Urban Resilience Sustainability, 2(1): 76–92.
DOI: 10.3934/urs.2024005
Received: 17 January 2024
Revised: 02 March 2024
Accepted: 18 March 2024
Published: 25 March 2024

Urban Resilience and Sustainability

http://www.aimspress.com/journal/urs

Research article

Placemaking strategies in greening Universiti Malaya Main Library

Fairuz Amanina and Zul Ilham*

Environmental Science and Management Program, Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603, Kuala Lumpur, Malaysia

* **Correspondence:** Email: ilham@um.edu.my; Tel: +60379674014.

Abstract: Libraries are vital for learning, literacy, and fostering innovation. Emphasizing green and sustainable practices is crucial to conserve resources. This research focused on transforming the Universiti Malaya (UM) Main Library into a greener space through placemaking and green initiatives. To assess the greening potential of the library, a systematic review was conducted to establish a list of green library initiatives. Eighteen distinctive themes or categories of green library initiatives were identified. Ten categories deemed of critical importance, including indoor air quality, water quality and management, energy consumption, noise control, policies, waste management, interior design, ecological environment, services and facilities, and library sources, were selected for inclusion in a comprehensive user survey. The survey encompassed five sections, namely: (A) Demographic information, (B) Users' satisfaction with the UM Main Library, (C) Users' knowledges of the green libraries and practices, (D) Users' perceptions towards greening UM Main Library, and (E) Users' additional aspects which include Likert-scale questions and open-ended question soliciting users' opinions on additional green initiatives or improvements. A total of 407 respondents completed the survey, offering valuable insights into their perspectives. Overall, most of respondents revealed a prevailing inclination among library users toward endorsing and adopting green library practices in alignment with those categories. A total of 12 categories and 67 initiatives and strategies were listed based on both article reviews and users' suggestions. This study underscores the significance of integrating greening strategies within the UM Main Library to enhance its environmental quality and user experience by incorporating user feedback.

Keywords: green library; green initiative; placemaking; user perception; urban sustainability

1. Introduction

Libraries have become one of the most prevalent types of new buildings to include sustainable design, and it promotes a new philosophy of accepting responsibility for nature's stability. As the library is a non-commercial and service-oriented institution, it is suitable to give examples to illustrate the idea of sustainability [1]. Being information hubs, libraries have a unique responsibility not just to disseminate the concept of sustainability, but also to lead by example and serve as examples [2].

The International Federation of Library Associations and Institutions (IFLA) has been introduced to promote the concept of green libraries and to encourage the adoption of more sustainable practices among libraries worldwide. The IFLA Environmental Sustainability and Libraries Special Interest Group (ENSULIB) provides resources and guidance for libraries on how to reduce their environmental impact. Yet, since its inception in 2016, the IFLA Green Library Award has received more than thirty submissions per year from throughout the globe [3]. This demonstrates that green library awareness exists internationally.

1.1. Sustainability

Libraries play a crucial role in preserving knowledge and fostering learning in society. There is no better location than the library to serve as an example of sustainable design methods that minimize energy usage and as an instructor for a vast array of novel concepts [4]. Compared to other places, libraries prioritize environmental stewardship and offer free access to resources for all members of society, making them ideal locations for promoting sustainability and fostering intellectual growth. Sustainability encompasses a comprehensive array of economic, environmental, and social dimensions, often recognized as the "three pillars" or components of sustainability. The term originated from the UN World Commission on Environment and Development's landmark report in 1987, commonly referred to as 'The Brundtland Report' after its chair, former Prime Minister of Norway, Gro Harlem Brundtland. In the context of creating green libraries, sustainability serves as the guiding principle for integrating environmental, economic, and social considerations into the design, operation, and function of library spaces. Adopting sustainable practices, such as placemaking strategies in greening the library, strives to minimize their ecological footprint while maximizing their positive impact on users and the surrounding environment. Thus, the concept of sustainability not only underpins the ethos of green libraries but also informs their role as catalysts for sustainable development within academic institutions and broader society.

1.2. Sustainable development goals

This study also explored the intersection of placemaking strategies and sustainable development goals (SDGs) within the context of greening the library. In the seminal Brundtland Report (1987), sustainable development is articulated as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This definition underscores the imperative of balancing present-day resource utilization with long-term environmental stewardship, ensuring that libraries serve as sustainable educational and community resources for current and future generations [5]. There were seven SDGs that were used as guidance during this study:

- SDG 3: Ensure healthy lives and promote well-being for all at all ages.

- SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
- SDG 6: Ensure availability and sustainable management of water and sanitation for all.
- SDG 7: Ensure access to affordable, reliable, sustainable, and modern energy for all.
- SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.
- SDG 13: Take urgent action to combat climate change and its impacts.
- SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels.

1.3. Definition of placemaking

According to Project for Public Places, placemaking is a multidimensional concept that involves the intentional design, planning, and activation of public spaces to create vibrant, inclusive, and meaningful environments that promote social interaction, cultural expression, and community identity [6]. In the realm of placemaking, the objective extends beyond merely erecting a new structure and attracting a substantial volume of visitors. It encompasses the endeavour of establishing meaningful connections among the occupants of the space and the recipients of the services by involving them in the planning process at the earliest opportunity [7]. In the context of libraries, placemaking strategies can help to create a welcoming environment that promotes learning and community building. One way to achieve this is by incorporating green elements into the design of the library, such as vegetation, natural lighting, sustainable materials, and eco-friendly practices, within the library setting.

1.4. Definition of green initiatives

Green initiatives refer to a range of sustainable practices that aim to reduce the impact of human activities on the environment [8]. Green initiatives can include a variety of measures, such as reducing energy consumption, promoting recycling and waste reduction, using renewable energy sources, and enhancing biodiversity [9]. These initiatives can be implemented in various settings, including businesses, households, and public institutions. In the context of libraries, green initiatives can include measures such as using eco-friendly materials for construction, implementing energy-efficient lighting systems, installing solar panels, and promoting sustainable practices among staff and users [10]. These initiatives not only benefit the environment but can also have economic and social benefits, such as reducing operating costs and improving the health and well-being of library users.

1.5. Definition of green library

Green libraries, also known as sustainable or eco-friendly libraries, are facilities that promote environmental responsibility and resource conservation through their design, construction, and operation [11]. These libraries prioritize the use of renewable energy sources, minimize waste and carbon emissions, and utilize eco-friendly building materials and technologies [12]. Green libraries not only reduce their ecological footprint but also serve as educational tools to promote sustainable practices and raise awareness about environmental issues [13]. They are also known for their commitment to social responsibility, including their promotion of accessibility, inclusivity, and community engagement [14]. As a result, green libraries have become an important component of the

sustainable development movement, and their continued development and success will have a significant impact on the future of the library profession [15].

1.6. Background of Universiti Malaya Main Library

Located in the capital city of Malaysia, Kuala Lumpur, Universiti Malaya is the leading urban research university in Malaysia that is deeply committed to the discovery and distribution of knowledge. Universiti Malaya presently has more than 30,000 enrolled as undergraduate and postgraduate students. Since the establishment of the university in 1949, the library has played a vital role in providing resources, services, and facilities in supporting the university's learning, teaching, research, and activities among the community. Universiti Malaya Main Library is located strategically in the center of the campus, and it is easily accessed by the students. The library comprises a total of four floors. It has amassed a wealth of resources throughout the years, especially print sources.

This study undertook a comprehensive exploration of greening Universiti Malaya Main Library, and encompassed three vital objectives. First, it delved into the library's potential for incorporating eco-friendly elements, assessing the feasibility and benefits of such a transformation. Second, it shed light on users' perspectives, delving into their perception of greening efforts within the library space. Finally, it culminated in proposing specific placemaking strategies to effectively implement greening solutions, ensuring successful integration and user acceptance. By addressing these interconnected objectives, the study strove to unlock Universiti Malaya Main Library's green potential, enhancing both environmental sustainability and user experience within its walls.

2. Materials and methods

2.1. List for green library initiatives

2.1.1. Literature review

In this study, a literature review was conducted in order to examine existing green initiatives in the library followed by developing this study's own list that focused on the library's facilities, applicable for an existing library that is under operation and applicable in Malaysia. The development of the assessment list involved the following steps [16]:

(a) Evaluating existing lists
(b) Coding the contents by themes
(c) Conducting meta-analysis

Based on these steps, this study was executed in three phases. The first phase involved analyzing facilities-related green library initiatives that were applicable to post-construction and feasible in Malaysia. The second phase involved analyzing green library initiatives based on the authors' research, and the third phase involved categorizing green library initiatives based on themes or categories.

One hundred articles related to assessing green library initiatives were collected. Both Google Scholar and Universiti Malaya's database were used as the research engine to locate relevant published articles.

2.1.2. Analyzing chosen articles

This list focuses on initiatives that meet three specific criteria: (a) relevance to facilities, (b) applicability during the post-construction stage, and (c) practicality in Malaysia. This method was modified from approaches by Cronbach [17], Field [18], Carmines and Zeller [19], and those that did not meet the criteria were excluded. In the second phase, the initiatives mentioned in these articles were summarized, highlighting similarities and differences. The third and final phase involved the development of themes or categories for the included initiatives, resulting in the identification of 14 categories, which are:

- Indoor Air Quality
- Water Quality and Management
- Energy Consumption
- Noise Control
- Policies
- Library Sources
- Waste Management
- Building Architecture
- Light
- Interior Design
- Ecological Environment
- Hygiene
- Fire Safety Devices
- Services and Facilities

2.2. Data sampling

2.2.1. Case study

The Universiti Malaya Main Library was selected as the research setting, with the term "users" denoting the students who avail themselves of its services. Positioned strategically at the center of the campus, the library boasts convenient accessibility for students and also promotes a sense of belonging and engagement with academic resources.

2.2.2. Survey design

The data collected was associated with quantitative findings. From 14 categories found on the checklist for evaluating green initiatives in the library, ten categories were chosen to build the questions. These were indoor air quality, water quality and management, energy consumption, noise control, policies, library sources, services and facilities, interior design, ecological environment, and waste management. These categories were chosen based on their suitability to be implemented in Universiti Malaya Main Library. The survey instrument consisted of the following five sections:

(a) Section A: Demographic

This section was developed to gather the demographic profile of the respondents, such as gender, age, citizenship, education level, and frequency of visiting the library.

(b) Section B: User's satisfaction with UM Main Library

This section was developed to see the overall user's satisfaction of UM Main Library based on ten chosen categories.

(c) Section C: User's knowledge of green libraries and practices

This section was designed to examine the degree of user's knowledge of green libraries and practices based on ten chosen categories.

(d) Section D: User's perception toward greening UM Main Library

This section aimed to assess the level of agreement among users regarding the implementation of green initiatives within the library, focusing on the ten selected categories.

(e) Section E: User's Additional Aspects

This section was created to see overall agreements on green library practices and initiatives. This section also has open-ended question, where respondents can freely write other implementations and initiatives they want in the library.

Online and physical methods were chosen to distribute the survey. The utilization of both approaches aimed to ensure comprehensive coverage and gather a diverse range of perspectives. The physical survey specifically targeted individuals who are frequent patrons of the Universiti Malaya Main Library, as they possess a deep familiarity with the library's resources and services. Consequently, these users were considered the most suitable respondents to provide valuable insights through the survey.

2.2.3. Administering the survey

The survey was conducted with meticulous attention to detail, spanning from early May to the end of June 2023. Utilizing a comprehensive approach, both online and physical methods were employed to ensure a diverse representation of respondents across various gender, age, and education levels.

To facilitate the online survey, distribution took place through prominent platforms such as WhatsApp, Instagram, and Universiti Malaya's student mail. This approach allowed respondents the flexibility to provide their valuable input at their convenience. On the other hand, the physical survey was strategically conducted during the library's peak hours, typically from 9:00 am to 6:00 pm, when users actively engaged in a multitude of library activities. During these hours, the researcher approached individuals present in the library, requesting their voluntary participation in the survey. The surveys, administered in a paper format, were thoughtfully designed to allow respondents ample time to provide thoughtful responses.

A remarkable level of participation was observed, surpassing the initial target of 370 respondents. A total of 407 completed surveys were collected, reflecting a response rate exceeding 100%. This high response rate signified the strong interest and engagement exhibited by the respondents, thereby enhancing the representativeness and reliability of the gathered data. Notably, all collected data underwent analysis utilizing the Statistical Package for Social Science (SPSS) Version 20 for Windows, ensuring robust statistical examination and accurate interpretation of the findings.

3. Results and discussions

3.1. Validity and reliability analysis

Construct validity was assessed through exploratory factor analysis, specifically using principal component analysis. The adequacy of the factor analysis models was evaluated by conducting Bartlett's test for sphericity and the Kaiser-Meyer-Olkin (KMO) test. Bartlett's test determines the likelihood that the initial correlation matrix is an identity matrix and should yield a probability value less than 0.05 [17]. The KMO measure of sampling adequacy was employed to verify if the sample size was sufficient for analysis, with a value greater than 0.5 indicating adequacy [18]. For the data collected, as shown in Table 1, the KMO Measure of Sampling Adequacy yielded a value of 0.710, surpassing the threshold of 0.5, thus indicating the acceptability of the factor analysis. Additionally, Bartlett's test of sphericity resulted in a value of 0.000, demonstrating significance in Table 1.

Reliability, which refers to the consistency and stability of results across repeated trials [19], plays a vital role in assessing the quality of measurement instruments. In this study, Cronbach's alpha was employed to assess the reliability of the survey conducted for Sections B, C, and D. Cronbach's alpha, with a value of 0.705 in Table 1, slightly exceeded the recommended threshold of 0.7 [20], indicating good internal reliability of the constructs [19,21].

Table 1. KMO, Bartlett's test and Cronbach's alpha.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.710
Bartlett's Test of Sphericity	Approx. Chi-Square	2457.644
	df	190
	Sig.	0.000
Cronbach's Alpha	0.705	

3.2. Demographic profile of respondents

The collected data, presented in Table 2, provides insightful demographics of the respondents. Analysis reveals that 43.7% of the participants identified as male, while 56.3% identified as female. Exploring the age distribution, a minority (4.7%) were below 20 years old, with the majority (85.7%) falling within the 20–25 years age bracket. A modest percentage (8.1%) represented the 26–30 years age range, while a mere 1.5% reported being older than 30 years old. Among the respondents, 84.5% identified as Malaysians, while the remainder consisted of non-Malaysians.

Regarding educational background, a significant proportion (83.5%) were undergraduate students, signifying their pivotal role in shaping the findings. Graduate students accounted for approximately 12.3% of the sample, underscoring their distinct perspectives. The remaining respondents were enrolled in foundation and diploma programs, representing an additional segment of interest.

Exploring library usage patterns, it was found that a considerable majority (46.2%) frequented the library and utilized its services several times a week. Other respondents reported visiting and using the library services on a daily basis, once a week, or less than once a week, illustrating diverse utilization patterns among participants.

Table 2. Demographic profile of respondents.

Demographic Characteristics		Percentage (%)
Gender	Male	43.7
	Female	56.3
Age	Less than 20 years old	4.7
	20–25 years old	85.7
	26–30 years old	8.1
	Above 30 years old	1.5
Citizenship	Malaysian	84.5
	Non-Malaysian	15.5
Education level	Foundation	3.7
	Diploma	0.5
	Undergraduate	83.5
	Graduate (Master's)	11.1
	Graduate (Doctoral)	1.2
Frequency of visits to the library	Daily	13.0
	Several times a week	46.2
	Once a week	12.3
	Less than once a week	27.5
	Never went to the library	1.0

3.3. Users' knowledge of green libraries and practices

As shown in Figure 1, the majority of the respondents demonstrated knowledge and awareness of green libraries and practices, as the overall percentage of each question in this section was more than 92.6%. This indicates that at least 377 respondents answered correctly in this section. Policies and indoor air quality scored the highest (100%) among all ten categories.

The high score for the Policies category indicated that users recognize the significance of having clear guidelines and protocols in place to promote and maintain green libraries and practices. This highlights the role of library managements in driving sustainable practices and creating an eco-friendly environment. There are several green library policies and guidelines that library managements can refer to for implementing sustainable practices in Universiti Malaya Main Library. Some of these include the International Federation of Library Associations and Institutions (IFLA) and Leadership in Energy and Environmental Design (LEED) for libraries. IFLA provides a comprehensive set of guidelines that address various aspects of sustainable library practices, including energy efficiency, waste reduction, sustainable purchasing, and community engagement. On the other hand, LEED for libraries provides a rating system and guidelines for designing and constructing green buildings, including libraries [22]. While LEED focuses on the broader construction and design aspects, its principles can be applied to develop specific green library policies.

Meanwhile, other than policies, Figure 1 also showed that users had a good understanding of the importance of indoor air quality in green libraries. This indicated a positive level of awareness and engagement among library users regarding environmental factors that contribute to a healthier and more comfortable space. Volatile organic compounds (VOCs), including formaldehyde, and total dust are considered ubiquitous indoor and outdoor pollutants [23]. The levels of these substances in indoor

air are often higher than those outside. Aside from that, there is the costly and considerable damage to cultural objects that libraries should take care of, such as academic books and journals [24].

On the other hand, water quality and consumption scored the lowest among the ten categories, indicating a relatively low level of awareness regarding the importance of water conservation in green libraries and practices. This finding highlighted an area where further attention and education are needed to raise awareness among library users. It is worth noting that educational facilities, including university libraries, typically consume significant amounts of water, particularly in restrooms and cooling and heating systems [25]. Therefore, addressing water usage and promoting water conservation practices within libraries can have a substantial impact on overall sustainability efforts.

One crucial aspect associated with water quality is the need for continuous maintenance. Ensuring water quality is vital not only for the effective usage of water but also for the health and well-being of library users and their surroundings. Poor water quality can lead to various health risks and negatively impact the overall user experience within the library environment. Thus, implementing measures to maintain high water-quality standards is essential in creating a safe and healthy space for library users.

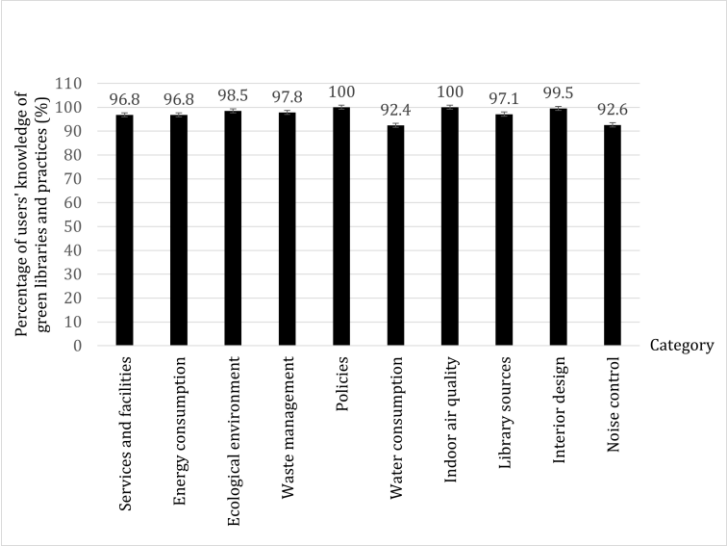

Figure 1. Percentage of users' knowledge of green libraries and practices. Note: Total number of respondents = 407.

3.4. Users' satisfaction with Universiti Malaya Main Library

Users' satisfaction is a crucial indicator of the effectiveness and quality of library services, as it directly reflects the extent to which libraries meet the needs and expectations of their users. Understanding and addressing users' satisfaction is vital for libraries to continuously improve their offerings, enhance user experience, and strengthen their role as key educational and community resources. In the context of green library initiatives and practices, where sustainability and user-centric design principles intersect, assessing users' satisfaction takes on added significance.

As depicted in Figure 2, ecological environments received the lowest satisfaction score (33.7%) among all ten categories, indicating a relatively low level of user satisfaction with the presence of greenery or green elements within and outside the Universiti Malaya Main Library. The library presents

a stark ambience characterized by plain white walls and a lack of greenery or natural elements, contributing to an overall dull atmosphere. Survey feedback from users indicated a prevalent feeling of drowsiness while in the library. This suggests that there is room for improvement in terms of implementing greening initiatives and incorporating more natural elements into the library environment. Introducing indoor plants could offer a refreshing contrast to the monotony of the library environment, potentially revitalizing users and fostering a more conducive atmosphere for studying and learning. The introduction of indoor greenery yields positive outcomes, enhancing the overall ambiance and providing individuals with a sense of well-being. It requires minimal natural light and can be accommodated within indoor spaces based on available room dimensions [26]. Numerous scientific studies have underscored the positive impact of indoor plants on indoor air quality, mitigation of Sick Building Syndrome symptoms, and enhancement of cognitive functions such as idea generation and problem-solving skills [27].

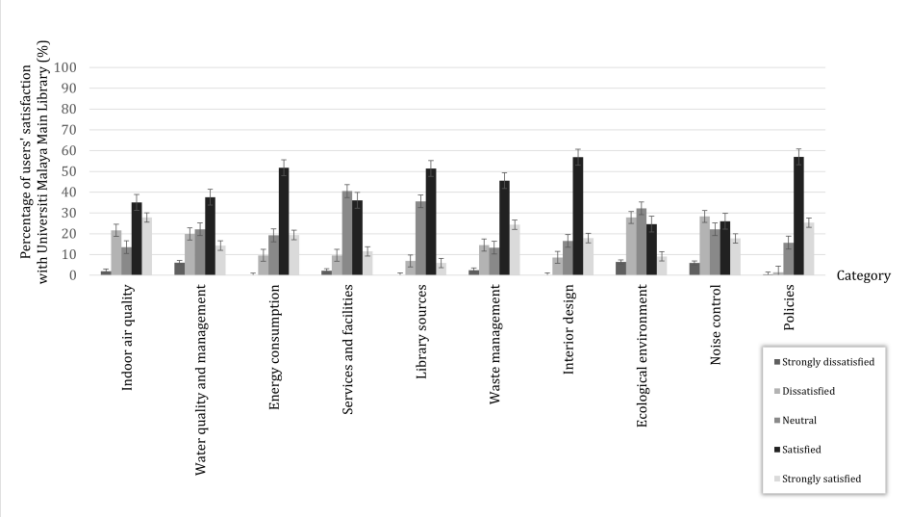

Figure 2. Percentage of users' satisfaction with Universiti Malaya Main Library. Note: Total number of respondents = 407.

3.5. Users' perceptions toward greening Universiti Malaya Main Library

As the library strives to create more sustainable and user-centered spaces, understanding users' perceptions of these greening initiatives becomes essential. Users' perceptions play a crucial role in evaluating the success and effectiveness of such initiatives, as it provides valuable insights into how users engage with and benefit from the environmentally friendly features and practices within the library.

As stated in Figure 3, the findings reveal that users generally hold a positive perception and exhibit high acceptance of the green library initiatives and practices toward Universiti Malaya Main Library, as evidenced by scores exceeding 83% across all categories. This indicates that users highly value and appreciate the efforts made to create a greener and more sustainable library environment.

Specifically, users demonstrated a strong agreement (98.8%) with the initiatives related to indoor air quality. This indicates that the measures to enhance air quality within the library, such as proper ventilation systems and air purification methods, have been successful in meeting the expectations and

satisfaction of users. The positive perception regarding indoor air quality reflects the importance users place on having a conducive and healthy environment for studying and learning.

However, it is worth noting that the categories of energy consumption and library resources received less concern by the users (83.3%) compared to other categories. Some users may perceive their individual energy-saving efforts as inconsequential in the larger scheme of things, leading to a lack of motivation to actively reduce energy consumption. This indicates that there is room for enhancing energy efficiency measures within the library, such as optimizing lighting systems, implementing energy-saving technologies, and promoting responsible energy use among users.

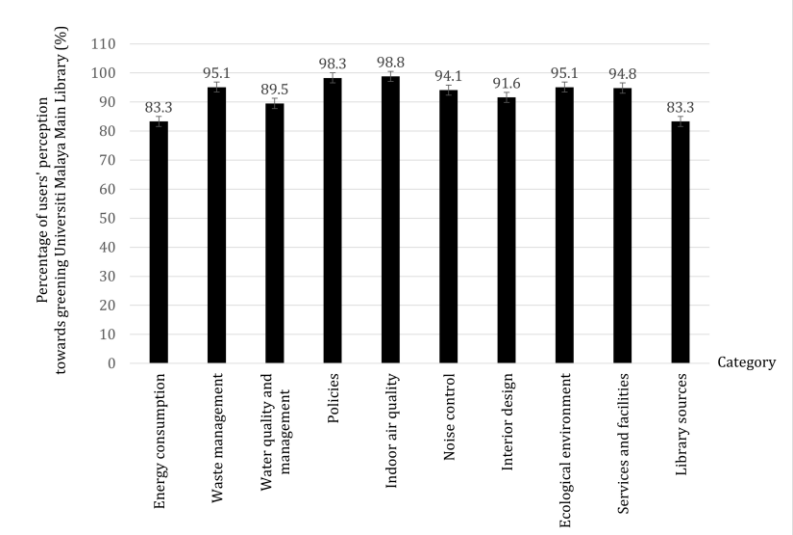

Figure 3. Percentage of users' perceptions toward greening Universiti Malaya Main Library. Note: Total number of respondents = 407.

3.5.1. Users' personal suggestions and improvements for Universiti Malaya Main Library and green library initiatives

In addition to the predefined green library initiatives provided, users were given the opportunity to contribute their personal suggestions and improvements for the Universiti Malaya Main Library and its green library initiatives (Table 3). The valuable input received from the 407 respondents yielded six new initiatives that garnered higher requests and attention among the participants. These initiatives can be categorized into the following areas: (1) ecological environment, (2) activities and campaigns, (3) services and facilities, (4) hygiene, and (5) water quality and management.

The category of ecological environment emerged as a prominent focus among users, indicating their desire for further enhancements in creating a greener and more environmentally conscious library space. This could include initiatives such as incorporating more plants and green elements, creating outdoor green spaces, and integrating sustainable landscaping practices within the library premises.

Activities and campaigns were also highlighted as an area of interest, suggesting the users' enthusiasm for engaging in environmentally themed programs and initiatives within the library. These activities can range from workshops and talks on environmental awareness and sustainability to interactive campaigns that encourage active participation and education on green practices.

Services and facilities were identified as another important aspect that users wished to see

improved. This includes initiatives such as expanding digital resources, improving access to online databases, and enhancing technological infrastructure (i.e., sockets) to support research and learning needs. By providing more diverse and advanced services and facilities, the library can meet the evolving demands of its users and promote more sustainable and efficient information access.

Hygiene emerged as a concern for users, indicating the importance of maintaining cleanliness and hygiene standards within the library. Implementing initiatives, such as regular cleaning schedules in the toilet, promoting personal hygiene practices among users, and ensuring proper waste management, contribute to creating a clean and healthy environment for all library visitors.

Lastly, water quality and management were identified as a crucial area for improvement. Users emphasized the need for continuous maintenance of water quality and efficient water management practices within the library. This includes measures such as regular water quality testing, promoting water conservation awareness, and optimizing water usage in restrooms and cooling systems.

Table 3. Users' personal suggestions and improvements for Universiti Malaya Main Library and green library initiatives.

Initiative and Improvement	Category
Provide green areas with plants and open space	Ecological Environment
Make activities related to green practices and sustainability	Activity and Campaign
Add more power sockets	Service and Facility
Clean the library with environmentally friendly products	Hygiene
Regularly clean the toilet	Hygiene
Improve library water resources	Water Quality and Management

3.5.2. Users' overall agreements toward greening Universiti Malaya Main Library

According to the survey results, a substantial majority of 92.9%, which represents 378 respondents, expressed the importance of the green library initiatives and practices. This high percentage indicates a strong positive sentiment among the library users towards the implementation of sustainable and environmentally friendly practices within the Universiti Malaya Main Library. It suggests that the respondents recognize the value and significance of adopting green initiatives, potentially indicating their awareness and concern for environmental sustainability (Figure 4).

Furthermore, all respondents showed their willingness to increase their visits to the Universiti Malaya Main Library when the library changes to prioritize the green library initiatives and practices (Figure 5). This finding indicates a positive response from the respondents and underscores the potential impact of sustainability-focused changes on user behavior and engagement. It also demonstrates their recognition and appreciation of the value that green initiatives can bring to the library environment while enhancing their overall experience and motivating them to spend more time in the library.

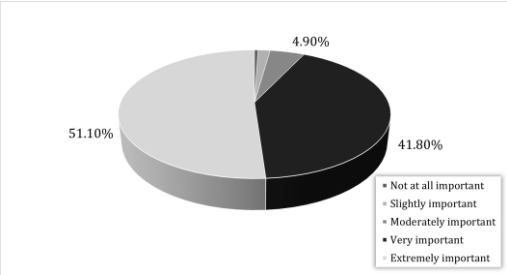

Figure 4. Percentage in adopting the green library initiatives and practices in Universiti Malaya Main Library among users. Note: Total number of respondents = 407.

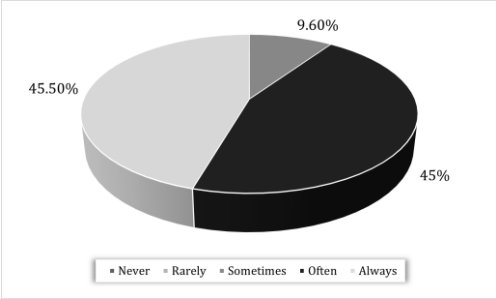

Figure 5. Percentage of users' likelihood of visiting Universiti Malaya Main Library when it changes to prioritize green library and initiatives. Note: Total number of respondents = 407.

3.6. Placemaking strategies in greening Universiti Malaya Main Library

Table 4 shows the list of placemaking strategies in greening Universiti Malaya Main Library incorporating insight from both the articles review and users' suggestions.

Table 4. Placemaking strategies in greening Universiti Malaya Main Library.

No.	Category	Green Library Initiative
1.	Indoor Air Quality	Installation of Indoor Air Quality (IAQ) monitoring systems
		Air ventilation and purification system
		Installation of three-level purification system
		Installation of computer-controlled air purification system
2.	Policies	Proper policies and guidelines for recycling damaged and unused books and documents
		Proper disposal policies
		Policies on sustainable development
		Proper mounting of signage on SD initiative to enhance visibility
3.	Waste Management	Ensure proper segregation of dry and wet waste
		Proper waste management of books
		Waste segregation in general, recycle, and hazardous waste

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No.	Category	Green Library Initiative
4.	Ecological Environment	Presence of vegetation in and around the library
		Vegetative roof/eco roof/rooftop planting
		Use eco-friendly pesticides
5.	Services and Facilities	Provision for off-campus access of resources and services
		Periodic updating of library resources and facilities
		Use of chatbots
		AI mediated references service
		Sensor controlled library tour
		AI mediated fees/overdue charge collection mechanism
		Sensor mediated retrieval system
		Use of robotics in library
		Sensor-based circulation system
		Use of robot crane to pick book from higher places
		Recycle ink cartridges
		Double-sided printing
		Use chlorine-free and FSC-certified paper
		Use cloud computing system
6.	Noise Control	Use of soft pads in chairs
		Installation of wall-mounted vibration absorber
		Introducing sound-masking systems
		Decibel-detecting sensor
7.	Interior Design	Free spaces between adjacent shelves
		Use of adjustable steel racks
		Proper arrangement of shelves, tables, and chairs
		Use retractable ladder
		Furniture made from recyclable materials
		Furniture required to be attractive, durable, comfortable, adjustable, workable, and sustainable
		Installation of stackable chairs and folding tables
		Installation of Pod-style desks
		Acoustic cost-effective furniture
		Furniture made from recyclable materials
		Put dustbins in a proper place
8.	Water Quality and Management	Use of sensor taps
		Use dual-flush toilet
		Rainwater harvesting systems
		Installation of waterless urinals
		Reuse of treated sewage water
		Provision of drinking water
		Installation of sensors for water conservation

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No.	Category	Green Library Initiative
9.	Energy Consumption	Installation of solar panels
		Installation of LED bulbs
		Installation of sensors to control energy consumption
		Installation of automatic lighting controls
		Installation of smart energy-saving systems
		Running multiple servers on one server box
		Switching to renewable energy
		Pairing natural light with electrical light
		Installation of energy-saving bulbs
		Use of CFL light
		Use network printer instead of personal printer
		Installation of sensors to operate ACs
10.	Library Sources	Digitization initiative
		Presence of e-resources
11.	Activities and Campaigns	Make activities related to green practices and sustainability
12.	Hygiene	Clean the library with environmentally friendly products
		Regularly clean the toilet

4. Conclusions

In conclusion, the placemaking strategies to green the Universiti Malaya Main Library hold significant importance in the pursuit of environmental sustainability within library spaces as the majority of the users showed their positive acceptance toward the initiatives and practices. Although the study focused on the Universiti Malaya Main Library as a specific case study, the findings could also be generalised and recommended for other libraries that are currently in the same initial condition (built in 1959 without any major green renovations or retrofitting). These strategies encompass a range of initiatives aimed at improving indoor air quality, waste management, energy consumption, and overall ecological health. The decision to embed these initiatives was driven by a recognition of the library's potential as a catalyst for environmental stewardship and the positive acceptance demonstrated by the majority of users toward such practices. In the end, this study has identified a comprehensive set of 12 categories encompassing 67 strategies and initiatives for greening the library, drawing insights from both the literature review and users' suggestions. The identified categories include indoor air quality, policies, waste management, ecological environment, services and facilities, noise control, interior design, water quality and management, energy consumption, library resources, activities and campaigns, and hygiene. These categories provide a comprehensive framework for guiding the implementation of green initiatives and serve as a roadmap for achieving environmental sustainability goals within the Universiti Malaya Main Library.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Acknowledgments

The authors would like to thank Universiti Malaya (RMF1449-2021) for the support given toward the completion of this study.

Conflict of interest

The authors declare that there are no conflicts of interest in this paper.

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