Journal of Architectural/Planning Research and Studies (JARS) Vol.21(2).2024
https://doi.org/10.56261/jars.v21.267601

Assessing Users' Demand for Library Space: Insights from an Architecture School

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Received 23/1/2024 Revised 4/3/2024 Accepted 19/3/2024

Abstract

The purpose of this paper is to conduct a post-occupancy evaluation to assess users' feedback on the use of the architecture school library at Thammasat University, Thailand. The proposed study also has a specific objective: to explore users' demand for library space in terms of academic library attributes. A case study of the library in the Faculty of Architecture and Planning was conducted at Thammasat University. Multiple data collection methods were used, including document analysis, a questionnaire survey, a workshop, and focus group interviews, to gather information on users' demand for the library space. The findings confirm the relevance of the variables in the conceptual model from previous studies, which encompass three key attributes regarding users' demand for library space: physical, social, and digital spaces. Functional obsolescence and changing learning approaches are revealed as dominant influential factors affecting users' demand for library space. The connection between post-occupancy evaluation (POE) and pre-design evaluation (PDE) in the redevelopment of a real estate project is considered as a shift from performance measurement to performance management, assisting in establishing agreed-upon performance goals for the operation. This study's findings, derived from a single case study, do affect affect generalisability. However, the study provides insights into academic library design and renovation by emphasising the alignment of library spaces with user needs for improved service effectiveness and user satisfaction. The research introduces an integration of POE and PDE, proposing a methodological framework for future library space redevelopment that could contribute to the broader discussion on library design and user experience.

Keywords

Academic library; Architecture; Learning commons; Real estate project; Obsolescence; Post-occupancy evaluation

1. Introduction

Changes in environmental factors, such as advancements in learning approaches, technology, and student behavior, are driving the demand for library space. As a result, many institutions are renovating their libraries to become information commons or learning commons (Lippincott, 2006). In the learning commons, students can engage in a wide range of technology and information-related activities in a space conducive to group

work (Brown, 2005). This includes supporting learning activities beyond the classroom, accessing digital media, and facilitating social interaction. To meet the increasing demand for learning spaces, academic libraries are incorporating non-traditional facilities, such as classrooms, cafes, and group study spaces (Shill & Tonner, 2004; Stewart, 2011). However, determining the gap between demand and supply is fundamental for managing and developing buildings and facilities. This becomes challenging due to building obsolescence resulting from the building life cycle, which creates a mismatch between the static building supply and the dynamic user demand.

Since 2019, Thammasat University's Faculty of Architecture and Planning in Thailand has been working on a four-year plan to develop its faculty building, including the library space. However, the Covid-19 pandemic has delayed the project phases, including the redevelopment of the faculty library. To resume the library development phase, consideration of changes in users' requirements is essential. Post-occupancy evaluation has been applied as an approach to gather feedback on the building in use, involving teams that designed the redevelopment. As part of the development plan, an appraisal of users' needs and preferences for the library space was initiated. This study aims to assess users' feedback on the use of the architecture school library to identify their demand regarding the academic library attributes, serving as an input on the redevelopment project.

2. Literature Review

2.1 Learning Environment in Higher Education

The exploration of the learning environment in higher education is foundational to understanding how contemporary pedagogical shifts and architectural designs influence user demands for library spaces. Higher education has undergone considerable change in recent decades (Johnson et al., 2011; Beckers, 2016). The shift in teaching and learning approaches, such as student-centered learning, has transferred power and responsibility from the teacher to the student (Mushi, 2004), influencing what students learn in schools. Barr and Tagg (1995) suggested that schools should transform from places of instruction into environments for co-produced learning among students, peers, and teachers, rather than merely consuming knowledge in a classroom. Continuing their argument, they emphasised the need for self-directed students who take responsibility for their own learning, build networks, cooperate with others, and use ICT to find resources that help them achieve their goals. Universities also face new challenges that demand the development of learning environments due to varying pedagogical approaches, ICT use, diverse student populations, and new expectations in the workforce (Valtonen et al., 2021).

Learning environments have multiple definitions. Manninen et al. (2007) defined them using five perspectives: physical spaces, teaching and learning approaches, social and collaborative aspects, technologies, and contextual learning outside campus. Radcliffe (2008) defined a learning environment using the Pedagogy-Space-Technology framework, which considers the connections among different elements of a learning environment and is useful for both individual and networked learning spaces. Van Aalst and Kok (2004) argued that the new ways of learning can be characterised as a shift from a supply-driven approach to more customised and demand-oriented ways of learning. In other words, there has been a shift toward more student-centred teaching and learning practices. As the context of higher education continues to evolve, there is a need to reassess the physical learning environment and explore how new learning spaces can effectively support pedagogical

transitions (Marmot, 2012).

This research synthesises perspectives on learning environments, integrating physical, social, and technological dimensions to meet evolving educational needs. It critically examines the shift towards more collaborative and digitally enhanced learning spaces, questioning the current designs' effectiveness in fulfilling modern learners' diverse requirements. This sets the stage for exploring how educational spaces can be better designed to support today's pedagogical objectives.

2.2 Academic Library Attributes

Exploring academic library attributes highlights the crucial role of blending physical, social, and digital dimensions in enriching learning environments, aligning with the aim to optimise library spaces according to user preferences. Kim (2016) mentioned that libraries in general serve as centers of social, cultural, information, and learning activities. Despite predictions that the rise of electronic information would diminish the physical library's role, its use and visits have actually increased (Kim, 2016). Several studies have indicated an increase in library usage, particularly following enhancements to library facilities (Lawson, 2004; Shill & Tonner, 2004; Weise, 2004). Physical space in an academic library is becoming increasingly important to fully support students' diverse needs for learning spaces (Cha & Kim, 2015; Scott-Webber, 2004). When adequately implemented, the design of library facilities can transform the physical library from a print-focused collection into a more inviting destination for discovery and learning (Lawson, 2004). As stated by Kim (2016), academic libraries serve not only as places for information seeking and learning but also as spaces for socialising, relaxation, and communication, enriching users' academic and social experiences as valued public spaces on campus. On the other hand, Lau et al. (2020) mentioned that future librarians are likely to be expected to design and actively deliver library resources and services in various digital formats. Furthermore, academic libraries are evolving into community centres in addition to their traditional role as academic hubs, emphasising the importance of nurturing a sense of place in academic libraries (Sanders, 2005).

Mehtonen (2016) observed that digitisation has emerged as a significant factor influencing library function and spatial solutions. He introduced a multidimensional model for library space in the digital age, with a focus on library design, identifying three key themes: digitisation, the design process, and library space conceptualisation. Through research analysis and collaboration with key stakeholders, Mehtonen (2016) developed a multidimensional model that encompasses physical, social, and digital spaces. Lotfy et al. (2022) also identified these three attributes as the primary components of academic libraries within the context of architectural education. These attributes will be discussed in Section 5, but are summarised in Figure 1.

This research integrates the diverse perspectives on academic libraries as multifunctional spaces, navigating the balance between socialising and learning. It critically evaluates insights from previous studies, such as those by Mehtonen (2016) on socialisation and Lotfy et al. (2022) on educational purposes, identifying potential inconsistencies in how libraries prioritise these functions. The study questions existing methodologies that often isolate social and educational roles, proposing an integrated approach to design strategies. This approach seeks to harmonise learning and social interaction, thereby addressing the dual functions of modern library spaces in catering to diverse user needs.

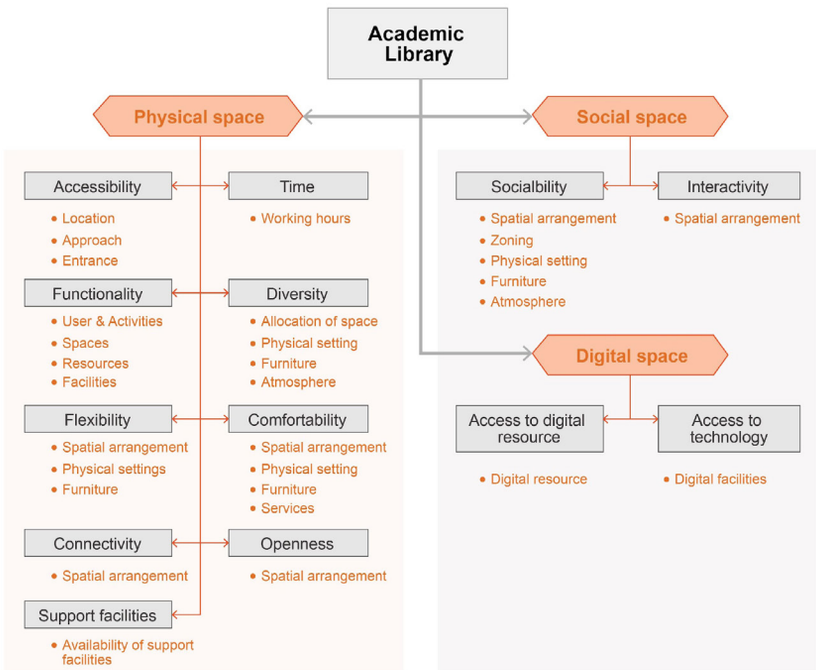

Figure 1. A multidimensional model for library space (Adapted from Lotfy et al., 2022)

2.3 Users' Needs and Preferences

Assessing users' needs and preferences underscores the importance of tailored library services and resources, directly contributing to the strategic development of library spaces that resonate with the diverse requirements of various types of users. Van Meel and Størdal (2017) mentioned that when it comes to real estate development, project objectives that are difficult to quantify, such as user experience or architectural quality, are no less important than those that are easily measurable. They also noted that assessing stakeholder needs involves considering both the added value of meeting those needs and the associated costs, which, though challenging to quantify, enable differentiation among 'must-haves' (where value exceeds costs), 'should-haves' (where value and costs are balanced), and 'could-haves' (where costs surpass value). When it comes to user experience, Rothe et al. (2012) discussed the distinction between needs and preferences. Needs can be compared with hygiene factors, where dissatisfaction increases if they are not met, while preferences serve as motivators—fulfilling preferences is essential for enhancing satisfaction. Drawing from environment-behavior studies, Vischer (1985) proposed the needs and preferences model, which addresses users' demands and incorporates them as primary assumptions:

1. Users' needs and preferences can be identified through direct questioning of the users or key informants who represent them.
2. The appropriate design and manipulation of the physical environment should aim to meet users' needs.
3. Meeting users' needs is a primary, if not the primary, objective of environmental design.

Vischer (2008) further stated that measuring occupants' experiences provides information about both the product—how spaces affect behavior in different situations—and the effects of building systems on comfort. It also offers insights into psychological processes—how people feel about and respond to the spaces they occupy—as well as the overall process itself.

Expanding on Vischer's model, this study critically assesses the relationship between users' expressed needs and preferences and their actual impact on space utility and satisfaction. It scrutinises past methodologies for capturing user feedback, proposing a more integrated approach in aligning design with user expectations.

2.4 Post-Occupancy and Pre-Design Evaluation

Exploring post-occupancy and pre-design evaluations reveals their pivotal role in shaping library environments that not only meet current user needs but also anticipate future demands, facilitating a seamless integration of functionality and user satisfaction in library space planning. Post-occupancy evaluation (POE) is the process of evaluating a building's performance after several years of occupation (Li et al., 2018). The concept and terminology of POE gained mainstream recognition in 1988 when it was defined as "the systematic and rigorous evaluation of buildings after they have been constructed and occupied for some time" (Preiser et al., 2015). In a previous study, POE was described as "a general approach to obtaining feedback about a building's performance in use, including energy performance, indoor environmental quality (IEQ), occupants' satisfaction, productivity, and more" (Li et al., 2018). Elsayed et al. (2023) noted that this process involves conducting rigorous audits and evaluations of 'buildings in use,' with continuous assessments throughout the building's lifespan. According to Altizer et al. (2019) and Davoodi et al. (2021), these assessments are ideally conducted in buildings that have been constructed and occupied for at least six months.

The purposes of POE include providing a continuous evaluation of a building's social and behavioral aspects, as well as verifying whether the design's intended principles and guidelines were successfully achieved and whether they were adequate (Pereira & Ornstein, 2023). Li et al. (2018) mentioned POE methods that encompass both subjective assessments and physical measurements. They explained that subjective methods include occupancy surveys (such as standardised occupant satisfaction surveys, thermal comfort surveys, visual comfort surveys, and customised surveys), whereas physical measurements cover in-situ measurements of IEQ (including thermal conditions, lighting, indoor air quality, and acoustics), as well as energy and water assessments.

Elf et al. (2019) and Vischer (2009) argued that one criticism of POE is its primary focus on user experience and perception, rather than providing evidence based on predetermined performance criteria. Hadjri and Crozier (2009) and Joseph et al. (2014) agreed that this narrow focus can hinder its effective integration into other research, design, and building procurement processes. Pereira and Ornstein (2023) assert that POE provides insights into the usability of the environment and often includes an evaluation of the building's performance, but it does not inherently present tools for effective intervention in these activities, despite its importance for offering feedback related to facilities and project management. This gap highlights the challenge in translating diagnostic insights and recommendations from POE into actionable changes for facility and project management. On the other hand, Pre-Design Evaluation (PDE) corresponds to an analysis of the design programming and the early architectural design, conducted by experts in design performance evaluation (DPE) (Ornstein et al., 2009). PDE focuses on providing just-in-time support for design decision-making, considering performance projections, while POE, which starts after construction is completed, occurs late in the process and demands a significant amount of time and cost to yield limited results in terms of improving the evaluated environment (Shin et al., 2017). Pereira and Ornstein (2023) concluded that for a new environment, the 'predicted performance' of a PDE is based on POE recommendations from similar cases, requiring the measured performance to be simulated. By shifting the reference point from 'actual occupation' to 'projected occupation,' assessment

instruments can be better defined and guide the selection of the most suitable one for various building life cycle stages. Integrating POE and PDE, this study critically evaluates these methodologies' roles in the iterative design process, highlighting their potential and limitations in real-world applications. It discusses the implications of adopting a cyclical evaluation framework for library spaces, ensuring they adapt over time to changing user needs and technological trends.

3. Research Methods

The author conducted a field study focused on the library of the Faculty of Architecture and Planning, also known as The Professor Dr. Vimolsiddhi Horayangkura Library, at Thammasat University in Thailand as part of the case study method. Data collection included document analysis, a questionnaire survey, a workshop, and focus group interviews. The case selection was influenced primarily by the type of library, specifically focusing on the Faculty Library of Architecture schools. This particular context was chosen due to its unique characteristics and the potential insights it could offer into spatial requirements and usage patterns distinct to architectural education. Furthermore, the real estate intervention, characterised by the redevelopment project of the library, presented an opportunity to apply POE techniques. This redevelopment aspect was critical in the case study selection process as it allowed for the exploration of how physical changes in the library space can impact user satisfaction, engagement, and functionality. The study was conducted between January 2023 and April 2023. All study procedures involving human participants complied with the ethical principles of the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

3.1 Single Case Study

This study employs a qualitative, exploratory single case study design using inductive reasoning to understand the current library spaces' suitability at a faculty level. It leverages content analysis to identify patterns and themes reflective of social reality without focusing on quantitative measures, as discussed by Zhang and Wildemuth (2009), and thematic analysis for pattern recognition within the data, leading to theme-based categories for analysis, following the approaches by Bowen (2009) and Fereday and Muir-Cochrane (2006).

3.2 Document Analysis

Document analysis in this study employed a systematic approach to evaluate documents, both printed and electronic, to extract thematic data and empirical knowledge, as described by Bowen (2009), Corbin and Strauss (2008), and Rapley (2007). This method has been applied to analyse both project documents and Tantiwanit's (2019) report, which systematically examined the physical characteristics and users' demands of a faculty building for spatial requirements. These analyses will be used alongside survey and interview data for a comprehensive analysis.

3.3 Questionnaire Survey

The questionnaire was designed to gather data about users' experiences with the current condition of the faculty library, in order to understand why and how they use the space or choose other locations to meet their needs. The questionnaire was piloted with 10 students to obtain feedback and was then improved for use in the survey. Initially, for the pilot, there were ten options related to library usage. However, a suggestion

was made to add more detailed questions that would encompass environmental factors influencing the choice to use the library space, such as open space for reading books and spending short periods, attractive atmosphere and interior design, and space for discussion and exchanging ideas. Additionally, there was a recommendation to include an open-ended question to allow participants to provide more comprehensive descriptions in their responses.

The secretary of each degree program disseminated the questionnaire online to students, academic staff, and administrative staff by posting the survey QR code on the faculty's communication channels without direct communication with the participants. The research assistant responsible for collecting data for the questionnaire survey confirmed that all 345 respondents to the survey did so anonymously. These respondents were volunteers who willingly participated in the survey. The research assistant had several key responsibilities, including collecting and storing data from the online Google Form survey. Additionally, she played an active role in both the workshop and focus group interviews by collecting data, transcribing the proceedings, and taking pictures of the library's physical environment and atmosphere during these sessions using a digital camera. She was the sole individual with access to the data, which were later reported to the lead researcher.

The survey gathered information about the frequency of participants' visits to the library, categorised as never, rarely, sometimes, usually, or always. Additionally, the survey collected data to determine why some participants visit the library only occasionally or not at all. The survey offered options such as difficult access, lack of variety in spaces, inability to talk or make noise, lack of support facilities, unattractive atmosphere and interior design, and limited operating hours. The questionnaire survey also asked about the respondents' use of other learning environments if they were not using the faculty library. Another question asked the respondents about their reasons for visiting the faculty library, with the aim of identifying similarities or differences with the reasons for not using the library space mentioned in the previous question. In addition, two open-ended questions asked the respondents about their preferred spaces within the library in general, followed by additional comments.

3.4 Workshop

Before each workshop and interview, the facilitator/interviewer informed participants about the study's objectives, consent, and anticipated compensation. Participants were compensated with a meal set and drinks (valued at 14 USD), following ethical guidelines to ensure compensation did not unduly influence participation or responses. In the workshop process, two groups were involved in the assessment of users' requirements for the library: facilitators and students. The facilitators of the workshop included two academic staff members who specialise in facility management and library design, and a librarian. Facilitators had a neutral role throughout and their main responsibility was to assist participants in raising issues, providing comments, and making evaluations. Twenty-three students were selected based on a stratified sampling method to ensure diverse representation across academic levels (second to fourth year undergraduates, Master's, and Doctorate students who have completed at least two academic years in the Faculty of Architecture and Planning). All participants had previously completed the questionnaire survey, ensuring familiarity with the research context.

The student workshop adopted full user participation in the POE process, as described by Kernohan et al. (1992). The workshop consisted of three core events: an introductory meeting, a touring interview, and a review meeting. The purpose of the introductory meeting was to establish clear objectives and processes for the workshop, encourage participants to raise issues, and provide information about the current and expected

future expansion of the library space to be covered during the walk-through. The touring interview involved a walk-through observation of the library space by the participant groups. During the tour, facilitators explained the environmental characteristics and usage of each library zone, including the reading zone, archive room, dissertation room, and other support spaces (e.g., prayer room, broadcast room). Facilitators raised issues related to spatial needs during the walk-through without posing direct questions but instead focused on the experience and space requirements. These issues were discussed later in the review meeting. The next step was to gather comments that reflected the collective themes in user responses to the architecture and environmental settings during the walk-through of the library space. This was done to create an inventory of physical and non-physical requirements that would be used during the discussion and verification of the findings from the questionnaire survey.

The facilitators presented the comments and issues raised during the walk-through observation using PowerPoint and a flip chart, sharing ideas about the academic library to provide an understanding of various aspects of library space, including physical, social, and digital dimensions. Their goal was to address questions related to the experience and limitations of using academic library space, such as: How often do you use the library's physical space (e.g., daily, weekly, monthly)? What types of activities or tasks do you typically come to the library for (e.g., studying, research, reading, group meetings)? Could you please describe your experience using the faculty library? Can you describe your favorite area or section of the library and explain why you prefer it? Are there any specific resources or amenities in the library that you find most useful or valuable? How would you rate the overall comfort of the library space (e.g., seating, lighting, temperature)?

Additionally, the workshop participants were asked to consider the future demand for library space in the next 3-5 years and compare it with the current supply. The final step of the workshop was the verification of findings from the questionnaire survey. Participants were asked to express their agreement or disagreement with the survey results and provide reasons for their stance.

3.5 Focus Group Interviews

The purpose of the focus group interviews was to gain insights into users' experiences and perceptions of the current library space, as well as their needs and preferences for the future. This approach served as a means of validating the findings from both the questionnaire and the workshop. The focus group interviews included twelve participants, divided into three groups of students, with each group consisting of four participants. These interviewees were selected from the workshop attendees to create a more relaxed atmosphere within smaller groups, thus fostering greater participation. Focus group participants were randomly selected to ensure diverse and unbiased insights into library space usage, enhancing the study's breadth of perspectives.

As part of the interview process, participants were requested to walk through the library and use their personal mobile phones to capture photos of areas they found appealing and those they did not appreciate. This technique, known as photo-elicitation interviews (Harper, 2002), was employed to facilitate discussions during the interviews. Participants were encouraged to reflect on these images through open-ended questions aimed at exploring the advantages and disadvantages of the library space in relation to their requirements and expectations. The interview questions covered a range of topics, including: Do you find the library environment conducive to focused work or study? Why or why not? Are there any noise levels or disturbances that you find distracting when using the library? Are there any specific changes or improvements you would suggest to enhance the physical environment of the library? How would you rate the accessibility of the library for

people with different needs (e.g., those with disabilities)? Are there any amenities or services that you believe the library should offer or expand on to better serve its users? Do you have any feedback on the availability of technology and equipment in the library, such as computers, printers, or charging stations? Are there any improvements or additional resources you would like to see for collaborative work within the library? Based on your experiences, what suggestions or recommendations do you have for making the library space more appealing and functional? Is there anything else you would like to share about your experiences with our library space that we haven't covered in this interview?

Employing a multi-faceted research approach, this study meticulously gathered and analysed data from various sources to understand users' demand for library space. As we shift our focus to the findings, the insights derived from this comprehensive methodology set the stage for a detailed exploration of how physical, social, and digital spaces within the library meet or adapt to user needs and preferences.

4. Case Study

The Faculty of Architecture and Planning library at Thammasat University has been in operation for 16 years, since 2007. It is situated on the 2nd floor of the faculty building and has two entrances/exits. The main entrance is located next to the main circulation on the 2nd floor. Library users can access the library by walking up the stairs from the ground floor or by taking the elevators. Figure 2 shows the faculty library on the second floor, which is connected to other areas of the faculty building.

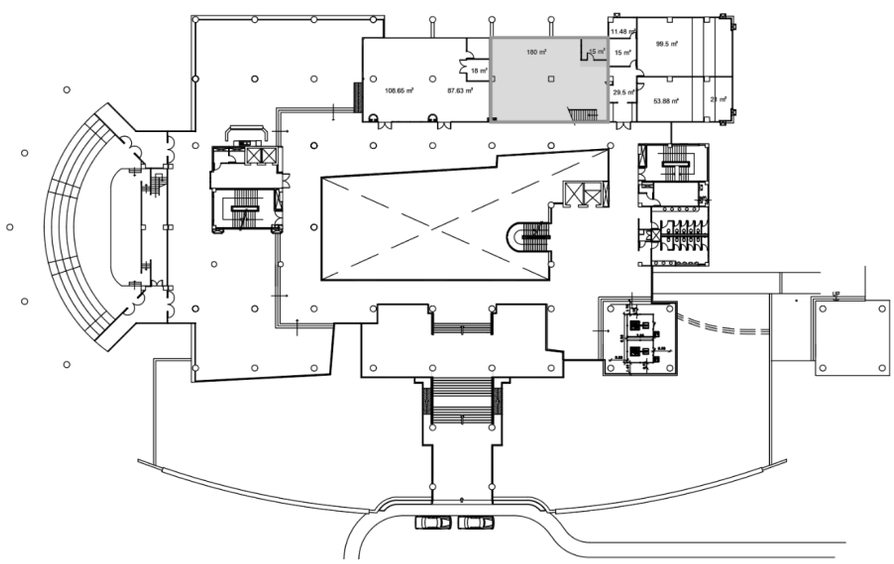

Figure 2. Faculty library on the second floor of the Faculty of Architecture building.

Figure 3 illustrates the library space on the second floor, located between the exhibition area and computer rooms, before the renovation plan. The library on the M floor of the faculty building features a staircase connecting to the lower level. Its 7.5-metre-high ceiling and open design between the lower and upper levels create a spacious atmosphere with unobstructed views throughout the library. This design also allows natural light to illuminate the reading area, providing an open and expansive ambiance. Figure 4 demonstrates the library space on the M floor, which opens to the lower level, before the renovation plan. The

faculty library, covering approximately 490 square metres in a rectangular shape, consists of various sections, including reading and working areas, staff rooms, broadcast rooms, document storage areas, and prayer rooms. Figure 5 showcases the library's atmosphere and interior space. It includes images of the M floor in the lower right and of the second floor in the upper right, upper left, and lower left.

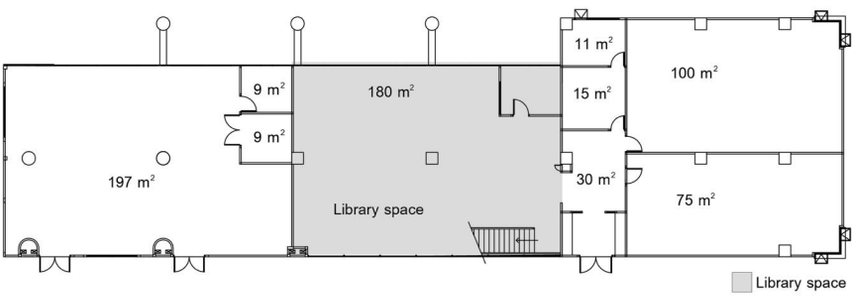

Figure 3. Faculty library on the second floor of the faculty building

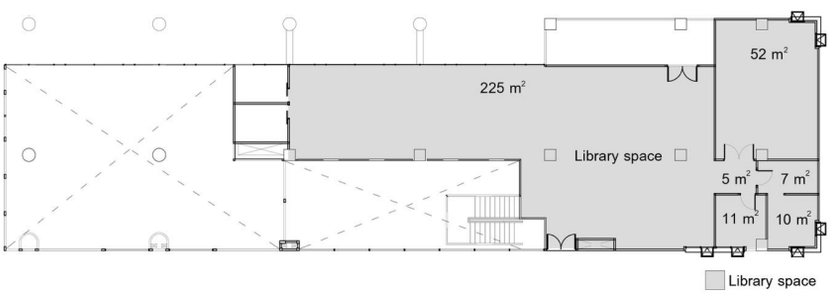

Figure 4. Faculty library on the M floor of the faculty building

Figure 5. Atmosphere and interior space of the faculty library

Initiated during the four-year plan to develop the faculty building in 2019, the plan to renovate the faculty library aimed to increase the square metre area and add some functions that respond to the changing needs of the users. The decision from the faculty development committee was made to extend the library into the exhibition hall space (106 square metres) and renovate the old computer rooms into a library space (231 square metres). The addition of functional spaces included a student touchpoint area (54 square metres) and a first-aid station (21 square metres). The total area of the library space after the redevelopment would become 800 square metres. Figure 6 shows the extension to exhibition space and the conversion of computer rooms to library space, student touchpoints, and a first-aid room.

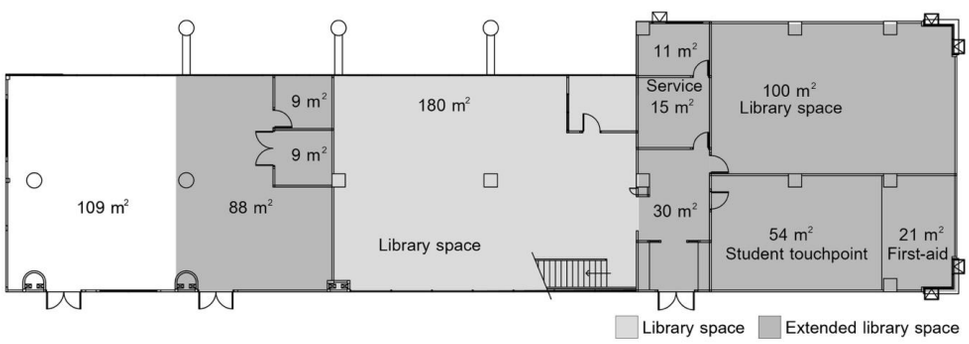

Figure 6. Extension of the library space on the second floor

5. Research Findings

Section 5 outlines key findings on user demands for library spaces, analysing data from questionnaires, observations, and interviews. This section illuminates users' preferences and identifies opportunities for improving physical, social, and digital library environments to meet community needs more effectively.

5.1 Findings from the Questionnaire Survey

As of 22 February 2023, the Faculty of Architecture and Planning community consists of 1,431 undergraduate students, 236 graduate students, 81 academic staff, and 53 administrative staff, totaling 1,801 individuals. From this diverse population, 345 respondents completed the questionnaire, representing 19% of the total. This group included 320 students (268 Bachelor's and 52 Master's), 20 academic staff, and 5 administrative staff, offering a broad perspective on the library's current usage and future needs.

The results indicate that a larger proportion of respondents reported either sometimes or rarely visiting the library (44% and 41% respectively). Most respondents reported that the main reason for not using the faculty library was the inadequate availability of required spaces and facilities, such as areas for socialising and discussing ideas with peers (51%), supporting amenities like power sockets and refreshments (42%), and the need for diverse types of spaces, such as individual reading areas and collaborative workspaces (37%) (Figure 7).

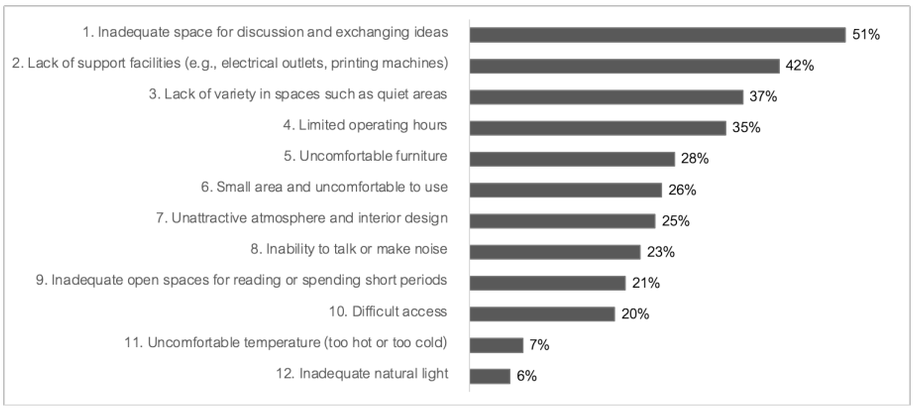

Figure 7. Percentage of respondents reported main reasons for not using the faculty library. More than one response per participant was accepted (N = 345).

Figure 8. illustrates the alternative learning spaces chosen by respondents who did not use the faculty library. The XSpace (17%), a 24-hour co-learning space located near the library, was preferred because of the variety of available spaces, including both collaborative and individual areas. The Puey Ungphakorn Library (15%) and the Self Access Learning Centre (7%) were selected for their modern design, flexible operating hours, ample support facilities, and diverse range of spaces. The availability of snack and drink provisions in these areas also was desirable to the respondents.

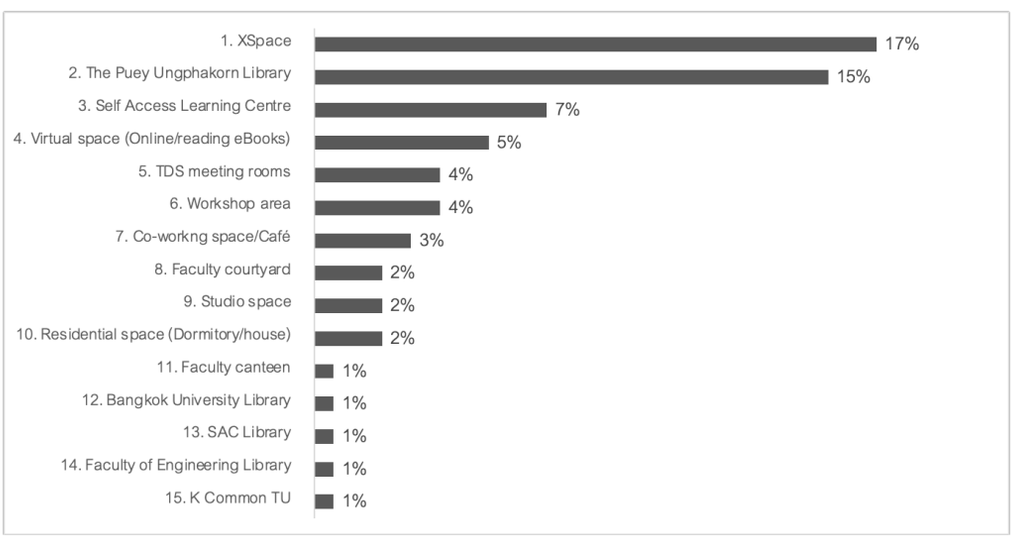

Figure 8. Percentage of respondents visited alternative learning environment outside the faculty. More than one response per participant was accepted(N = 345).

The fourth question asked respondents what they think are the important aspects of the faculty library. The survey revealed that the respondents prioritised a greater variety of spaces (56%), followed by adequate support facilities (42%), and adequate space for discussion and exchange of ideas (36%) (Figure 9). This feedback corresponds with the reasons cited by respondents for not using the faculty library. In the fifth, open-ended question, respondents were asked to identify the essential features that an academic library should have. The majority of respondents (36%) indicated a preference for collaborative spaces that facilitate communication, followed by relaxing areas for activities such as napping and playing board games (23%), individual reading and workspace (17%), and multipurpose spaces offering a range of configurations for diverse

working activities, including a podcast zone (14%). The final question asked for any additional opinions from respondents. The results revealed that the majority of respondents prioritised having more flexible operating hours, including on weekends (15%), followed by the availability of support facilities such as vending machines for food and drinks (6%).

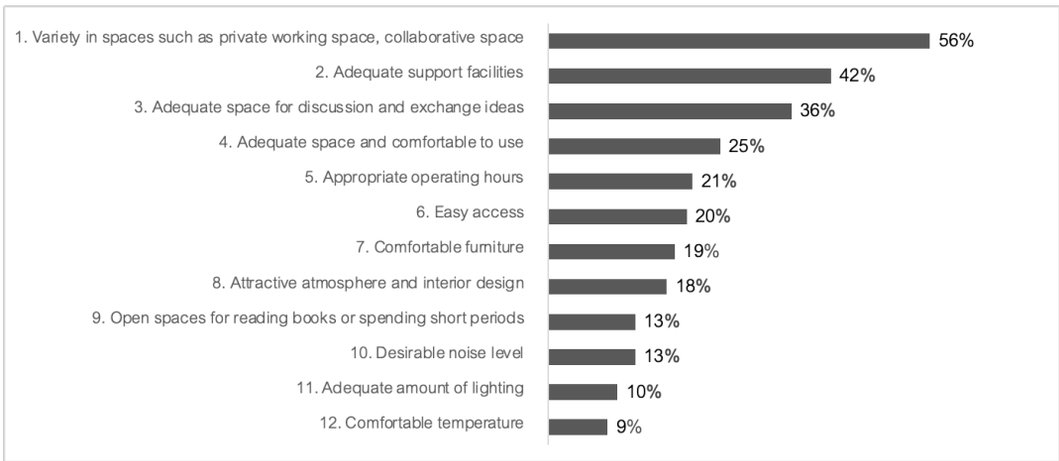

Figure 9. Percentage of respondents perceived most important aspects of the faculty library. More than one response per participant was accepted (N = 345).

5.2 Findings from the Workshop and Focus Group Interviews

The findings from the workshop and focus group interviews regarding users' demands for library space showed similarities with the attributes mentioned in the literature: physical, social, and technological spaces (Mehtonen, 2016; Lotfy et al., 2022). Table 1 presents the workshop and focus group interview findings related to users' demands for library space across various aspects of the multidimensional model. The users' demand regarding various aspects of library space were influenced both by the current building conditions and the evolving needs and preferences of the users. For instance, the need for facilities that provide access to digital resources reflects both functional obsolescence and changes in learning approaches. Similarly, the preference for a variety of furniture that promotes social activities also is associated with the functional obsolescence of the library.

Table 1. Similarities of the findings from workshop and focus group interviews.

	Workshop (N = 23)	Focus group interviews (N = 12)
Physical space		
Accessibility	The library entrance was not clearly visible from various locations in the building, affecting accessibility.	The pathway to the entrance was not clearly visible.
	The entrance doors were designed to allow only one door to open at a time, making it difficult for visitors to pass through the RFID security gate.	The entrance was obstructed by a circulation hall between two computer rooms and the library door.
Time	There is a need to extend operating hours to 11 PM.	There is a need for flexible operating hours, including weekends.

Table 1. Similarities of the findings from workshop and focus group interviews. (continue)

	Workshop (N = 23)	Focus group interviews (N = 12)
Functionality	A preference for clear zoning between quiet spaces and areas designated for other activities.	A need for dedicated spaces for different settings (such as quiet zones, individual work, and group work).
	n/a	Dissatisfaction with the individual reading spaces being too close to the bookshelves, which compromised privacy.
	n/a	The material exhibition space should have a larger, exclusively dedicated area.
	n/a	The space under the stairs should be properly arranged because the current placement of CD and DVD racks is impractical due to infrequent use.
	n/a	Some areas required additional artificial lighting to make the area more conducive to reading.
	Need a more attractive interior design to foster a conducive learning atmosphere within the Faculty of Architecture.	Prefer a design and appearance that is reflective of the Faculty of Architecture.
Diversity	A need for flexible spaces of various types.	n/a
Flexibility	A need for flexible spaces of various types.	Dissatisfaction with furniture and settings that are difficult to rearrange for different uses.
Comfortability	Dissatisfaction with the furniture and settings, which generated noise during use (e.g., chairs and stairs).	Concerns about the materials used for the furniture and staircase that create noise when used.
Connectivity	Extending the library space to the exhibition hall would facilitate a seamless connection of spaces from the library entrance to the reading and exhibition areas.	The glass wall adjacent to the reading area on the first floor provides a clear view of the exterior, allowing users to enjoy natural light and feel more connected to their surroundings.
Openness	The double volume and glass walls impact the library's openness.	Some participants referred to the openness created by the double volume from the first to the second floor as a contemplation space.
Support facilities	Prefer to have snacks and drinks in the library, while also considering the cleanliness of the area and the potential damage they could cause to the books.	Provision of vending machines and an area for drinks would be beneficial.
	n/a	A need for improvement of the library borrowing and returning system.
	n/a	Insufficient support facilities and services, including power sockets, downlights, and printing machines.
	n/a	Requested lockers for secure storage of users' belongings. Requested lockers for secure storage of users' belongings.
Social space		
Sociability	Provide opportunities for visitors outside the faculty to utilise the library.	Required environment that promotes collaboration.
	The need for space to be allocated for students from each school year.	The need is for a space that supports activities among students from different school years.
	Require a collaborative space.	n/a
Interactivity	Preference for extending exhibition halls to promote activities.	Preference for the design of exhibition hall as a place to attract external users.

Table 1. Similarities of the findings from workshop and focus group interviews. (continue)

	Workshop (N = 23)	Focus group interviews (N = 12)
Digital space		
Access to digital resources	The need to access e-books and e-journals.	The need is for a support system that can connect to the university network to access international publications.
Access to technology	Requested the installation of power sockets at the reading tables.	n/a

6. Discussion

The discussion section begins by connecting findings to their implications for library design and management. The research reveals a strong user demand for spaces that are flexible, inclusive, and technologically advanced, emphasising the need for libraries to evolve in response. This connection underscores the study's relevance in guiding the evolution of library environments towards greater adaptability and user focus, paving the way for a discourse on effective strategies to address these emerging needs.

6.1 User's Feedback on Library Space Usage

Findings from the questionnaire survey, workshop, and focus group interviews regarding users' demand for a library space can be discussed in terms of physical, social, and digital space aspects (Mehtonen, 2016; Lotfy et al., 2022).

6.1.1 Physical Space

Physical space is discussed in terms of academic library attributes including accessibility, time, functionality, comfortability, connectivity, openness, and support facilities (Figure 1).

Accessibility

Overall, the findings highlighted concerns about the library's visibility and entrance due to its location. The workshop and interview findings revealed that many participants experienced difficulty in locating the library entrance, primarily because it was situated behind the elevator hall, making it challenging to find from the main circulation areas. Conversely, having the entrance located near the main staircase offers an opportunity to improve accessibility for users on both the ground and second floors, fostering social interaction between the faculty community and external users. Accessibility generally is recognised as an important element of architectural design practice. A shift towards more physically accessible environments has occurred over the past decades and there is an overall higher level of attention on accessibility (Zallio & Clarkson, 2021). Inclusive design embraces the principles of accessibility and its extended definition encompasses key sociological and behavioral aspects, including physical, sensory, and cognitive needs (Hacihasanoglu & Hacihasanoglu, 2001; Wauters et al., 2014). Despite the proliferation of user-centered design approaches, there remains a strong focus on addressing physical accessibility challenges in building design, such as wheelchair-accessible entrances, walker-friendly elevators, and easy-to-operate door handles.

Time

The findings revealed that one reason students were not using the library was its limited operating hours. Long opening hours, as emphasised by Harrop and Turpin (2013), are crucial to provide on-demand access to spaces. Based on the results from the questionnaire survey, workshops, and interviews, there is a clear need to extend the library's operating hours, including weekends and an extension to 11 PM from the current

4:30 PM. A student-centred approach with flexible operating hours allows users to tailor their library use to their preferences, as learners choose spaces based on their specific needs and activities. This variety in space usage highlights the importance of accommodating different requirements. However, concerns about user security after regular operating hours emerged in the workshop and focus group interviews. Consequently, proposed measures include implementing an access control system and CCTV for security enhancement, along with the introduction of an automated book borrowing and return system.

Functionality and Diversity

These two aspects are interrelated. Functionality includes supporting discipline-specific resources, meeting architecture majors' needs, and offering various types of spaces (Lotfy et al., 2022). Diversity, on the other hand, pertains to the various settings within different working zones, including seating areas, quiet individual and private workspaces, and communal work areas, all catering to the needs of library users (Lotfy et al., 2022). The availability of diverse furniture types addresses users' immediate demands, supporting various learning activities and preferences. The findings underscore the demand for a variety of spaces, as space plays a vital role in all learning activities. The design of different learning spaces either can favour or hinder various learning styles (Scott-Webber, 2004). Therefore, it is essential to understand which activities are best suited for different types of spaces. While the current library layout offers some degree of variety, such as individual reading areas and workspaces, the total square metre area does not effectively support their use. In some cases, functional spaces are placed too close to each other, impacting privacy and causing discomfort.

Flexibility

This aspect pertains to spaces that accommodate a variety of learning activities, featuring multifunctional areas, movable furniture, and open layouts without unnecessary structural elements. Workshop outcomes and focus group interviews indicate a demand for more flexible furnishings in multipurpose spaces, such as adjustable seating and movable furniture, enabling users to adapt the space for various activities. Additionally, providing multipurpose spaces aligns with the strategic approach for faculty building development, aiming to enhance learning environment flexibility in response to uncertainties in the changing environmental context (Riratanaphong, 2022).

Comfortability

The limited square metre area and furniture arrangement can impact the comfort of library users. Properly selected furniture and furnishings can greatly enhance the attractiveness and functionality of library spaces, making them more desirable for students (Choy & Goh, 2016). The library's existing furniture, including tables and chairs, has been in use for an extended period and was not designed with ergonomics in mind, leading to user discomfort. Following the increased demand for library space post-Covid-19, the current 490 square metre area has become quite inadequate. This surge in demand has affected the layout of individual reading and working spaces, as well as the library catalog, resulting in issues like overcrowding and increased noise levels. This situation can be attributed to functional obsolescence, where the building no longer fulfills its original intended functions and requirements, leading to a loss of utility (Grover & Grover, 2015; Pourebrahimi et al., 2020).

Connectivity

The size and volume of the space, along with the transparency of the materials, have an impact on connectivity both within and outside the library. During the workshop and interviews, the majority of participants agreed that extending the library space into the exhibition hall would facilitate a seamless connection between the library entrance and the reading and exhibition areas (Figure 6). The double-volume reading space on the

first floor creates a connection between the interior spaces and helps improve users' perception of library density, despite the limited square metre area. The glass wall adjacent to the reading area on the first floor provides a clear view of the exterior, allowing users to enjoy natural light and feel more connected to their surroundings (Figure 5). Providing natural lighting and a connection to the outdoors is considered an essential aspect that fosters a motivating learning environment, encouraging students to spend more time in the library (AboWardah et al., 2019). Oseland (2021) mentioned that this issue can be considered in terms of technological connectivity, such as internet access and WiFi, which offer the opportunity for learning outside the campus by connecting to the library database from other locations.

Openness

Most participants perceived that the double volume and glass walls influenced the library's openness. The library's design incorporates glass walls on both sides of the layout, allowing ample natural light to flood the interior and promoting a sense of openness and visibility. Lighting and natural light were frequently cited by learners as crucial positive factors (Harrop & Turpin, 2013). The double volume of the library space creates a more open and spacious interior environment. Interestingly, some participants referred to the openness facilitated by the double volume between the first and second floors as a contemplation space. They found this area beneficial for taking breaks, reenergising, and refocusing their work and thoughts after long hours of study (Oseland, 2021).

Support Facilities

Support facilities are needed to enhance both the comfort and security of library users. Although there were some conflicting opinions, the discussions during data collection led to communal agreements. Many participants emphasised the importance of upgrading the library's security system, which would involve implementing an access control system, installing RFID gates, and increasing the number of CCTV cameras. This is particularly crucial when considering an extension of the library's operating hours. Food and drink also were frequently mentioned in the qualitative research, with learners who prefer a home environment highlighting easy access to food and drink as one of the reasons (Harrop & Turpin, 2013). From a student-centred perspective, the library cafe is regarded as a communal space where individuals and groups of students frequently gather, actively engaging in various forms of social networking and learning. They share their knowledge in both structured and unstructured ways while actively participating in mutually building each other's understanding. This process involves students enhancing each other's grasp of subjects through continuous dialogue and shared insights (Deng et al., 2019). During the workshops, concern was expressed about allowing users to bring refreshments such as drinks and snacks from vending machines into the library space due to the potential for damage to books and other materials. However, suggestions from focus groups have shown that allowing library users to bring water into certain designated spaces through zoning is beneficial. A previous study indicated that 63% of learners reported food and drink helped them stay focused when studying (O'Conner, 2012, p. 66).

6.1.2 Social Space

According to Lotfy et al. (2022), the library's architectural spaces that meet the attributes of informal learning spaces include a social space that incorporates sociability and interactivity.

Sociability

Leighton and Weber (1999) support this perspective by noting that higher education increasingly is viewed as a social activity and the library serves as the primary academic home with spaces specifically

designed for social learning. Today, academic libraries are evolving into technology-enhanced collaborative research facilities to accommodate the demands of the new generation of learners who are constantly connected to each other through technology to manage the influx of information (Lippincott, 2006; McLaughlin & Faulkner, 2012; Sens, 2010). Sociability encompasses social spaces such as display areas, lounges, and cafes for social activities, discussions, and debates, fostering an atmosphere that encourages interaction. Research findings, gathered from various data sources, collectively indicate a pressing need for social spaces within the academic library setting, such as lounges and cafes, that allow for noisy activities like discussions or conversations with friends (Kim, 2016). The demand for vending machines for refreshments also is associated with the social space, where students can relax and engage in casual conversations during their breaks. The walk-through findings indicated a lack of suitable furniture to support social activities in the library's current condition. To create areas that can be utilised by students for brief, informal conversations during breaks, well-designed furnishings should be incorporated.

Interactivity

Interactivity refers to spaces that support community connections, such as open exhibition halls, multipurpose halls, lounges, and cafes, which can be accessed by external students. The findings from the workshop and focus group interviews revealed a preference for expanding the library to include an exhibition hall and designing an open area that allows for visitors from outside the faculty to enhance interactivity. This aspect can be linked to the concept of 'the third space,' developed by Oldenburg (1999). It is a place where people can socialise with friends and connect with university staff as needed (Miller, 2013).

6.1.3 Digital Space

The evolving nature of learning activities and the rapid development of digital resources and technologies have enabled students to access knowledge through digital facilities. The concept of digital space in the academic library encompasses access to digital resources and technology.

Access to Digital Resources

Academic libraries are no longer solely focused on providing space for shelving print and physical collections (Choy & Goh, 2016). The use of digital resources will continue to evolve significantly as more content becomes available and as providers, including libraries, gain a better understanding of users' preferences and how they engage with electronic materials (Bengtson, 2006).

The provision of access to digital resources can be discussed in terms of the faculty's policy direction and its integration with the university's networks. Findings from surveys, workshops, and interviews underscore the need for support systems, including access to digital resources such as e-books and e-journals. Although Thammasat University Library offers free access to academic journals and databases through a link, some journals and books still have limitations. The Faculty Library Development Committee has a plan to reduce the acquisition of physical books and place greater emphasis on digital resources. This involves discontinuing the submission of physical copies of thesis books to the library and digitising copyrighted reading materials. In the context of learning outside the campus, accessibility to digital resources enables users to connect to the library from their location of choice.

Access to Technology

Access to IT resources was deemed important by the majority of learners. This typically included PCs, printers, large screens, and access to the internet and software (Harrop & Turpin, 2013). This aspect pertains to the need for interior space in a digital learning environment, as well as the availability of ICT support facilities.

Regarding the physical condition of the library, it was not originally designed to support the use of laptops and tablets in the working spaces. Additional support facilities, such as modern PCs for searching the library database and a faster WiFi connection, were required. Furthermore, the specific requirements, including power outlets, USB sockets, and associated devices (e.g., cables, switches) for connecting electronic devices, need to be discussed and determined during the technical briefing.

6.2 Factors Influencing Users' Demand for Library Space

Table 2 presents the findings related to various aspects of library attributes associated with building obsolescence, including functional and technological obsolescence, as well as learning approaches. Based on an analytical approach used in the previous study by Pourebrahimi et al. (2020), building obsolescence types have been classified into 10 categories: economic, functional, locational, physical, legal, social, technological, aesthetic, environmental, and tenure obsolescence. The findings indicate that the majority of user feedback on library attributes is related to demands concerning the functionality and usability of the library space, which, in turn, contribute to functional obsolescence (Grover & Grover, 2015; Pourebrahimi et al., 2020) of the library's physical condition. For instance, issues such as the location of the library entrance, which hindered accessibility, and the need for a greater variety of spaces that impacted the functionality of the library space, were identified.

Table 2 Factors influencing users' demand for library space.

Items	Influential factors	Findings
Accessibility	Functional obsolescence	- Visibility was hindered by library entrance - Demand for more inclusive design
Time	Learning approach	- The changing demands of users for a learning environment, such as flexible operating hours
Functionality	Functional obsolescence	- Demand for more variety of space
Diversity	Functional obsolescence	- Demand for variety of furniture for different activities
Flexibility	Functional obsolescence	- Demand for different range of learning activities
Comfortability	Functional obsolescence	- Limited square metre affects comfortability
		- Demand for more appropriate furniture and furnishing
Support Facilities	Functional obsolescence	- Demand for support facilities such as the library borrowing and returning system, refreshments, and security system
Sociability	Learning approach	- Demand for social spaces to encourage interaction
Interactivity	Learning approach	- Preference for interactivity with external users
Access to Digital Resource	Learning approach	- Changes in user demand to access electronic materials, e.g., e-books and e-journals
Access to Technology	- Learning approach	- The needs for the interior space for a digital learning environment
	- Technological obsolescence	- The demand for ICT supporting facilities

The demand for various library attributes can be assessed based on the needs and preferences of library users (Vischer, 1985). According to Rothe et al. (2012) and Van Meel and Størdal (2017), needs are considered in terms of hygiene factors. Dissatisfaction increases if these needs are not met or if they are seen as 'must-have' attributes. Preferences, on the other hand, serve as motivators. Fulfilling preferences is necessary to enhance satisfaction or to meet 'should-have' characteristics. The findings demonstrate a demand for library

space, encompassing preferences such as easy accessibility, flexible operating hours, refreshments, and spaces that facilitate social interactions and engagement with external users. Additionally, there is a need for flexible spaces, suitable furniture, ample lighting, security systems, interior space to create a conducive learning atmosphere, and support facilities to ensure access to digital resources and technology.

Regarding the assessment process, in addition to document analysis, a questionnaire survey, and focus group interviews, full user participation in the POE process, as described by Kernohan et al. (1992), was implemented during the workshop. This participation included an introductory meeting, touring interviews, and a review meeting. The findings from the POE not only examine the current building condition, as identified by Preiser et al. (2015), which includes assessing environmental quality and identifying building obsolescence, but also establish a connection between the users' demands for the library space—specifically, their needs and preferences—and the design criteria for the library's redevelopment. This connection is considered an implementation derived from Pre-Design Evaluation, as discussed by Ornstein et al. (2009).

7. Conclusions and Recommendations

This section summarises the study's findings, emphasising the significance of critical attributes, the role of functional obsolescence, and learning approaches in shaping library space demand. It offers recommendations for library design and management, reflects on the research methodologies, and suggests areas for future investigation to enhance library spaces in alignment with evolving user needs.

7.1 Conclusions

1. The findings confirm the relevance of the variables in the conceptual model from previous studies (Mehtonen, 2016; Lotfy et al., 2022), encompassing three key attributes regarding users' demand for library space: physical, social, and digital spaces. In this research, we introduced a multidimensional model of library space and discussed it using data from a case study in which user demands were described as both needs and preferences for the learning environment related to library space. The findings indicate a connection between users' needs and preferences regarding physical space, which subsequently influences digital and social spaces. For instance, users' preferences for certain support facilities, like refreshments and comfortable furniture, facilitate social interactions, whereas their fundamental needs for these facilities are critical for ensuring access to digital resources and technology.

2. Functional obsolescence and changes in learning approaches caused the library space demand-supply gap. The findings from the case study reveal that functional obsolescence and changes in learning approaches have a dominant impact on users' demand for library attributes compared to other factors (Table 2). For instance, functional obsolescence affects users' demand for accessibility, functionality, diversity, flexibility, comfort, and support facilities, while changes in learning approaches drive the demand for time, sociability, interactivity, access to digital resources, and technology access.

3. The study demonstrated the connection between post-occupancy evaluation (POE) and pre-design evaluation (PDE) of the redevelopment of a real estate project. The assessment of the gap between library space demand and supply, along with the identification of new library environment requirements, serves as a reference point for evaluating the building's performance through POE. Additionally, it aids in the decision-making process for the PDE focus by taking into account performance projections, such as expectations regarding the improved design quality of the library's interior environment and the provision of support facilities.

This shift from performance measurement to management highlights the strategic importance of integrating POE and PDE for effective library space redevelopment.

7.2 Recommendations for Library Design and Management

Assessing users' demands through POE and PDE is essential for aligning library spaces with both current and future needs, guiding redesigns to reflect user preferences. By integrating these evaluations into the design process, a feedback loop for continuous improvement is established, prioritising flexibility, diverse functionality, technology integration, and comfort. This methodology ensures that libraries can evolve in response to user feedback and the changing landscape of library use. The study underscores the importance of addressing functional obsolescence through proactive alignment with the multifaceted demands of library users, including the need for adaptable spaces and the integration of advanced technologies. Emphasising a user-focused approach in both management and design, the research supports the adoption of flexible design principles and the creation of inclusive environments to ensure libraries remain pertinent and responsive to ongoing changes in user needs and preferences.

7.3 Methodological Reflections

The findings from the case study were analysed inductively, providing insights into user feedback on the phenomenon of buildings in use. This analysis helped identify key factors influencing building conditions, along with users' needs and preferences. However, the study's reliance on a single case study limits its generalisability to other types of library spaces. Realising that some participants hesitated to speak up among a large group during the workshop, conducting smaller group interviews creates a more relaxed atmosphere and helps them participate to a greater extent. Triangulation of data collected from different sources (documents, survey, workshop, interviews) also helps to validate the findings through cross verification, i.e. reduce weakness or intrinsic biases from the researcher's background knowledge.

7.4 Suggestions for Further Research

The findings of this study regarding users' needs and preferences can serve as input for further exploration related to PDE, which emphasises supporting design decision-making and incorporates performance projections. Some questions that could guide future research include: How can we establish a connection between post-occupancy evaluation and pre-design evaluation? What are the deliverables from post-occupancy evaluation that can be applied to pre-design evaluation? This study employed a case study approach to conduct a POE, assessing users' feedback and exploring users' demand for library space. The gathered questionnaire data, capturing the users' experiences within the library, present opportunities for additional quantitative analysis. Analysing this dataset, in conjunction with findings from other case studies through statistical methods, will allow for a deeper insight into the complex interplay between various related factors.

8. Acknowledgements

The author would like to express considerable thanks to the participants of the survey, workshop, and interviews. Special thanks go to Kullanit Foithong for her assistance during data collection. This research unit is supported by the Faculty of Architecture and Planning Research Fund, Thammasat University, contract no. TDS 11/2021.

Author Contributions

Conceptualisation, methodology, formal analysis, investigation, resources, data curation, writing (original draft, review, and editing), visualisation, supervision, and project administration: Riratanaphong, C.

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