Nearby Pocket Settings for Social Learning on Tropical Universities Campuses

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***Abstract*— Nearby pockets on university campuses, known as nearby pocket settings, have become essential for enhancing the academic experience by encouraging casual social learning activities. However, universities in tropical countries, such as Malaysian public universities, predominantly emphasize formal indoor learning, neglecting informal social education that aligns with modern academic goals. Therefore, this study seeks to identify the design factors influencing students' social learning experiences in nearby pocket settings on university campuses in a tropical context. Data were collected through a survey involving 408 participants from three public universities in a tropical region in Malaysia. The findings revealed a variety of factors impacting students' social learning experiences on tropical campuses pocket settings, including design elements (such as softscape elements, furniture, and sensory elements), environmental conditions (temperature, rainfall, sunlight, and shade), access (proximity and accessibility), and noise levels. Additionally, demographics like gender, education level, and university also played a role in shaping students' experiences in university campuses in tropical region. This study provides valuable insights for designing campus environments in tropical universities, especially in Malaysia, to incorporate pocket settings that foster social interaction and enhance sustainable academic social learning experiences.**

***Keywords*:** design factors, informal learning spaces, on-campus pocket settings, Malaysian universities, social learning, tropical campuses.

I. Introduction

Public spaces and green settings play a vital role in enhancing human experiences and fulfilling daily life needs by facilitating social interactions and routine activities (Baur & Tynon, 2010; Krishnan & Maruthaveeran, 2021). In recent years, these spaces have become essential, requiring proximity and easy accessibility due to their significant contribution to improving quality of life (Douglas et al., 2017). They support diverse activities across various socio-demographic groups, offering numerous health, environmental, aesthetic, socio-cultural, and educational benefits (Salih et al., 2020). However, the rapid pace of urbanization and population growth globally has negatively impacted the availability of large public spaces. This reduction in natural settings and public spaces has led to adverse effects on the environment, climate, human health, and social and cultural dimensions (Sankari et al., 2018; Jarocki, 2019; Zhang et al., 2022).

Pocket settings and pocket parks, which are small, low-cost spaces typically under 5000 m², are effective in supporting diverse activities and offering various benefits to users (Baur & Tynon, 2010; Krishnan & Maruthaveeran, 2021). These spaces are valuable investments in fostering social interactions within urban communities and are often considered safer and more secure than larger public spaces and parks (Krishnan & Maruthaveeran, 2021). Consequently, urban authorities worldwide have shifted their focus toward creating and maintaining smaller public settings instead of large ones (Crook & Mitchell, 2012; Salih et al., 2020). Pocket settings have recently been integrated into initiatives to enhance specific groups' experiences, such as students (Peker & Ataov, 2019; Salih et al., 2020) and adolescent learners (Hafner et al., 2018; Mertens et al., 2019). However, these spaces must be carefully designed with appropriate characteristics to achieve their intended benefits (Peker & Ataov, 2019; Hafner et al., 2018). Factors influencing the use of pocket settings play a crucial role in their success and effectiveness (Peschardt et al., 2014; Sinou & Kenton, 2013; Salih et al., 2020).

Existing research highlights differing views on the factors influencing the use of pocket settings. According to Nordh et al. (2011) and Salih (2021), natural elements (such as plants and water), hard features (like benches), and activities are the most common factors impacting pocket settings usage. Hussein et al.

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(2016) emphasized the importance of sense elements—features that engage the five human senses—within natural landscapes and garden settings design. Environmental factors, including temperature, rainfall, and shade, are also critical components of successful urban pocket spaces (Peschardt et al., 2014; Kerishnan & Maruthaveeran, 2021). Abd El-Aziz (2015) highlighted that pocket settings foster collaboration among various stakeholders in their design, construction, and maintenance. Additionally, on-campus facilities such as refreshment services (food and drink) and power outlets for connectivity play a crucial role in encouraging student participation and engagement (Ibrahim et al., 2013; Ibrahim & Fadzil, 2013).

Nearby pocket settings on campus grounds serve as vital social learning spaces, enhancing students' social cohesion and fostering learning activities (Oblinger, 2005; Rea, 2009; Keppell et al., 2011; Hedges, 2018). Pocket settings on campus grounds are typically small, flexible areas interspersed throughout the campus, designed for spontaneous interaction and individual or small group activities (Peker and Ataöv, 2019; Alzamil et al., 2023). They might include nooks and courtyards within buildings, transitional spaces and hallway spaces, and semi-outdoor and outdoor spaces (Peker and Ataöv, 2019; Alzamil et al., 2023; Salih et al., 2024). The nearby pocket settings are usually designed as informal learning spaces to support socialisation and learning outside the formal classroom. They encourage active learning, peer-to-peer interaction, and the application of knowledge in less structured settings (Keppell et al., 2011; Hedges, 2018; Peker and Ataöv, 2019; Alzamil et al., 2023). Integrating pockets as informal learning areas into campus design can significantly enhance the learning environment by catering to the diverse needs of students for social learning activities. Therefore, their design factors are critically important to enhance students' social education (Ramu et al., 2022; Ahmad et al., 2023; Yau et al., 2023). By considering a variety of social, environmental, and cultural factors, pocket settings on campuses can effectively enhance students' social education and contribute to a more vibrant and engaging campus environment (Ramu et al., 2022; Ahmad et al., 2023; Salih et al., 2024).

On the other hand, traditional classroom-based learning alone no longer meets modern social and educational needs (Keppell et al., 2011; Ibrahim & Fadzil, 2013; Alzamil et al., 2023). Instead, informal social learning spaces, such as pocket settings and outdoor learning spaces, have emerged as sociable learning environments that significantly boost student engagement and participation in both formal and informal activities (Matthews et al., 2009; Keppell et al., 2011; Neely & Marone, 2016; Yau et al., 2023). Globally, many universities leverage nearby pocket settings and open spaces for social, formal, and informal learning activities. In contrast, universities in tropical countries, such as Malaysian universities, predominantly focus on formal indoor learning, often neglecting the integration of pocket settings and social learning spaces, which hampers the realization of modern academic goals (Ibrahim et al., 2013; Maheran et al., 2017; Alzamil et al., 2023). Research indicates that pocket settings as social learning spaces on Malaysian campuses remain underutilized and poorly explored (Tahir et al., 2009; Ibrahim et al., 2013; Shamsudin et al., 2014; Zanariah & Norsidah, 2014; Alzamil et al., 2023). Furthermore, studies on the design factors and design parameters of pocket settings and social learning settings on university campuses in tropical countries are limited (Maheran et al., 2017; Ramu et al., 2022; Alzamil et al., 2023). This highlights a gap in understanding the design factors influencing the social learning experiences of students in these settings on university campuses in tropical contexts. Therefore, this study aims to identify the key design factors of nearby pocket settings that affect students' social learning experiences in tropical universities, especially in Malaysia.

II.Materials and Methods

Research Design

This study employed a quantitative survey method to gather and analyze data, focusing on students' perceptions of design factors influencing the use of nearby pocket spaces on tropical campuses in Malaysia. Creswell (2014) highlighted that quantitative surveys are effective tools for social research involving large population samples. The survey process included data collection through face-to-face verbal questionnaires, data analysis using SPSS, and the interpretation and discussion of findings. The questionnaire was developed based on an extensive systematic literature review of prior studies on pocket settings, social learning spaces and their design factors (Salih et al., 2024). The content analysis of the literature provided a foundation for creating a reliable data collection instrument and also served to validate the survey's quantitative results (Creswell, 2014). The current study data collection tool is designed based on the results of another study published by Salih et al. (2024). Therefore, this study is a part and continuation of the previous study by Salih et al. (2024).

Study site

This study aims to identify the design factors of nearby pocket spaces that influence students' social learning experiences in tropical universities in Malaysia. To achieve this, Malaysian public universities is selected as the study area. Malaysia has 20 public universities and 34 private universities, with approximately 700,000 students enrolled in various programs (Da Wan et al., 2015; Sheriff & Abdullah, 2017).

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Following Creswell's (2014) recommendation to use site selection criteria to ensure data accuracy and mitigate external validity threats, the study employed a stratified judgmental sampling approach using the site and sample selection criteria. The selection criteria included (a) selecting research public universities, as aligned with the problem statement of this study. Besides, Sheriff and Abdullah (2017) highlighted that students in research universities possess substantial expertise in conducting research and participating in survey studies. (b) choosing universities near Kuala Lumpur, within Klang Valley, based on the study's objectives and limitations, and (c) focusing on samples from schools of engineering, architecture, and the built environment. Taherdoost (2016) emphasized that the targeted sample should be closely aligned with the study's subject matter. Accordingly, engineering students, particularly those specializing in architecture and built environments, were chosen as the target population for this study due to their familiarity with and understanding of the survey study content. Based on these criteria, three research public universities in Klang Valley with schools of engineering, architecture, and the built environment were chosen: Universiti Malaya (UM), Universiti Putra Malaysia (UPM), and Universiti Kebangsaan Malaysia (UKM). The sample is drawn from pocket spaces near the schools of the selected universities.

The University of Malaya (UM) is a public research university situated in the southwest of Kuala Lumpur, Malaysia (refer to Figure 1). UM has a diverse campus environment, spanning 900 acres (365 hectares) of natural parkland, including hills and valleys. The university comprises 12 faculties, two academies, three centres, a central library, banking services, food courts, health services, and sports facilities, all distributed throughout the campus. The Faculty of Built Environment is located in the southwest area, near the campus lake. This faculty occupies a multi-story building adjacent to a small pocket park covering approximately 160 m² (Universiti Malaya, 2019).

Universiti Putra Malaysia (UPM) is a public research university situated in Serdang, south of Kuala Lumpur and adjacent to Putrajaya. The main campus spans over 1,000 hectares and encompasses 16 faculties, 16 centres, nine institutes, two schools, and one academy. The campus offers a variety of facilities, including libraries, bookstores, banking services, food courts, and recreational and sports amenities, which are distributed throughout the area (refer to Figure 1). The Faculty of Design and Architecture is located southeast of the main entrance, near the Faculty of Engineering, and approximately 3 km from the main library (Universiti Putra Malaysia, 2019). The faculty building is a three-story structure featuring a central courtyard that serves as a primary gathering area, measuring about 100 m². Nearby the main building, a few small pocket spaces cover less than 36 m² each.

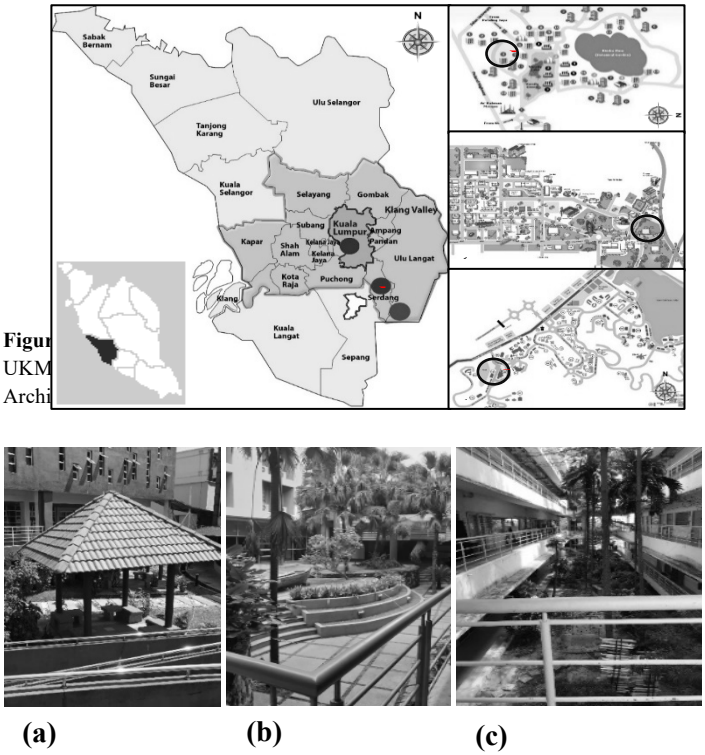

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Figure 2. The pocket settings as area of the study. **(a)** Nearby pocket space, Faculty of Built Environment, UM. **(b)** Courtyard pockets, Faculty of Design and Architecture, UPM. **(c)** Courtyard pocket space, Faculty of Engineering Built Environment, UKM. Adapted from Salih, S. A. (2021).

Universiti Kebangsaan Malaysia (UKM), also known as The National University of Malaysia, is a public research institution located in Bandar Baru Bangi, Selangor within Klang Valley, approximately 30 km south of Kuala Lumpur (refer to Figure 1). The main campus spans a lush green valley covering 1,096 hectares and is home to 13 faculties, 16 research institutes, 10 residential colleges, 10 service centres, and two additional entities (studymalaysia.com, 2019b). The Department of Architecture is part of the Faculty of Engineering and Built Environment and is situated in the southwest area of the campus, occupying approximately 2.30 hectares of land. The department's building is designed around a central courtyard and features four floors encircling a pocket space with an area of roughly 75 m² (see Figure 2; Universiti Kebangsaan Malaysia, 2019).

Study sample

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The study population comprised students from Malaysian universities. A stratified judgmental sample was drawn from the engineering, architecture, and built environment schools of three research universities in Klang Valley, Malaysia (refer to Figure 1). Collectively, these universities have an enrollment of over 75,000 students across various programs. The study's sample size was determined using Yamane's Simplified Formula (1973). Using this method (refer to Equation 1), 420 questionnaires are distributed, with 140 allocated to each university and administered in the nearby pocket spaces of the chosen schools.

$$n = \frac{N}{1 + N(e)^2} = \frac{700000}{1 + 700000(\pm 0.05\%)^2} = \pm 400$$

Equation 1. A Simplified Formula for Proportions (Source: Yamane, 1967).

Verbal questionnaire and procedure

The verbal questionnaire is divided into three sections: (a) participants' demographic characteristics (participant variables); (b) their social learning experiences on campus grounds (dependent variable); and (c) factors influencing their use of nearby pocket settings on campus grounds (independent variables). The questionnaire content is developed following a comprehensive systematic literature review (SLR) of original research studies published in indexed journals, details of the SLR search strategy is discussed in the previous study of Salih et al. (2024). To develop a valid data collection tool, a comprehensive SLR is conducted on research studies published between 2004 and 2024 from four databases, including ScienceDirect, Scopus, and IEEE Xplore. The systematic search led to the collection of a total of 3,394 articles of which 37 full-text research articles are used to develop the tool of the current study (Salih et al., 2024) . However, from the previous SLR by Salih et al. (2024), only empirical quantitative and mixed method studies (total of 29 studies) are included to develop the methodology and data collection tool of this study (Waxman et al., 2007; Donkai et al., 2011; Matthews et al., 2011; Crook & Mitchell, 2012; Harrop & Turpin, 2013; Ibrahim et al., 2013; Hunter & Cox, 2014; Thomas et al., 2015; Beckers et al., 2016a; 2016b; Clement et al., 2018; Sankari et al., 2018; Jarocki, 2019; Winks et al., 2020; Wu et al., 2020; Zhou et al., 2020; Wang & Han, 2021; Wu et al., 2021; Chen et al., 2022; Lotfy et al., 2022; Ng et al., 2022; Ramu et al., 2022; Zhang et al., 2022; Alzamil et al., 2023; Kansal & Bassi, 2023; Salih et al., 2023; Yau et al., 2023; Zhang et al., 2023; Harris et al., 2024); see the summary of the selected study in Appendix 1

The demographic characteristics section included five questions (items): age (continuous variable), gender (1 = male, 2 = female), ethnicity (1 = Malay, 2 = Chinese, 3 = Indian, 4 = others), education level (1 = Bachelor, 2 = Master, 3 = PhD, and 4 = others), and university (1 = UM, 2 = UPM, 3 = UKM). The social learning section of the questionnaire consisted of two main items divided into seven closed-ended questions (items): four focused on participants' social interactions and three on their learning activity in nearby pocket settings. The social interaction questions assessed participants' campus social activities, such as socializing (chatting and communication), recreational activities, social refreshments (eating and drinking), and other social interactions. The learning activity questions focused on informal group study, individual study, and formal study outside classroom. Responses were measured using a three-point ratio scale: 1 = never use, 2 = less than 30 minutes daily, and 3 = 30 minutes and over daily. It is noted that the recommended average time for physical activities in outdoor spaces is between 30 and 60 minutes per day to achieve various health and social benefits (Mertens et al., 2019).

The factors influencing participants' use of nearby pocket settings (NPS) included seven factors divided into 21 items (questions): design and image, design elements (softscape elements, furniture, and sensory elements), environmental conditions (temperature, rain, humidity, wind, sunlight, and shade), access (accessibility and proximity), settings management (management, maintenance, and safety and security), facilities (connectivity, refreshment, and resources), social factor (sociability, participation, and noise level). The softscape elements represented the natural green components of the spaces such as plants, trees, shrubs, flowers, and grass. The sensory elements indicate the aspects of the spaces that appeal to the users' senses of sight, sound, smell, touch, and taste (Alzamil et al., 2023). The connectivity factor refers to internet access and power outlets for laptops (Ibrahim & Fadzil, 2013). The participation factor involved the roles of users, responsible authorities, and private sectors in designing, maintaining, and creating pocket settings (Abd El-Aziz, 2015). The resource factor is related to the availability of materials like books, workspaces, and boards (Ibrahim et al., 2013; Ibrahim & Fadzil, 2013). A 5-point Likert scale was employed to evaluate the impact of these factors on participants' use of the nearby pocket spaces, with ratings ranging from 1 (no effect) to 5 (major effect) (Kaplan & Kaplan, 1989; De Vaus, 2013; Creswell, 2014). The questionnaire survey was self-administered during weekdays between April and July 2022, conducted in the morning (10:00 am to 11:00 am) and afternoon (12:00 pm to 3:00 pm). A total of 408 completed questionnaires were included in the study, with 12 incomplete forms excluded from the analysis. On average, participants answered 15 questionnaires per day, with each participant taking approximately 10 minutes to complete the survey.

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Validity and reliability of the questionnaire

The content of the questionnaire is first reviewed for content validity by a committee of six experts, consisting of three associate professors and three PhD lecturers specialising in architecture and urban planning from the three public research universities (study area). The review of the questionnaire items focused on readability, clarity, and comprehensiveness (see Table 1). Content validity was assessed using the Content Validity Index for Items (I-CVI) for the main questionnaire items (see Table 1). The CVI results were higher than 0.80 for all three sections of the questionnaire, indicating that the experts agreed the questionnaire items were relevant and valid for the survey (Shrotryia & Dhanda, 2019). Besides, the six experts confirmed that the study protocol and methodology are proper and approved.

Table 1. I-CVI for questionnaires by six experts using a 4-point relevancy scale.

Items		Expert_ 1	Expert_ 2	Expert_ 3	Expert_ 4	Expert_ 5	Expert_ 6	No of agreement	I-CVI	Average I-CVI
Item 1: Demographic characteristics	**Relevancy**	4	3	3	3	3	2	5	0.883	0.922
	Readability	4	4	3	3	2	4	5	0.883	
	Clarity	3	4	3	3	3	3	6	1	
Item 2: Social learning	**Relevancy**	3	3	3	3	3	2	5	0.883	0.961
	Readability	4	4	3	3	3	4	6	1	
	Clarity	4	4	4	3	3	4	6	1	
Item 3: Design factors of NPS	**Relevancy**	4	4	4	4	3	4	6	1	1
	Readability	3	3	3	4	3	3	6	1	
	Clarity	4	3	4	3	4	4	6	1	

1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant

Then, a pilot test is carried out with 26 participants to assess the questionnaire's clarity, language, completion time, reliability (factor load (FL) and internal consistency reliability using Cronbach's alpha (CA)). FL and CA were measured with SPSS 25 (Shrotryia & Dhanda, 2019). The Cronbach's alpha of the internal consistency reliability yielded a value above the threshold 0.70 for each item. However, due to low factor loading values (<0.70), one item from the environmental condition factor is excluded (Table 2). As a result, the final factor loading (FL) value for the remaining items exceeded 0.70, demonstrating strong internal consistency. Additionally, the FL test identified a fixed factor accounting for 20.580% of the total variance. The results revealed that respondents required approximately 5 minutes to complete the questionnaire, and no concerns regarding clarity or language were reported. These findings, combined with the outcomes of the validity assessment, pilot test, FL analysis, and reliability testing, confirmed that the questionnaire was valid and reliable (see Table 2). All participants provided informed consent before participating in the survey or any associated activities.

Table 2. FL, CA, and Overall I-CVI of the Questionnaire.

Sections	Items		FL (>.70)	CA (>.70)	I-CVI	Source of data from literature review
Design factors of NPS	Design & image	Item1: well-design	.732	.702	.961	Ibrahim et al. (2013); Ng et al. (2022);
	Design elements	Item 1: softscape	.780	.708		Donkai et al. (2011); Hunter & Cox (2014); Thomas et al. (2015); Beckers et al. (2016b); Clement et al., (2018); Chen et al. (2022); Yau et al., (2023)
		Item 2: furniture	.775			
		Item 3: sensory factor	.762			
	Environmental condition	Item 1: temperature	.723	.735		Ibrahim et al. (2013); Ramu et al. (2022)
		Item 2: rain	.820			
		Item 3: humidity	.707			
		Item 4: wind	.662*			
		Item 5: sunlight	.832			
		Item 6: shade	.852			
	Access	Item 1: accessibility	.742	.716		Ibrahim et al. (2013); Thomas et al. (2015); Sankari et al. (2018); Chen et al. (2022) Salih et al. (2023)
		Item 2: proximity	.721			
	Settings management	Item 1: management	.739	.713		Salih et al. (2023)
		Item 2: maintenance	.719			
		Item 3: safety and security	.722			
	Facilities	Item 1: connectivity	.782	.780		Waxman et al. (2007); Crook & Mitchell (2012); Ibrahim et al. (2013); Beckers et al. (2016b); Sankari et al. (2018); Winks et al. (2020); Zhou et al. (2020); Wu et al. (2021); Lotfy et al. (2022); Kamal & Bassi (2023); Yau et al., (2023)
		Item 2: refreshment	.752			
		Item 3: resources	.732			
	Social factor	Item 1: sociability	.748	.714		Beckers et al. (2016a; 2016b); Winks et al. (2020); Kamal & Bassi (2023); Salih et al. (2023); Zhang et al. (2023)
		Item 2: participation	.704			
		Item 3: noise level	.701			
Demographic characteristics		Item 1: Age	.713	.812	.961	Beckers et al. (2016a); Wang & Han (2021); Zhang et al. (2022); Harris et al. (2024)
		Item 2: Gender	.731	.819		
		Item 3: Ethnicity	.743	.813		
		Item 4: Education level	.789	.816		
		Item 5: university	.734	.818		
Social learning	Social interactions	Item 1: socializing	.764	.816	.961	Matthews et al. (2011); Harrop & Turpin (2013); Janocki (2019); Wu et al. (2020); Alzamil et al. (2023); Yau et al., (2023); Harris et al. (2024)
		Item 2: recreational activities	.742			
		Item 3: social refreshment	.711			
		Item 4: other social interactions	.701			
	Learning activity	Item 1: informal group study	.701	.802		
		Item 2: individual study	.706			
		Item 3: formal learning	.703			

*Note: The deleted items were environment condition: item 4.

Data analysis process

This study utilized frequency and descriptive statistics to examine participants' demographic characteristics (participant variables) and their social learning activities on campus grounds (dependent variables). Descriptive statistics were also applied to evaluate the factors influencing users' activities in nearby pocket settings on campus grounds (independent variables). Additionally, bivariate analysis using Pearson's correlation was conducted to explore the relationships between the study's variables. Multiple regression analyses were employed to assess the multivariate relationships between the overall social learning experience (dependent variable), demographic characteristics (participant variables), and the influencing factors in nearby pockets (independent variables). A p-value of < 0.05 was considered statistically significant. Data analysis was performed using SPSS version 23, a comprehensive software tool for analyzing social science research data.

II.Results

Participants' demographic characteristic

A total of 408 students (respondents) participated in the survey. The respondents had an average age of 23.80 years (±10.80), with ages ranging from 18 to 40 years. Female

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participants accounted for 50.0% (n = 204) of the sample, slightly exceeding male participants who represented 49.0% (n = 203); one response was missing. The largest ethnic group was Malay (46.8%, n = 191), followed by Chinese (29.7%, n = 121), other ethnicities (14.2%, n = 58), and Indian participants forming the smallest group (9.3%, n = 38). Regarding education levels, 46.8% (n = 191) of the participants were pursuing a Bachelor's degree, 39.0% (n = 159) were Master's students, and 14.2% (n = 58) were PhD students (see Table 3). Additionally, most respondents were from UKM (38.1%, n = 158), followed by UPM (36.1%, n = 150) and UM (24.1%, n = 100). The demographic characteristics of the participants are detailed in Table 3.

Table 3. Frequency statistics of participants' demographic.

Variable		Frequency	%	Ranges	Total	Missing
Gender	Male	203	49.0	1-2	407	1
	Female	204	50.0			
Ethnicity	Malay	191	46.8	1-4	408	-
	Chinese	121	29.7			
	Indian	38	9.3			
	Others	58	14.2			
Education	Bachelor	191	46.8	1-3	408	-
	Masters	159	39.0			
	PhD	58	14.2			
University	UM	100	24.1	1-3	408	-
	UPM	150	36.1			
	UKM	158	38.1			
Socialization	Never use NOS	244	59.8	1-3	408	-
	< 30 min daily	151	37.0			
	≥ 30 min daily	13	3.2			
Social-recreational activity	Never use NOS	238	58.3	1-3	408	-
	< 30 min daily	136	33.3			
	≥ 30 min daily	34	8.3			
Social refreshment activity (eating and drinking)	Never use NOS	149	36.5	1-3	408	-
	< 30 min daily	173	42.4			
	≥ 30 min daily	86	21.1			
Other social interations	Never use NOS	216	52.9	1-3	408	-
	< 30 min daily	153	37.5			
	≥ 30 min daily	39	9.6			
Informal group study	Never use NOS	273	66.9	1-3	408	-
	< 30 min daily	123	30.1			
	≥ 30 min daily	12	2.9			
Individual study	Never use NOS	196	48.0	1-3	408	-
	< 30 min daily	160	39.2			
	≥ 30 min daily	52	12.7			
Formal learning	Never use NOS	247	60.5	1-3	408	-
	< 30 min daily	130	31.9			
	≥ 30 min daily	31	7.6			

Social learning activities and NPS influencing factors

The analysis of students' use of NPS on Malaysian university campuses revealed that the majority rarely utilized these spaces for social interactions. Specifically, 59.8% (n = 244) never visited the on-campus pockets for socialization, 58.3% (n = 238) for social recreation, and 52.9% (n = 216) for other social activities. About 79% (n = 322) of participants used the NPS for less than 30 minutes daily for social refreshments, such as eating or drinking with others (see Tables 4 and 5). Conversely, fewer than 10% of participants spent 30 minutes or more daily in the pockets for socialization (3.2%, n = 13), social recreation (8.3%, n = 34), or other social activities (9.6%, n = 39).

Additionally, a significant majority never used these spaces for academic purposes, with 66.9% (n = 273) not engaging in informal group study and 60.5% (n = 247) avoiding formal learning in these nearby pockets. Only a small percentage—2.9% (n = 12) for informal group study and 7.6% (n = 31) for formal learning—spent 30 minutes or more daily in these areas. Regarding the individual informal study, about 48% (n = 196) reported never using the on-campus NPS, and only 12.7% spent 30 minutes or more daily studying there. Overall, the findings indicate that most participants either do not utilize the NPS or use them for very brief periods, primarily for social learning activities.

The descriptive analysis of factors influencing students' use of NPS on Malaysian (tropical) university campuses revealed that shade had the highest mean score (4.14 ± 0.815), indicating it was the most significant factor. This is followed by rain (4.03 ± 0.945), furniture (4.01 ± 0.902), connectivity (3.96 ± 1.036), temperature (3.93 ± 1.000), refreshment (3.92 ± 0.959), resources (3.92 ± 0.972), sociability (3.85 ± 0.857), participation (3.74 ± 1.030), maintenance (3.65 ± 1.093), sunlight (3.64 ± 1.044), accessibility (3.61 ± 1.044), and management maintenance (3.60 ± 1.098). Additional factors with notable mean scores included sense elements (3.55 ± 0.902), softscape elements (3.55 ± 1.030), design and image (3.55 ± 1.062), noise level (3.52 ± 1.066), safety and security (3.50 ± 1.135), and proximity (3.43 ± 0.999). The humidity factor had the lowest mean score (3.22 ± 1.138), suggesting it had the least influence, yet it is considered a significant factor.

The findings suggest that the most impactful design factors influencing students' use of on-campus NPS are, in order, shade, rain, furniture, connectivity, temperature, refreshment, resources, sociability, participation, maintenance, sunlight, accessibility, management, sense elements, softscape element, and design and image. Conversely, other design factors such as noise level, safety, activity, proximity, and humidity were found to have a more neutral or lesser effect on students' activities within these spaces.

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Bivariate correlation for the demographic, social learning, and NPS influencing factors

Pearson's correlation analysis is conducted to examine the bivariate relationships between individual activities (social learning), the factors of NPS, and demographic variables. The results, presented in Tables 4 and 5, showed significant correlations ($p < 0.05$) between various social activities on-campus and the design factors such as design and image, design elements, environmental conditions (excluding humidity), access, pocket settings management, facilities (excluding refreshment), sociability, participation, and noise levels.

For learning activities, significant correlations ($p < 0.05$) are observed with several design factors: furniture elements, environmental factors (excluding sunlight), proximity, connectivity, sociability, participation, and noise levels. Notably, temperature, rain, shade, and sociability emerged as key factors influencing all types of social activities, while temperature and shade were significant determinants of all learning activities.

The analysis also revealed significant associations between on-campus social activities and participants' demographic characteristics, such as ethnicity, education level, and university ($p < 0.05$; refer to Table 4). Similarly, on-campus learning activities were significantly associated with participants' demographic variables ($p < 0.05$; refer to Table 5).

These findings indicate that a range of site-specific, environmental, and demographic factors impact students' social learning activities in NPS on Malaysian (tropical) university campuses.

Table 4. Descriptive and bivariate analysis for the demographic characteristics, social activities, and NPS influencing factors.

Variables			Mean ± SD	Values	1	2	3	4	5	6	7	8
1	*Social interaction*	*Socialization*	1.43 ± .557	*(1-5)****	-	-	-	-				
2		*Social recreation*	1.50 ± .646	*(1-5)****	-	-	-	-				
3		*Social refreshment*	1.85 ± .744	*(1-5)****	-	-	-	-				
4		*Other social interactions*	1.57 ± .662	*(1-5)****	-	-	-	-				
5	*Gender*		-	-	-.050	.006	-.049	-.010	-			
6	Ethnicity		-	-	-.179**	-.188**	-.226**	-.221**	-.109*	-		
7	Education Status		-	-	-.287**	-.265**	-.286**	-.281**	-.110*	.505**	-	
8	University		-	-	.123*	.165**	.080	.252**	.003	-.088	-.111*	-
9	**Design and image**		3.55 ± 1.060		.035	**-.149****	.100	-.082	.110*	-.087	-.037	-.020
10	**Elements**	*Softscape*	3.55 ± 1.030	*(1-5)*****	.064	**-.191****	.085	-.049	.055	-.150**	-.020	-.043
11		*Furniture*	**4.01 ± .902**	*(1-5)*****	**-.158****	**-.129****	-.006	**-.114***	.046	.019	.069	-.106*
12		*Sence Elementz*	3.55 ± .902	*(1-5)*****	-.053	**-.145****	.027	**-.145****	.028	-.061	.010	-.030
13		*Temperature*	3.93 ± 1.000	*(1-5)*****	**-.185****	**-.284****	**-.151****	**-.259****	.022	.019	.142**	-.037
14		*Rain*	**4.03 ± .945**	*(1-5)*****	**-.108***	**-.233****	**-.130****	**-.211****	.101*	.074	.175**	-.006
15	**Environmental conditions**	*Humidity*	3.22 ± 1.138	*(1-5)*****	.057	-.097*	.092	-.016	.021	-.065	-.025	.040
16		*Sunlight*	3.64 ± 1.044	*(1-5)*****	.059	**-.228****	.030	-.081	.041	-.027	.006	.023
17		*Shade*	**4.14 ± .814**	*(1-5)*****	**-.172****	**-.232****	**-.244****	**-.321****	.000	.174**	.206**	-.031
18	**Access**	*Accessibility*	3.61 ± 1.044	*(1-5)*****	**-.098***	**-.220****	.044	**-.120***	.082	-.023	-.035	-.031
19		*Proximity*	3.43 ± .999	*(1-5)*****	.058	**-.166****	.087	**-.135****	.080	-.037	-.005	-.022
20	**Settings management**	*Management*	3.60 ± 1.098	*(1-5)*****	.055	**-.237****	.038	**-.158****	.023	-.097	.042	-.084
21		*Maintenance*	3.65 ± 1.093	*(1-5)*****	.059	**-.255****	.019	**-.138****	.012	.090	.088	-.089
22		*Safety and Security*	3.50 ± 1.135	*(1-5)*****	**-.118***	**-.131****	.036	**-.113***	.040	-.111*	-.038	-.011
23	**Facilities**	*Connectivity*	3.96 ± 1.036	*(1-5)*****	-.031	**-.106***	**-.168****	**-.135****	.100*	-.033	.040	-.171**
24		*Refreshment*	3.92 ± .959	*(1-5)*****	-.035	-.073	-.006	-.075	-.023	-.009	.032	-.113*
25		*Resources*	3.92 ± .972	*(1-5)*****	-.034	**-.127***	-.006	.002	.033	-.062	.014	.140**
26	**Sociability**		3.85 ± .857	*(1-5)*****	**-.206****	**-.253****	**-.151****	**-.256****	.058	.072	.167**	-.068
27	**Participation**		3.74 ± 1.030	*(1-5)*****	-.009	-.037	-.079	**-.133****	.079	-.090	-.031	-.240**
28	**Noise level**		3.52 ± 1.066	*(1-5)*****	**.194****	**-.126***	**.165****	.043	.104*	-.106*	-.112*	.056

Note: The table reports Pearson's correlations.
**P < 0.05 (2-tailed).*
***P < 0.01 (2-tailed).*
*Values: ***(1= Never use NOS; 2= < 30 min daily; 3= ≥ 1 hour daily)*
*Values: ****(1 = No affect; 2 = Minor affect; 3 = Neutral; 4 = Moderate affect; 5 = Major affect)*

Table 5. Descriptive and bivariate analysis for the demographic characteristics, learning activities, and pocket parks' influencing factors.

Variables			Mean ± SD	Values	1	2	3	4	5	6	7
1	*Learning experience*	*Informal group study*	1.36 ± .539	(1-3)***	-	-	-				
2		*Individual study*	1.65 ± .696	(1-3)***	-	-	-				
3		*Formal learning*	1.47 ± .634	(1-3)***	-	-	-				
4	*Gender*				-.098*	-.175**	.006	-			
5	Ethnicity				-.102*	-.127**	-.192**	-.109*	-		
6	Education Status				-.296**	-.228**	-.253**	-.110*	.505**	-	
7	University				.123*	.142**	.241**	.003	-.088	-.111*	-
8	**Design and image**				-.001	.056	-.011	.110*	-.087	-.037	-.020
9	**Elements**	*Softscape*			.057	.058	.042	.055	-.150**	-.020	-.043
10		*Furniture*			**-.127***	-.078	**-.122***	.046	.019	.069	-.106*
11		*Sence element*			.029	.038	.039	.028	-.061	.010	-.030
12		*Temperature*			**-.246****	**-.122***	**-.130****	.022	.019	.142**	-.037
13		*Rain*			**-.122***	**-.186****	-.093	.101*	.074	.175**	-.006
14	**Environmental conditions**	*Humidity*			**-.132****	-.068	**-.109***	.054	.036	.090	-.110*
15		*Sunlight*			.023	-.001	.001	.041	-.027	.006	.023
16		*Shade*			**-.194****	**-.147****	**-.190****	.000	.174**	.206**	-.031
17	**Access**	*Accessibility*			.046	.068	.025	.082	-.023	-.035	-.031
18		*Proximity*			**-.120***	**-.101***	.042	.080	-.037	-.005	-.022
19	**Settings management**	*Management*			.056	.044	-.040	.023	-.097	.042	-.084
20		*Maintenance*			.057	-.030	.066	-.023	.092	.065	-.092
21		*Safety and Security*			.095	.072	.007	.040	-.111*	-.038	-.011
22	**Facilities**	*Connectivity*			-.059	**-.124***	**-.196****	.100*	-.033	.040	-.171**
23		*Refreshment*			.006	.015	-.046	-.023	-.009	.032	-.113*
24		*Resources*			.057	.055	.074	.033	-.062	.014	.140**
25	**Sociability**				**-.146****	-.075	-.008	.058	.072	.167**	-.068
26	**Participation**				-.062	**-.110***	**-.193****	.079	-.090	-.031	-.240**
27	**Noise level**				.074	**.162****	**.109***	.104*	-.106*	-.112*	.056

Note: The table reports Pearson's correlations.
**P < 0.05 (2-tailed).*
***P < 0.01 (2-tailed).*
*Values: ***(1= Never use NOS; 2= < 30 min daily; 3= ≥ 1 hour daily)*

Multivariate relationship for the demographic, social learning, and NPS influencing factors

A two-step multiple regression analysis is conducted to predict students' social learning experience, which combines social and learning activities (dependent variable) based on nearby pocket park factors and participant characteristics (independent variables). Only significant factors identified in the bivariate analysis are included: design and image, the sum of the mean score of elements variables (softscape, furniture, and sensing elements), the sum of the mean score of environmental variables (temperature, rain, humidity, sunlight, and shade), the sum of access variables mean scores (accessibility and proximity), the sum of mean score of pockets management variables (management, maintenance, and safety and security) the sum of the mean scores of facility variables (connectivity and resources), sociability, participation, and noise level.

In the first step, demographic characteristics are analyzed in relation to the informal social learning experience (Model 1, Table 6). This model explained 22.6% of the variance in the social learning experience ($R^2 = 0.226$, $F = 29.166$, $P < 0.001$). Statistically significant associations are found between gender ($\beta = -0.136$, $P < 0.01$), education status ($\beta = -0.356$, $P < 0.001$), university affiliation ($\beta = 0.194$, $P < 0.001$), and the outdoor social-learning experience (refer to Table 6). These results indicate that demographic characteristics significantly influence students' social learning in NPS on Malaysian campuses, with education status and university having particularly strong effects.

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Table 6. Multivariate analysis to predict social-learning experience based on NPS influencing factors and demographic characteristics.

Variables		Model 1		Model 2	
		Standardized Coefficients	Sig.	Standardized Coefficients	Sig.
Influencing Factors	(Constant)		.000***		.000***
	Gender	-.136	**.002****	-.131	**.002****
	Ethnicity	-.085	.098	-.079	.109
	Education Status	-.356	**.000*****	-.272	**.000*****
	University	.194	**.000*****	.172	**.000*****
	Design and image			.087	.093
	Elements			-.119	**.030***
	Environmental conditions			-.244	**.000*****
	Access			-.138	**.017***
	Settings Management			-.017	.779
	Facilities			-.051	.311
	Sociability			-.092	.065
	Participation			-.005	.924
	Noise Level			.143	**.006****

Dependent Variable: Overall social learning experience. Model 1: R= 0.476, R^2= *0.226, F= 29.166. Model 2: R= 0.570,* R^2= *0.325, F= 14.443.*
*$P < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

In the second step of the multiple regression analysis, significant factors affecting students' activities in NPS are included to predict participants' social learning (Model 2, Table 6). This step improved the model's fit, explaining 32.5% of the variance in the social learning experience ($R^2 = 0.325$, $F = 14.443$, $P < 0.001$). Model 2 revealed statistically significant negative associations between participants' social learning and the following factors: design elements ($\beta = -0.119$, $P < 0.05$), environmental factors ($\beta = -0.224$, $P < 0.001$), and access ($\beta = -0.138$, $P < 0.05$). These findings suggest that limited design elements, unfavourable environmental conditions, and restricted access negatively impacted students' social learning experiences in NPS. Conversely, the analysis showed a significant positive association between the noise level factor and participants' social learning ($\beta = 0.143$, $P < 0.01$). This indicates that noise levels positively influenced students with less social learning experience in NPS.

Model 2 revealed a significant correlation between students' gender, education status, university, and their social learning experiences on campus ($P < 0.01$); this finding suggests that students with varying demographic characteristics—such as gender, education level, and university—exhibit differing levels of engagement in social learning activities within the NPS. In summary, the key predictor factors of students' social learning in NPS on Malaysian (tropical) campuses include design elements (encompassing softscape, furniture, and sensory elements), environmental factors (such as temperature, rain, humidity, sunlight, and shade), access (including accessibility and proximity), noise level, and demographic factors (such as gender, education status, and university affiliation).

III.Discussion

The study aimed to explore the factors influencing students' social learning in nearby pocket settings in tropical university campuses, taking Malaysian universities as a study area. The multiple regression analysis revealed that the key design factors of social learning experiences included various types of design elements (softscape elements, furniture, and sensory elements), environmental conditions (temperature, rain, humidity, sunlight, and shade), accessibility and proximity, and noise levels (refer to Figure 3). These findings align with prior research by Ibrahim and Fadzil (2013), emphasizing the importance of informal learning spaces near educational institutions offering diverse elements and activities to encourage student engagement. Similarly, Kim and Lee (2015) highlighted that social learning spaces on campus, designed with appropriate features, can facilitate shared environments for social learning.

However, this study found that most students engage minimally in social learning activities within NPS on university campuses. This observation is consistent with earlier findings in Malaysia, which point to a focus on formal indoor learning at Malaysian universities and a lack of informal learning opportunities (Ibrahim et al., 2013; Maheran et al., 2017; Salih et al., 2020). This may be attributed to the inadequate design of existing informal spaces on Malaysian campuses, particularly the absence of essential environmental and hardscape features (Zanariah & Norsidah, 2014; Alzamil et al., 2023).

The study further revealed that most students who did not participate in daily social and learning activities were negatively affected by various design factors in the nearby pockets, except noise levels, which positively influenced their experiences. This positive association may stem from the relatively low noise levels in current on-campus pockets. Nevertheless, students must actively use these spaces to gain social, physical, and health benefits (Ibrahim & Fadzil, 2013; Beckers et al., 2016a; 2016b).

Improvements in the design and condition of NPS on Malaysian tropical) university campuses are necessary to enhance students' social learning. This includes integrating diverse design elements, optimizing environmental factors, and ensuring easy access to these spaces.

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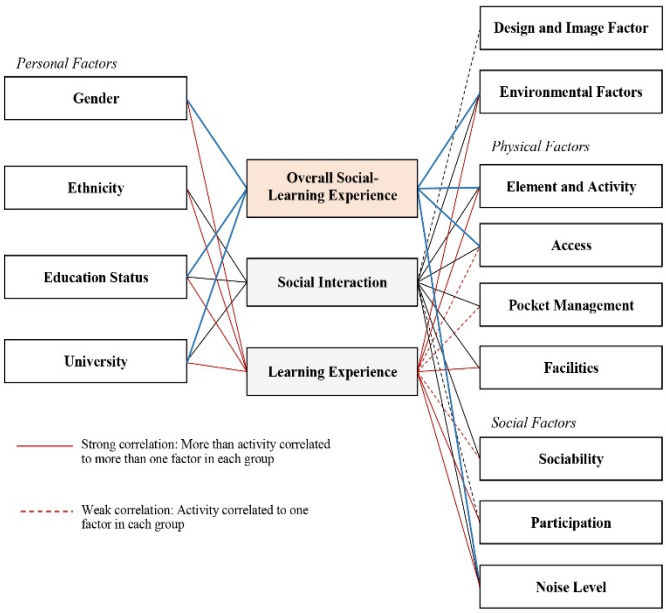

Figure 3. Factors influencing the social learning experience in pocket settingss of Malaysian universities.

The bivariate analysis of the current study revealed that students' individual social and learning activities on campus are influenced by a variety of design, social, and environmental factors. Key factors such as design and image, design elements, environmental factors, access, pockets management, facilities, participation, sociability, and noise level are all found to affect students' social interactions in Malaysian (tropical) universities. Additionally, students' outdoor learning activities are influenced by furniture, environmental factors, proximity, noise level, connectivity, participation, and sociability (refer to Figure 3).

Sociability and environmental factors, including temperature, rain, and shade, are found to have a significant impact on all types of social interaction. Temperature and shade also had a considerable effect on both formal and informal learning activities in nearby pocket spaces in Malaysian (tropical) universities. These findings contribute to the existing literature by confirming that environmental factors, particularly temperature, rain, and shading, are crucial for utilizing nearby social learning spaces, especially in hot and tropical climates (Ramu et al., 2022; Alzamil et al., 2023).

Moreover, previous studies have highlighted that successful pocket spaces should be designed with a range of softscape and hardscape elements, diverse activities, easy access, proper maintenance, safety, and sociability (Nordh et al., 2011; Hunter & Cox, 2014; Thomas et al., 2015; Beckers et al., 2016b; Salih et al., 2020). These factors are confirmed as critical for encouraging social interaction and learning in informal learning spaces.

The findings from the multivariate analysis of this study revealed that students' gender, education status, and university were significant predictors of their social learning experiences in NPS on tropical university campuses (refer to Figure 3). Regarding individual activities, the bivariate analysis highlighted that students' social interaction and formal learning activities are significantly associated with their ethnicity, education status, and university affiliation. Furthermore, informal learning experiences are significantly linked to various demographic factors, including gender, ethnicity, education status, and university. These results suggest that students from different backgrounds experience varying levels of social learning engagement in NPS on tropical university campuses.

This finding aligns with a systematic review by Kerishnan and Maruthaveeran (2021), which indicated that factors such as age, gender, education, and ethnicity might influence students' participation in pocket spaces. On the other hand, a survey study by Salih et al. (2020) found relatively homogeneous social activity across different demographic groups. One possible explanation for these contrasting results could be the cultural diversity of the participants in the current study, which included students from multiple ethnic backgrounds.Regardless of students' individual factors, the study emphasizes that on-campus pocket settings, alongside their design and environmental attributes, play a crucial role in either enhancing or hindering the social learning experience.

The findings of this study highlighted the importance of considering physical, social, environmental, and personal factors when designing nearby pocket settings to enhance students' social learning experiences in Malaysian and tropical university campuses. However, there are a few limitations to this study. Firstly, the sampling selection is based on a stratified judgmental sample, which included 408 respondents from the engineering, architecture, and built environment schools of three public research universities in Malaysia. This sample may not fully represent the broader academic community, so the findings should be interpreted with caution. Secondly, the study focused on four social activities and three learning activities to assess social learning experiences on the tropical campus. However, users of pocket settings likely engage in a wider variety of activities and derive additional benefits, as noted in previous studies (Matthews et al., 2011; Harrop & Turpin, 2013; Mertens et al., 2019; Salih et al., 2020; Harris et al., 2024). Thirdly, the study only considered four demographic characteristics: gender, ethnicity, education status, and university. Existing research suggests that other factors, such as age, income level, and occupation, also influence the use and activities in nearby open spaces (Beckers et al., 2016a; Wang & Han, 2021; Zhang et al., 2022; Kerishnan & Maruthaveeran,

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2021). However, due to practical limitations, these additional factors were not included in this study to avoid overburdening respondents.

Therefore, the study recommends further research that explores the comprehensive relationship between pocket space design, user activities, and demographic variables. Given the central role of nearby pocket settings in students' academic lives, a more holistic approach would provide deeper insights into how these spaces can be optimized to support students' social learning experiences.

Despite the limitations mentioned, the current study makes a valuable contribution to the theoretical framework for designing responsive on-campus pockets that enhance the social learning experiences of the academic community, particularly in Malaysia and tropical regions. The study underscores the significant factors that influence on-campus social learning experiences, offering insights into how the design and environment of these spaces can support student engagement. The findings suggest that university development committees should prioritize creating interactive natural and informal learning environments, such as nearby pocket settings, to foster social interaction and encourage students to connect with nature. By doing so, universities can contribute to a sustainable academic life and support students' overall well-being, both socially and academically.

Conclusion

Pocket spaces are small-scale, low-cost urban spaces that offer nearby communities various social, health, and well-being benefits. In recent years, informal social learning environments, including pocket settings, have become as vital as formal educational spaces to enhance the social learning experience and achieve academic goals. This study highlighted that nearby pocket settings with specific design factors, such as well-planned softscape elements, furniture, sensory elements, easy accessibility, shading, natural light, and protection from extreme weather conditions like high temperature and rain, can significantly enhance students' social learning in tropical campus settings. The extent of students' participation in social learning activities within these pockets may vary based on demographic factors, including gender, ethnicity, education level, and institution. Well-designed on-campus pockets that align with the campus environment and cater to the academic community's needs for social interaction and learning are more effective in delivering multiple benefits. This study underscores the critical design factors of nearby pocket settings on campus and their role in supporting nearby urban sustainable academic communities.

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Appendix 1. Summary of the selected studies in the SLR to design the data collection tool.

No	Refrence	Country	Theme (%)	Objective of the Study	Methodology	Variables	Main Findings
1	(Waxman et al., 2007)	United States	Informal social learning space (ISLS) 100%	To offer practical insights and perspectives on the requirements of college students concerning gathering spaces, community development, and restoration opportunities on campus.	Method: mixed methods: Quanti: observation, questionnaire; Quali: case study Sample: Quanti: N= 44; Qulati: N= 1 case study Case study: Third place in Colorado State University at the US Year: 2006 Sampling: Purposive sample Validation: Multiple sources of evidence	IV: Type of the third place DV: Preferred activity: socialization, relaxation, and restoration	The third place is usually located outside traditional formal learning settings, such as coffee shops and restaurants, designed to enhance socialization, relaxation, enjoying food and drink, getting away from formal learning, and health and restoration.
2	(Donkai et al., 2011)	Japan	ISLS 100%	To assess the current informal learning spaces within university libraries in Japan.	Method: Quanti: questionnaire survey Sample: N= 524 respondents Ages: +19 years old Case study: 755 university libraries in Japan Year: 2010 Sampling: Purposive sampling Validation: Sample selection for external validity	IV: Design of learning commons: (a) the facilities, materials, and services (b) their existing condition (c) the facilities, materials, and service DV: Learning support	Learning commons must be designedaccording to the following criteria: chatting space, student-centred services, group learning room with Wi-Fi access, collaborative space with ICT equipment, and collaborative social learning space with desk and chair.
3	(Matthews et al., 2011)	Australia	ISLS 100%	To expand the student opinion to examine the impact of social learning space (SLS) on their academic experience.	Method: mixed methods: Quanti: observations; Quali: semi-structured interviews Sample: N= 103 students Case study: Social learning space (SLS) in a research university in Australia Year: 2008 Sampling: Purposive sample Validation: Multiple sources of evidence	Exposure: Informal learning spaces. Outcome: Student social learning experience	Social learning space (SLS) must be designed with proper spatial design and planning, such as comfortable furniture, large tables, controlled temperature, open space, eating facilities, and adequate location. SLS is critical for socialization, interaction, and engagement by fostering active learning.
4	(Crook and Mitchell, 2012)	United Kingdom	ISLS 100%	To identify the usage of open social learning space and its role in enhancing a variety of study preferences.	Method: mixed methods: Quanti: fieldwork observation; Quali: focus group discussion (FGD) Sample: Observation: N= All students; FGD: N= 6 groups of 4-6 students + 5 individual students. Ages: +19 years old Case study: Arts and Social Sciences Library in the UK Validation: Multiple sources of evidence	Exposure: "HUB" space: (a) The design aspect of the space (b) The resources of the space Outcome: Experience of students in the social learning "HUB" space	The "Hub" is a social learning space that must be designed with proper spatial design, such as worksurfaces, comfortable furniture, collaborative technologies, enhancing the sense of the 'social' through appropriate design, and enhancing learning with pen and paper or PC. Therefore, the "Hub" is an important social learning space for social qualities, conversational activity, group study, engagement, and active learning.
5	(Harrop and Turpin, 2013)	United Kingdom	ILS 100%	To understand students' behaviours, attitudes, and preferences toward informal social learning spaces in higher education.	Method: mixed methods: Quanti: observational sweeps; quali: coordinate and photographic mapping Sample: N= 240 interviews (two phases) Ages: +19 years old Case study: Sheffield Hallam University in the UK	IV: Informal learning space: Preferred types and design DV: Informal study	Informal learning spaces called learning centres are usually affected by several design factors, including proximity, identity (multiple identities), conversations, shared settings, flexible opening hours, quick access to IT, proper spatial attributes (furniture, lighting,

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					Year: Phase I: 2008-2009; Phase II: 2010 Sampling: Stratified random sampling Validation: Pilot test and Inter-observer reliability		sound levels, tables), access to outdoor spaces, weather (temperature), and availability of food and drink. These spaces are important ILS for quiet study, group study, and access to IT and ICT.
6	(Ibrahim and Fadzil, 2013)	Malaysia	ISLS 100%	To explore students' learning activities and preferred spaces on campus outside classroom hours.	Method: Quanti: questionnaire survey Sample: N= 225 students Case study: a public university in Malaysia Year: 2012 Sampling: Judgmental sample Validation: Sample selection for external validity	IV: Informal learning space: (a) Setting preference and usage b) Physical conditions of the setting DV: Students preference for on-campus activity PV: General profile	The successful design attributes of ISLS contribute to providing various benefits to the academic community and are designed with connectivity, sociability, elements, and design characteristics. ISLS are critical for social interaction, sitting and rest, informal learning activities, and well-being.
7	(Hunter and Cox, 2014)	United Kingdom	ISLS 100%	To explore the usage of informal learning spaces for students studies at the University of Sheffield in the UK.	Method: mixed methods: Quanti: questionnaires, observations; Quali: interviews Sample: Quanti: 174; Quali: N= 3 Case study: University of Sheffield in the UK Year: 2013 Sampling: Random from the case study Validation: Multiple sources of evidence	IV: Informal learning space: preferred DV: Student study and activity PV: Students' demography	The background atmosphere, stimuli, and spatial design greatly influenced the choice of study location in the nearby informal space. However, technological devices were only used sparingly in the ISLS.
8	(Thomas et al., 2015)	United States	ISLS 100%	To understand usage and non-usage patterns of learning commons and reasons for not using the Learning Commons according to students' demographics	Method: Quanti: observation, taking notes, survey Sample: N= 2068 student Case study: Learning Commons, University of Iowa in the US Year: 2014-2015	IV: Learning Commons (space) DV1: Students level of satisfaction DV2: Students demographic characteristics	Factors affecting students' use of the learning commons are location, proximity to the space, and availability of enough furniture (spatial design). Usually, students use the space to use the computer, ICT, and the internet, as well as group learning, co-working, sleep, eating, using the service desk, and waiting between classes.
9	(Beckers et al., 2016a)	Netherlands	ILS (private) 16.7%; ISLS 83.3%	To understand students' preferences for learning space in higher education.	Method: Quanti: questionnaires (survey) Sample: N= 697 respondents Case study: HAN University of Applied Sciences in the Netherlands. Year: March 2015 Sampling: Random from the case study Validation: pilot test; Cronbach's Alpha; factor analysis	DV: Learning space preferences (a) Social dimension of the learning environment (b) Physical dimension of the learning environment IV: Students learning activity	ILS contribute to the outcome of the study activities and collaboration. Different design, behavioural, and social factors affect students' learning space preferences, such as demographic characteristics, type of space, and type of activity. Therefore, space preferences are more related to perceived effectiveness than experience value.
10	(Beckers et al., 2016b)	Netherlands	ILS (private) 16.7%; ISLS 83.3%	To understand the students' learning space choices in relation to their learning activities in higher education.	Method: Mixed methods: Quanti: questionnaire survey; Quali: interviews Sample: Quanti: N= 52 student; Quali: N= 8 Students Age: 17+ years old Case study: Dutch University of Applied Sciences in the Netherlands Year: Quanti: May 2014; Quali: December 2014 Sampling: Purposive sample Validation: Sample selection for external validity	IV: Learning space DV1: Students learning activity DV2: Students' motivation DV3: Students' demographic	Various informal learning spaces replace traditional classroom spaces to support contemporary learning activities. The key factors affecting the usage of ILS and ISLS are noise level, socialisation, availability of food and drink, location of the space, and physical and social characteristics of learning spaces. ILS and ISLS also encourage working individually, in small groups, or in larger groups.
11	(Clement et al., 2018)	United States	ILS 100%	To assess the impact of this informal social learning space on library	Method: Quanti: Survey and observation Sample: N= 138 Case study: Informal learning space (ILS),	IV: Active learning space and its equipment	The key factors affecting the use of ALS are spatial design, such as furniture (standing desk workstations and

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				users' trends and user perceptions.	Australian university Year: April and September 2017 Sampling: Random from the case study Validation: Multiple sources of evidence	DV: User perceptions: studying and health	accompanying tall chairs), stationary bike workstations, treadmill desks and balance-ball chairs. The proper ALS can contribute to mental and physical health and social values.
12	(Sankari et al., 2018)	Finland	ISLS 100%	To determine the need for co-working space as a setting for learning activities from the viewpoint of academic space users.	Method: mixed methods: Quanti: Online survey; Quali: Interviews and FGDs Sample: Survey: N = 124 (35 staff, 89 students) Interview: N= 15 (7 staff members, 8 students) FGDs: N = 5 (2 staff members, 3 students) Ages: 19 to 66 years old Area: Aalto University School of Electrical Engineering (Aalto ELEC), Espoo, Finland. Year: Survey: 2012 Interview: 2013 FGD: 2016 Sampling: Purposive sample Validation: Sample selection for external validity	IV: Informal learning space: Coworking DV: Students preferences and study	ISLS is a co-working space that refers to a multipurpose academic space with attractive and high accessibility. Its criteria are supporting a sense of community by providing local IT services, inspiring and participatory lobbies and hallways, multipurpose spaces for ad hoc collaboration, and easy accessibility to support, participation, and community creation.
13	(Jarocki, 2019)	United States	ISLS 100%	To determine the efficacy of redesigned academic spaces instructional spaces.	Method: Quanti: questionnaire and experimental learning sessions Sample: survey: N= 100 students; experiment: N= 12 article per session Case study: library at San Diego State University in the US Year: 2018	IV: Active learning classroom (ALC) IV2: Traditional computer lab (CL) DV: Student preference	Overall, students have a positive attitude toward ISLS, such as ALS. The ALS is designed for collaborative social group learning; thus, it is preferred for group social learning activities. It also produces more quality learning outcomes than computer labs and traditional classrooms.
14	(Winks et al., 2020)	United Kingdom	ISLS 100%	To examine how campus spaces at a UK university are utilised for peer learning and to understand affordances for innovation and creativity in educational.	Method: mixed methods: Quanti: observation: mapping and drawing spaces; Quali: interview Sample: Quali: N= 12 participents Case study: Public spaces in a UK university Sampling: Purposive sampling Validation: Multiple sources of evidence	Exposure: ISLS design Outcome: innovation and creativity	ISLS, such as public semi-indoor/outdoor spaces, that are designed with aspects of technology, resources, availability, and social aspects are important for interaction, collaboration innovation, and creativity.
15	(Wu et al., 2020)	United Kingdom	ISLS 100%	To compare the spatial openness of different spaces within an atrium in a higher education institution. To understand the students' activities within the spaces of the atrium.	Method: mixed methods: Quanti: observation QGIS; Quali: interview Sample: Quali: N= 15 students Case study: Atrium, University of Nottingham in the UK Year: February, 2018 Sampling: Random from the case study Validation: Pilot study	Exposure: Spatial design of the atrium Outcome: Social informal learning	The Atria space provides high levels of see-and-been activities, enhancing students' social participation. Other Atria activities include phoning, looking around, waiting, gathering, group study, individual study, and eating. Therefore, spatial openness (such as Atria) is an essential learning built environment.
16	(Zhou et al., 2020)	United States	ISLS 100%	To test the relationships between collaborative design outcomes and social interaction among students in different spatial and material contexts.	Method: Quanti: experimental and questionnaire survey Sample: N= 16 Age: 21-37 years old Case study: academic institute, United State Sampling: Purposive sample Validation: Sample selection for external validity	IV: Common space context DV 1: Social interaction dynamics DV 2: Collaboration quality DV 3: Creative fluency	The architecture design and urban planning context of common areas are critically important to perceptions of collaboration, creativity, and participation. The factors affecting the common areas are collaborative design, computer-supported design, and conversation dynamics.
17	(Wang and Han, 2021)	China	ISLS 100%	To identify the preferred learning spaces by students on campuses	Method: Mixed methods: questionnaire survey (online); Quali: focus group discussions (FGDs) Sample: Quanti: N= 178; Quali: N= 5 students	IV: learning space DV: Preferred learning patterns	ISLS highly enhances learning and social activities outside classrooms due to its positive atmosphere, promotion of free talk, socialisation, and food support; this

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				and to determine their spatial characteristics.	Case study: 6 universities in China Year: 2020 Sampling: snowball Validation: validity: pilot test; reliability: Cronbach's alphas	PV: Students' demographic	also depends on users' characteristics and preferences, spatial design, available facilities, noise level, atmosphere, social aspect, and accessibility.
18	(Wu et al., 2021)	United Kingdom	ISLS 100%	To compare the spatial openness of different spaces within an atrium in a higher education institution. To understand the students' activities within the spaces of the atrium.	Method: mixed methods: Quanti: observation QGIS; Quali: interview Sample: Quali: N= 15 students Case study: Atrium, University of Nottingham in the UK Year: February, 2018 Sampling: Random from the case study Validation: Pilot study	Exposure: Spatial design of the atrium Outcome: Social informal learning	The Atria space is affected by several design and urban planning factors, including comfort, flexibility, functionality, spatial hierarchy, openness, and other support facilities. The Atria is important to promote several activities, such as socialisation, phoning, looking around, waiting, gathering, group study, and eating.
19	(Chen et al., 2022)	China	ILS (private) 25%; ISLS 75%	To explore practical optimal design approaches for informal learning spaces in universities and to study the users' perception of these spaces.	Method: Quanti: Visual observation Sample: 11 case study Case study: Southeast University, Nanjing University, China Year: March 2015 Sampling: Random from the case study Validation: Pilot study	IV: Classification of space DV: Preferred spatial elements	The key factors affecting the use of ILS and ISLS spaces are physical space (such as size, enclosure, richness, transparency, and other elements), material and colours, facilities' number, location, accessibility, and combined landscape to create a natural atmosphere.
20	(Lotfy et al., 2022)	Egypt	ILS 100%	To explore the learning spaces at the university library that are appropriate for the architecture students' contemporary learning needs and informal activity.	Method: Quanti: survey and observation (using a checklist) Sample: N= 105 students Case study: academic library spaces in the Faculty of Engineering (FOE), Ain Shams University (ASU), Egypt Sampling: Purposive sample Validation: Pilot study	IV 1: Physical space (informal learning space) IV 1: Other informal learning space on campus DV: Social learning activity outside the scheduled time	The library's key spatial factors of ILS are spatial choices for students' various activities, proximity, availability, sociability, functionality, flexibility, diversity, comfortability, connectivity of its spaces, and accessibility to digital technology. It is also recommended to promote long opening hours, sufficiently flexible and comfortable furniture, social and collaborative working spaces beside the quiet reading area, access to wi-fi, technology, and access to refreshments.
21	(Ramu et al., 2022)	Malaysia	ISLS 100%	To understand the informal learning space preferences for learners' informal learning activities.	Method: Quanti: questionnaire survey Sample: N= 1,079 students Case study: three polytechnics, namely, Ungku Omar Polytechnic (PUO), Sultan Abdul Halim Muadzam Shah Polytechnic (POLIMAS) and Seberang Prai Polytechnic (PSP) in Malaysia. Sampling: Multistage probability sampling Validation: Pilot test, review by three expert reviewers, standardized factor loading and Cronbach's alpha	IV: Informal academic learning space DV 1: Social variable DV 2: Physical variable	Overall, students prefer ISLS that are semi-outdoor and connected to nature, which contributes to collaborative learning, social interaction, group work and gatherings, and informal learning.
22	Ng et al. (2022)	Malaysia	ISLS 100%	To test how the design qualities of informal shared spaces can facilitate learning and cultivate a sense of community.	Method: Quanti: observation and behaviour mapping Case study: 9 shared spaces in Tay-lor's University Lakeside Campus, Malaysia Year: 2020 Validation: Pilot study	IV: ISLS DV1: Sense of community DV2: Users in-formal learning on campus grounds	It is critical to provide proper shared space on campuses for the interplay between the individual (student), the environ-ment, and their behaviour. The space should be de-signed with its intended purpose, striking a balance between structured and unstructured activities and promoting a sense of belonging to nurture a strong sense of communi-ty.
23	(Zhang et al., 2022)	Australia	ISLS 100%	To examine privacy and interaction preferences in the social dimension of	Method: Quanti: Questionnaires survey Sample: N= 219 Case study: Informal learning space (ILS),	IV: Spatial configuration of informal learning	Students with different characteristics have different needs for privacy and interaction spaces. Besides, the spatial

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				learning and to understand how spatial configuration affects students' choices of learning spaces.	Australian university Year: May to October 2019 Sampling: Random from the case study	spaces DV: Privacy and interaction preferences about the social dimension PV: Participants' individual characteristics	configuration of the space affects students' choices of learning spaces. Usually, students prefer private spaces for privacy and being alone. However, public informal learning spaces are typically used for social, collaborative activity and being together.
24	(Alzamil et al., 2023)	Malaysia	ISLS 100%	To highlight the factors of nearby (sustainable) pockets affecting social learning experiences on tropical campuses.	Method: Quanti: verbal-visual preference survey Sample: N= 408 respondents Age: 20+ Case study: Three informal social learning pockets, public universities, Malaysia Year: March 2015 Sampling: stratified judgmental sample Validation: Validity: Content Validity Index (CVI); Relibitiy: Pilot study and internal consistency reliability.	IV: Design of pocket settings DV: Social learning activities on-campus grounds PV: Students' demographic variables	Pocket setting is ISLS that might be affected by several spatial design and urban factors, including elements and activities, natural environment factors, perceived environment factors, and social factors. Personal social factors such as students' demographics (education and university affiliation) influence social learning experience and students' usage of pocket settings.
25	(Kansal and Bassi, 2023)	India	ISLS 100%	To identify the change required in formal and informal learning spaces in architecture schools to accommodate new learning and skills in Architecture Education.	Method: Mixed methods: Quanti: survey; Quali: interviews Sample: Quanti: N= 105 students; Quali: N= 75 teachers. Ages: +19 years old Case study: four architectural institutions in North India Year: 2020 Sampling: Random from the case studies Validation: Multiple sources of evidence	IV: Learning spaces: preferred space (studio space, informal space, library, computer lab, and cafeteria spaces) DV: Preferred for students activities	There is an equal need for both formal and informal learning spaces to enhance students' various needs and activities, and these spaces must incorporate three factors: flexibility, integration of technology, and interactive social spaces. Overall, students prefer gathering spaces for socialisation, transformation spaces between formal spaces, learning commons, and outdoor spaces for interaction.
26	(Salih et al., 2023)	Malaysia	ISLS 100%	To highlight the preferred aspects of pocket settings on campus grounds to enhance students' social learning experience in a tropical context.	Method: Quanti: verbal-visual preference survey Sample: N= 408 respondents Age: 20+ Case study: Three informal social learning pockets, public universities, Malaysia Year: March 2015 Sampling: stratified judgmental sample Validation: Validity: Content Validity Index (CVI); Relibitiy: pilot study and internal consistency reliability.	IV: Design of pocket settings DV: Social learning activities on-campus grounds PV: Students' demographic variables	Pocket setting on campus ground is affected by design and urban factors, such as sustainable shading structure and different types of softscape and hardscapes. Personal social factors such as demographics affect students' preferences for pocket space.
27	(Yau et al., 2023)	Hong Kong	ILS (private) 25%; ISLS 75%	To explore students' usage patterns of different informal learning spaces on campuses.	Method: mixed-method: Quali: interview and FGD; Quanti: survey Sample: Quali: N= 10 interview; N= 4 FGDs with N=6 students each; Quanti: N= 999 student Case study: Informal learning space in a university in Hong Kong Year: October, 2018 Validation: Multiple sources of evidence	IV: informal learning space (ILS) DV: Students' use and satisfaction PV: Students' demographic	The main activities in the ILS and ISLS include learning and study, group discussion and study, waiting for class, rest, refreshment, socialisation, and relaxation. The factors affecting the spatial design of these spaces are ICT and IT facilities and charging stations, comfortable furniture and flexible usage, certain noise levels, management and maintenance, location, and access to food and drink.
28	(Zhang et al., 2023)	Australia	ISLS 100%	To explore students' sound environment perceptions based on their characteristics and	Method: Quanti: questionnaire survey Sample: N= 219 students Case study: Informal learning spaces (ILSs), university campus in Australia	IV: Informal learning spaces (ILSs) DV: Sound environment	Sound level affects students' activity and activity type in the informal learning spaces, which is also affected by students' characteristics and tasks. Students'

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				preferences for the type of ILS.	Sampling: Random from the case study Validation: Pilot test: validity: factor loadings; reliability: Cronbach's alpha	perceptions and sound environment sensitivities	sensitivities to the sound environment play a vital role in their spatial choices; for example, those less sensitive to sound environments prefer to choose more active ISLS.
29	(Harris et al., 2024)	United States	ISLS 100%	To evaluate informal learning spaces based on students' usage of the space and the space features.	Method: Mixed methods: Quanti: heatmap camera technology; Quali: a semi-structured interview Sample: Quali: N= 1 participant; Quanti: observation of the space for 24h/9 days Case study: Student Technology Center (STC) at a public research university in the US Year: September, 2022 Validation: Multiple sources of evidence	Exposure: STC underutilization Outcome: Students' purposes for using the STC	Students' use of the ISLS is limited due to the location on campus grounds and circumstances surrounding students' day-to-day schedules and needs. Yet, the ISLS is critical for students' collaboration, interaction, informal study, and other activities and events.

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