and inductive coding techniques (Miller, 2021, 2024a, 2025). For this study, this color-coding strategy was used within a spreadsheet, which allowed for similarity/affinity diagram trends to emerge from this qualitative research process.

This process used a codebook which is a product created to organize and generate short phrases—the code—and assign them to the data extracted from the literature to interpret their meaning. Asher and Miller (2011) explained how these codes can be predefined or interpretive, where an example of the former is a type of ‘closed coding’ approach using an existing set of codes and an interpretive code is a code for someone's attitudes or opinions (a type of ‘open coding’ approach). This study used both types at different phases, starting with interpretive (inductive coding based on my interpretation and confirmed by an external reviewer) and then predefined (closed coding, based on my first round of codes).

Iterative analysis and inductive coding of themes resulted in 112 themes. The codes that apply to these themes underwent subsequent analysis with closed coding, a typical process used to create a standardized group of codes across all extracted data that can be uniformly queried (Asher & Miller, 2011). The closed coding results consolidated the count of themes from 112 to 24 and are discussed later. The following are the inductive coding analysis, extracted with affinity diagramming and each category is summarized below:

- **Research question similarity by topic**

There are connections among the research questions for the six studies. The topic of *student use* or *student perception* is part of the research questions for five of the six studies (studies 1-5). The next most concentrated topic is that of explicitly *understanding user needs* or *what students do* (studies 1, 2, 4). *UX* as a key component of the research question (studies 2, 6) and the *role of the library* (studies 3, 6) rounded out the highest concentration of similarities across the research questions.

- **Theory similarity by topic**

There are seven theory topics across all six studies, and within this, there are three topics that are identified in at least two studies (the rest are identified in only one study each). *Paradigm shifts* or library building paradigms according to the Bennett model (studies 1, 3). *Space use* data as a baseline measure or space assessment to guide decisions (studies 2, 4). *Design thinking* or UX design theories as a method of space design (studies 5, 6).

- **Variable similarity by topic**

Of the twelve variables depicted across all six studies, five topics are presented in at least two of the studies. *Occupancy rates* are key variables that have conflicting results and are noted for the potential difficulty in calculation accuracy (studies 1, 2, 4). *Floors* or floor maps fluctuate collection methods and results (studies 1, 2), as well as *furniture*, including furniture with technology (studies 2, 4), *noise level* (studies 1, 2), and *rooms*, including rooms created on the fly, solo spaces, group spaces, and multipurpose rooms (studies 2, 4).

- **Method similarity by topic**

Of the twelve methods discussed in the six studies, four topics are presented in at least two of the studies. Methods used include quantitative, qualitative, theoretical, or a combination of these, with the most prevalent including *headcounts* or sweat sweeps (studies 1, 2, 4, 5), *data visualizations* or heat maps (studies 1, 2, 4), *interviews* or focus groups (studies 3, 5), and observations (studies 3, 4).

- **Claim similarity by topic**

Nineteen claims were identified across all six articles. Finding similarities among them is difficult as the claims are specific to their studies, but this does not mean the claims are not applicable to the field at large. The largest correlation among the nineteen claims can be found in three topics: *Space characteristics affect usage*, including variations by floor, noise levels, signage, flexibility of the space, attraction to the space, and perception of occupancy (studies 1, 2, 5, 6). *User perception affects usage*, how a user feels, thinks about, or understands or thinks about the physical space (studies 1, 3, 5). *Headcounts* are a qualifying and useful method for space assessments (studies 2, 4). It is important to note that headcounts are used as a method in more than two studies, but headcounts are also explicitly stated as a claim of importance in two studies.

- **Gaps by topic**

There are 27 gaps or limitations identified across all six studies. Each gap was identified in at least two articles, and all 27 gaps can be consolidated into five topics below, each with detailed breakdown as below. Study number is in parenthesis.

- **Topic 1: Future research identified within articles (studies 2, 3, 4, 5, 6)**
 - Low use of graduate study rooms warrants research into graduate student needs (2)
 - Perform future studies not solely on occupancy but also on services (3)
 - Future studies based on user space needs, expectations, or desires (4)
 - Research the user activities conducted in the library (4)
 - Perform user perception of the physical environment (4)
 - Research should look more closely at how users react to signage, especially signs that incorporate humor (5)
 - Future studies should use focus groups, interviews, or observations to assess the visceral, behavioral, and reflective designs present in library spaces (6)
 - Wayfinding as a means for users to understand the encoding process (the wayfinding model for more than just books, but also services, units, etc.) (6)
- **Topic 2: Relationships (1, 3, 6)**
 - Relationship between group and solo work (1, 3)
 - Investigate the relationship of library use and learning behavior with academic status (3)
 - Consider the role of librarians as hosts in the physical space (6)
 - Consider the digital-physical interaction of libraries and users (6)
- **Topic 3: Difficulties (1, 2, 3, 4)**
 - Difficulty with instrument (annotated map), hard for people to interpret (1)
 - Difficulty with consistent data (no typical week for assessment) (1)
 - Difficulty with counting challenges (people standing in crowded areas were not counted) (1) and occupancy rate difficult to calculate (percentage of full) (1, 2, 4)
 - Occupancy is not a perfect measure (chairs are pulled up from other spaces, creating an occupancy rate over 100 percent) (2)
 - The space survey could have been larger (limitation) to understand how use fluctuations over time (1)
 - The renovation only impacted one floor of a 4-story building; therefore, a partial renovation of one floor did not markedly impact student learning behavior (3)
- **Topic 4: Discrepancies between data and opinion (2, 4, 6)**
 - The data and what students say they want do not correlate (2)
 - Discrepancy of soft furniture being popular (4)
 - Discrepancy with noise as a factor in spot selection (4)
- **Topic 5: Decision factors in spot selection (2, 4)**
 - Need to understand what factors students consider when making a seating choice (individuals sitting in collaborative areas) (2)
 - Consider user furniture preference (4)
 - Factors in how users select a study space at various points in time (4)

RESULTS

From the data extraction, analysis, and inductive coding results, a consolidated total of 24 themes were found and shown in Table 3 in Appendix B. The categories of these themes correspond to the research questions, especially the categories of methods (RQ1), claims or gaps (RQ2), and theory (RQ3). To recap these questions, please see RQ1, RQ2 and RQ3 listed early under the header, “Problem Statement and Literature Review Protocol”.

From the consolidated 24 themes, three scoping themes emerged as highly relevant across the studies. The review found that the literature can be narrowed to the following three key themes for the problem statement: *methods varietales as beneficial*, *user perception*, and

change and flexibility as critical to the future. Subsequently, closed coding correlated the original 24 themes into the three predefined themes, as in Table 4 in Appendix B.

DISCUSSION

This discussion section addresses the sources reviewed for this study, some of which may not have been introduced earlier in the literature review (which focused more on background information and helpful definitions). The following discussion explores the results in more detail with a particular focus on data that address the three research questions mentioned earlier—RQ1, RQ2 and RQ3.

Several studies discussed methods and ways to investigate wayfinding or user location selection, addressing RQ1. Khoo, Rozaklis, Hall, and Kusunoki (2016) analyzed the academic library in terms of relationships for workspaces, whether solo or group-based. This study found that technology has influenced student use of library spaces, and the multiple methods for data collection and analysis illustrate the utility of space assessments. The merger of their qualitative and quantitative studies discussed correlations between noisy, quiet, and busy spaces, as well as space characteristics by floor. These authors notably argue the occupancy rate is difficult to capture accurately, as do other studies in this review (Gullikson & Meyer, 2016; Castro, Spina, & Xu, 2019), which provides an important lesson for any future space designers to consider. The qualitative assessment revealed four distinct themes after using an inductive coding approach:

- perceptions of library services,
- perceptions of the library building,
- ambiance and affect, and
- the 'character' of each floor.

The latter two themes are reminiscent of Don Norman's behavioral, visceral, and reflective design levels, as described in McArthur and Graham (2015), where there is a correlation between design and use of a space based on the feelings of a person and the atmosphere of their surroundings. Khoo, Rozaklis, Hall, and Kusunoki (2016) also used annotated maps during interviews, which helped to understand user perception at a more detailed level.

Relatedly, some studies looked at user behavior and its relation to shifting contexts in learning spaces which is a lesson for libraries today (addressing RQ2). Montgomery (2014) and Khoo, Rozaklis, Hall, and Kusunoki (2016) conducted studies with research questions based on Scott Bennett's model of library design (shift towards a "learning-centered" paradigm of library space). Montgomery's goal was to ascertain if social learning, including user interaction, conversation, and work collaboration, changed as a result of the renovation which can also address RQ3 where social learning and user behavior theories led to understanding context. According to Montgomery (2014), library spaces are shifting from content on shelves to active and needs-based spaces. In order to determine how a library space renovation changed user-learning behavior, a study was conducted pre-and-post renovation at an academic library. Montgomery's case study is part of the ongoing discussion of library space assessment and user learning behavior in renovated library spaces through the use of an institutional review board (IRB) approved study involving pre-and post-library redesign surveys.

Additionally, several studies describe theories used for explaining user behavior in learning spaces, addressing RQ3. McArthur and Graham (2015) connected Don Norman's theory about behavioral, cognitive, and reflective responses of consumer products to design levels for emerging trends and innovations in library space design. Norman's behavioral

design emphasis reinforces the importance of *usability*, where the concept behind a (library) design should be relatable to the user and the designer. McArthur and Graham (2015) specifically point to an example of this in libraries, where *understandability* is often derived from library signage and a user's wayfinding experience in the building. Signage is also a key factor in library wayfinding success, as shown by Luca and Narayan (2016). McArthur and Graham (as well as Khoo, Rozaklis, Hall, and Kusunoki, 2016) also noted terminology as a factor in *understandability*, touching on Norman's behavioral design level. These two factors equally limit gaps that need further research: wayfinding as a means for users to understand the encoding process (a how-to-find model) and the disassociation of the term "library", as well as understanding wayfinding and library terminology. Such lessons address RQ2 and can help libraries design space studies with this knowledge in mind.

Luca and Narayan (2016) described how an academic library in Australia uses design thinking as an approach to improve the UX of library spaces and signage. The authors used a signage audit to understand human wayfinding behaviors. Design thinking was also identified as a theory and a claim by McArthur and Graham (2015) as an important role in space design which addresses RQ3.

Castro, Spina, and Xu (2019) conducted a library user space preferences study at an academic library in order to develop a stronger understanding of how students used the seating available in the library. These authors used gate count data to help determine how frequently to conduct headcount checks. Therefore, gate counts were helpful tools in assisting other methods, an approach also used by Montgomery (2014) which addressed RQ1. This process produced both expected and unexpected results. Castro, Spina, & Xu (2019) found weekends to have the lowest occupancy. Heavy focus on types of spaces (solo space, group space, multipurpose space), and rooms created on the fly were also measured (Gullikson & Meyer, 2016; Castro, Spina, & Xu, 2019).

Gullikson and Meyer (2016) examined library space usage projects at two different academic libraries (US and Canada) that had the same purpose: to better understand how students use the library spaces in order to improve these experiences. Although these authors used similar methods at their respective institutions, the resulting data produced very different claims (addressing RQ1 and RQ2). This is insightful evidence to support why library space design should be specific to the institution rather than relying on data and research done elsewhere (another lesson that future space designers should heed). Several studies used headcounts or seat sweeps as a method (Khoo, Rozaklis, Hall, and Kusunoki, 2016; Gullikson & Meyer, 2016; Luca & Narayan, 2016; Castro, Spina, & Xu, 2019); however, Gullikson and Meyer's (2016) use surpassed them all in terms of quality of data description and data visualizations created.

Consolidated Themes

The theme of *method varieties as beneficial* is prevalent across the studies and addresses RQ1. As seen in Table 2 study characteristics (quantitative, qualitative, theoretical, or combination), there are a variety of methods used to produce space assessments, including signage audits, headcounts, gate counts, interviews, focus groups, observations, and theories. A few of the studies that mainly used quantitative methods found that to be a limitation where future research would include either follow-up qualitative studies or a mixed methods approach in the future (Montgomery, 2014; McArthur & Graham, 2015; Gullikson & Meyer, 2016; Castro, Spina, & Xu, 2019). Additionally, the literature mentioned that a mixed-methods approach, using more than one of these methods alone, is a best practice for

producing accurate and high-quality space assessments.

The theme of *user perception* is noted to distinguish between the user and that of the space designer or library perception. This theme is depicted in data extraction from the research questions, variables, methods, claims, and gaps from the six studies. Additionally, there is a discrepancy between what a user perceives and what they actually do (Gullikson & Meyer, 2016). User perceptions also include terminology and understanding of what "library" means today, as well as the role of the library (McArthur & Graham, 2015). This lesson of user perception addresses RQ2 and RQ3 as it relates to user behavior.

The theme of *change and flexibility* is critical to future space designs when analyzing the six studies. No two institutions are the same, and thus, a space assessment for one institution does not fit another (addressing RQ2). Paradigm shifts will continue to fluctuate as users change (and therefore, their behaviors and needs change, which addresses RQ3), and characteristics of spaces vary by many attributes (by floor, noise level, occupancy perception, ambiance, etc.). Creating spaces based on wayfinding and design thinking practices can help plan for the flexibility and adaptability that is critical to the success of libraries.

CONCLUSION

Designing learning and community spaces is trending in literature. Among the most asked questions are how such spaces are being used and the reasoning for space usage, including preferences, frustrations, and needs. Seating or spot selection is just one characteristic that can help identify ways to understand and improve the physical environment. The importance of the library, archive, or community space goes beyond books, articles, and electronic resources. Library spaces are shifting from content on shelves to active and needs-based spaces. One specific way to improve library spaces is by looking at how and why library (or learning space) users select spaces to use as they do.

Through the literature analysis, a relationship between users and their workspaces emerged, whether solo or group-based, where technology appears to influence student use of library spaces. This study uncovered answers to its three research questions on the user experience and wayfinding of spot selection by looking at research methods (RQ1), lessons learned (RQ2), and explanations for user behavior (RQ3). The literature shows there are a variety of methods used to produce space assessments, including signage audits, headcounts, gate counts, surveys, interviews, focus groups, observations, and theories. The *method varieties* are seen as beneficial across the studies reviewed with an important lesson that purely quantitative studies or a single method alone was a limitation to understanding true user and space assessment data. The themes of *user perception* and *change and flexibility* are also important to understanding why space assessments do not transfer from place to place as paradigm shifts continue to fluctuate as users, norms, and characteristics of spaces change. These behavioural characterizes and attitudes impact how spaces are considered and used.

Additionally, the multiple methods for data collection and analysis illustrate the utility of space assessments. Multiple methods and triangulated methodologies are recommended to understand library space usage. For example, headcount methodologies can help discover metrics on noise level and furniture preferences, while qualitative interviews can reveal insights into favourite and least favourite spaces and users' wants and needs for changes in space designs. As furniture, buildings, and technology change, so do the users who occupy learning spaces that contain these items. Hence, there is a need to collect both quantitative and qualitative data in order to assess the UX learning spaces accurately. Changes to the physical

environment will help or hinder space usage, and user preferences, frustrations, and needs will help identify resolutions.

For institutions with future plans for library, community, or learning space redesigns, the results of this review will be informative and time-saving. This review helps give insight into the preparation of the larger, next-level study at the specific site. This review has uncovered what research methods have been used to investigate wayfinding in libraries, lessons learned from those studies, and general theories used to explain user behavior in library space use selection. Moving forward, these insights can be applied to local wayfinding and space design protocols in order to improve the UX of learning spaces.

FUTURE RESEARCH

Additional research is needed and underscored by the frequency and quantity of gaps and limitations identified in the six articles as presented in the preceding *Gaps by Topic* section. To understand what factors the users consider when making a seating choice, a mixed-methods approach is beneficial to elicit the reactions and preferences of users. To get started on this next phase of research, see the *Template for Planning, Surveys, and Interviews for Learning Spaces Redesign* in Appendix A. This template is applicable to any type of learning space (not just libraries) and provides suggestions, including project scope and goal reflection, ethical and inclusive design considerations, people resources and audiences, and advice on tools and methods. The template offers suggestions based on the findings from this study for others to consider in a pick-and-choose format as some administrators may not find every item applicable to their unique situation. I have used many of these recommendations in the next phase of this study which will later be published as a case study that uses surveys and interviews based on this critical review's findings.

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APPENDIX A

Template for Planning, Surveys, and Interviews of Learning Spaces Redesign

This template offers recommendations based on the culminating findings from this study. After reviewing the state of the field through this review, the next step is to plan for a site assessment by observing and interacting with users. Use this template to begin thinking about the next steps, modifying and adapting as needed. Consider the following in the planning stages:

Administrative matters to include but are not limited to the following:

- Purpose and goals for the site assessment; and buy-in and feedback from within and outside the learning space
- Consider both inside and outside spaces, adjacencies, and flows of a user's experience or journey throughout a building or throughout a user's goal (intended use)
- People and stakeholders (across campus and within the building, including staff, faculty, students, and community members) and their roles in this project. Consider inclusive design principles in the makeup for the project team and user base, including but not limited to ranges in age, gender, ethnicity, language, educational status, as well as motor and cognitive abilities
- Budgets, fundraising, facilities, and campus planning timelines and efforts

Ethical and inclusive design considerations, including but not limited to:

- Project scope (roles and responsibilities of team members)
- Outside review of survey and interview questions prior to use, considering readability, usability, understandability of text, length, and association
- Consent forms for surveys, interviews, and user participation
- IRB or other review boards, especially if planning to publish the results of the study
- Protocol developed that details the purpose of the study, purpose, methods, recruitment methods, and documentation and reporting strategies
- For compensation for surveys and or interviews, how will the study compensate someone's time and effort in participating
- Moderator's script for interviews so every interviewee is getting equal access and treatment throughout the study

Tools and methods that help with both quantitative and qualitative means of assessment:

- Surveys, online and/or paper (consider accessible forms in order to meet the widest variety of potential users)
- Occupancy counts for the building over a period of time, tallying at different times and days throughout different semesters, finding themes within that data to help in further assessment
- Space use by location, furniture choice, technology, noise level, and so forth
- Developing questions that get answers needed
- Use a mix of demographic questions and scaled questions, and most helpful are open-ended questions where users can explain their behavior, needs, and wants in learning spaces

- Avoid leading questions, and during interviews, ask follow-up questions to get clarity from the participant
- Use a variety of methods—a mixed-methods approach (quantitative, qualitative, theoretical, or a combination)
- Be mindful, consider training on inclusive design for team members; consider inclusive design checklists (Microsoft, n.d.; Miller, 2024b)

Action and trends to consider:

- Watch for future trends, including reports from EDUCASE and Designing Libraries
- Remote and hybrid work, learning, and studying trends
- Flexible spaces, furniture, and technology
- Do something with the data, take action, and make a positive change

APPENDIX B

Table 1. Chronologically listed literature included in the review for quality assessment phase

Year	Journal	Author	Title	Country	Article keywords
2009	Journal of library administration	Neal, James G.	What do users want? What do users need? W(h)ither the academic research library?	United States (US)	Research libraries; academic libraries; library users; library 2.0; Libraries & teachers; libraries & students; library 2.0; library and faculty relations; library space; library user
2012	Partnership: The Canadian journal of library & information practice & research	Wortman, Beth	What are they doing and what do they want: The library spaces customer survey at Edmonton Public Library	Canada	Libraries; public libraries; industrial surveys; business planning; Edmonton Public Library
2014	Behaviors in the library	Montgomery, Susan E.	Library space assessment: user learning behaviors in the library	US	Library space; assessment; survey; renovation; ethnography; academic libraries
2015	Weave: Journal of library UX	Marquez, Joe; Downey, Annie	Service Design: An introduction to a holistic assessment methodology of library services	US	Service design; user experience; bibliography. library science. information resources
2015	Journal of library innovation	McArthur, John A.; Graham, Valerie Johnson	UX design and library spaces: A pathway to Innovation	US	Digital libraries; information & communication technologies; technological innovations; cognitive science; Queens Borough Public Library
2016	Weave: Journal of library UX	Gullikson, Shelley Meyer, Kristin	Collecting space use data to improve the UX of library space	Canada; US	UX Bibliography. Library science. Information resources
2016	College & research libraries	Khoo, Michael J.; Rozaklis, Lily; Hall, Catherine; Kusunoki, Diana	"A really nice spot": Evaluating place, space, and technology in academic libraries	US	Academic libraries; library design & construction; Information & communication technologies; Space utilization in academic libraries; Bennett, Scott
2016	Weave: Journal of library UX	Luca, Edward; Narayan, Bhuva	Signage by design: A design-thinking approach to library UX	Australia	UX; bibliography. library science. information resources
2017	Portal: Libraries and the academy	Spencer, Mary Ellen; Watstein, Sarah Barbara	Academic library spaces: Advancing student success and helping students thrive	US	Academic libraries; library facilities; library services; school space; learning; college students; evaluation
2019	Journal of library Administration	Castro, Rodrigo; Spina, Carli; Xu, Yaqing (Allison)	Measuring space and furniture occupancy in academic libraries: from data gathering to visualization	US	Academic library administration; academic librarians; socialization; data visualization software; educational cooperation

Table 2. Characteristics of reviews included in the six selected review articles

#	Study	Timeframe covered	Quantitative surveys or tools used	Other quantitative (if any)	Qualitative surveys or tools used
	Only 1 st author listed				
1.	Khoo 2016	Oct 2010-Jun 2011	114 (headcounts)		Place survey (n=98)
2.	Gullikson 2016	Nov-Dec 2014; Jan-Apr 2015; Fall 2013-Spring 2014	292 (headcounts) 654 (headcounts)		
3.	Montgomery 2014	Feb-Apr 2012 and Feb-Apr 2013	15 % average increase between years (gate counts)		Pre-and-post redesign survey (n=240); a mix of Likert scale, demographic, and open-ended questions
4.	Castro 2019	Jan-May 2019	May is the highest occupancy @ 35%+ (headcounts by percentage full by month, rather than number)	(gate counts) used to identify how frequently to do headcounts	
5.	Luca 2016	2013-2014	17 of 55 counts of immediate sign removal (signage sweeps)	(signage audit)	
6.	McArthur 2015	2004-2012 (literature review scope)			UX design framework (3 design levels from Don Norman, 2004)

Table 3. Inductive coding of themes by category and quantity

Category	Total number of themes	Consolidated number of themes
Research question	17	4 with similarities in 2+ studies
Theory	10	3 with similarities in 2+ studies
Variable	18	5 with similarities in 2+ studies
Methods	19	4 with similarities in 2+ studies
Claims	19	3 consolidated themes
Gaps	29	5 consolidated themes
Total	112	24

Table 4. Closed coding of the 24 themes by quantity and similarity

Theme	Studies # applicable (higher = more relevant)	Closed coding of themes
Student use/student perception	5	User perception
Understanding user needs/what students do	3	Method varietals (to understand); user perception (to learn); flexibility (to change as users do)
User experience	2	User perception; method varietals (to analyze)
Role of library	2	User perception; Change (for future)
Paradigm shifts/library building paradigm (Bennett)	2	Change (for future); Method varietals
Space use data as a baseline measure; Space assessment guides short/long-term decisions	2	Method varietals; Change
Design thinking, UX design theories	2	Method varietals
Occupancy rate	3	User perception (determines use); Change (for future)
Floor, floor maps	2	Method varietals; Change (for future)
Furniture, furniture with technology	2	User perception (determines use); Change (for future)
Noise level	2	User perception (determines use); Change (for future)
Rooms created on the fly, solo space, group space, multipurpose space	2	User perception (determines use); Change (for future)
Headcounts, seat sweeps	4	Method varietals
Data visualization; heat maps	3	Method varietals
Focus groups, interviews	2	Method varietals; Change
Observations	2	Method varietals; Change
User perception	3	User perception
Space characteristics affect use	4	User perception; Change
Headcount as a method	2	Method varietals
Challenges	3	Method varietals; User perception
Relationships	3	User perception; Change
Discrepancies	3	Method varietals; User perception
Factors in decision of spot selection	2	User perception; Change
Future research identified	5	User perception (determines use); Change (for future)