

Developing a Taxonomy of Informal Learning Space

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Received: September 17, 2021 Accepted: October 20, 2021 Published: November 12, 2021

doi:10.5296/ije.v13i4.19016 URL: <https://doi.org/10.5296/ije.v13i4.19016>

Abstract

The move from traditional teaching-centred approach to student-centred approach has resulted in more student collaboration outside classroom, contributing to the growing importance of information learning space (ILS). Review of recent literature suggests the ILS research agenda is at an initial stage of development, without convergence in research methods and lacks theoretical underpinning. Research studies were conducted on a piece meal basis, lacking comparability and generalization. Using a mixed-method approach, this study contributes to ILS knowledge by introducing a qualitative methodology based on concept mapping and sorting for idea generation; to develop a taxonomy of four user-generated ILS types from a portfolio of 38 ILS sites on campus. This is followed by quantitative validation using seven ILS sites to evaluate satisfaction and usage behaviour. Drawing from middle range theory and the ILS taxonomy, practical design principles are proposed based on functionalities and features for the four ILS types. The learnings can be shared with designers, policy makers and different institutions to facilitate knowledge transfer, which contributes to generalization of learnings and theory building.

Keywords: informal learning space, learning space development, concept mapping, higher education, middle range theory

1. Introduction

Informal learning space (ILS) is defined as spaces for self-directed learning activities outside classroom environment (Harrop & Turpin, 2013). Over the last few decades, there has been a move from traditional teaching-centred approach, which emphasizes one-way information dissemination; to a student-centred approach whereby knowledge is socially constructed by students working together and collaborating, with an emphasis on critical thinking and solving practical problems (Cunningham & Walton, 2016). This requires students spending more time outside classrooms for individual and collaborative work. The provision of ILS is important because only one-fifth of college students' time is spent in the classroom, with the majority of their time learning in informal settings (Matthews, Andrews & Adams, 2011).

With the advent of technology and a new generation of millennials' learning style (Yoo-Lee, Heon Lee & Velez, 2013), two broad lines of research in learning and teaching have evolved. The first line of research explores informal learning, which is a complex web of relationships based on experiences gained from a wide range of environments (Jamieson, 2013; Malcolm, Hodgkinson & Colley, 2003; Cox, 2018). This is where students work collaboratively to construct knowledge (Malcolm, Hodgkinson & Colley, 2003). The second line of research investigates ILS, which is the focus of this paper (Harrop & Turpin, 2013; Berman, 2020).

Generally, it has been claimed that more learning takes place in ILS than in classrooms (Brown & Lippincott, 2003), and hence, this provides support for more ILS investments. However, given physical space tends to stay for a long time, ideally, we should adopt evidence-based evaluation to justify investment and optimize learner experiences (Deed & Alterator, 2017). In reality, students and staff rarely have the opportunities to provide input to facility design, and discussions of learning space tend to be *ex post facto* (Jamieson et al., 2000). Often, university ILS are developed without a particular purpose, and an institutional estate policy for developing ILS is an exception rather than the rule (Walton & Matthews, 2013).

Despite its importance, ILS is an under-researched topic (Temple, 2008). A common pitfall in education spaces research is the focus on outcomes rather than processes, probably a result of the bias towards quantitative measures (Berman, 2020). Recently, there has been attempts for more rigorous methods to make explicit connection between pedagogy and space. These include studies on new generation learning environments in secondary school setting, using methodologies such as quasi-experiment observations, interviews and focus groups (Byers, 2016; Rose-Munro, 2016). Within higher education, given the nature and state of ILS development, most studies are case-specific in nature.

Berman (2020) conducted a critical review of ILS and noted many insights have been gained from schools as opposed to higher education. She noted a tendency for ILS work to be treated in a romanticised and overdetermined way. Given the multidimensionality of ILS, clearer definitions are needed for a taxonomy of learning space. Before ILS can be systematically examined, we need to properly define "ILS types", and understand how "ILS types" differ in terms of perception and user behaviour. The goal is to help understand how to design ILS, by measuring the learning experiences that happen in each ILS type. A base understanding in the classification and definition of ILS types is a first step in the theory building process, which

helps move from a descriptive, to predictive, and finally a prescriptive level of understanding (Imms, Cleveland & Fisher, 2016).

In this study, the research objective is to identify and generate different ILS types and understand respective user perception and behaviours; by introducing a qualitative methodology using conceptual mapping and sorting, to develop a taxonomy of ILS types from the portfolio of ILS in a university. This is followed by quantitative validation to enrich our understanding for each ILS type in terms of usage behaviour, frequency of use and satisfaction. The findings will also inform us on the do's and don'ts in ILS development.

2. Literature Review

2.1 Studies Related to Libraries

Several studies focused on ILS within libraries, given they are common and important venue for informal learning and their evolving role. As libraries have massive experience in developing learning spaces, they should extend their reach via collaboration with other departments on campus (Walton & Matthews, 2013). Using the National Survey of Student Engagement inventory, Matthews, Adams and Gannaway (2009) explored the impact of three social learning spaces (including a library) on student experience and suggested ILS usage has positive correlation with increased levels of student engagement. Ramsden (2011), using a mixed-method approach, suggested library staff should provide guidance on how a particular space or furniture should be used. Students mostly use internet, followed by physical or e-resources; and they prefer to occupy individual learning as opposed to group and silent areas.

Cunningham and Walton (2016) explored five ILS within the library and nine other ILS on campus, including IT labs, converted general learning areas and student halls. The study suggested more cross-campus collaboration between university stakeholders to look at ILS needs more holistically, and besides furniture, provide mobile technology support. Cox (2018) investigated students' experience of ILS by interviewing library staff and students; and conducted focus groups with students. The participants had a strong feeling for sensory possibilities, and indicated that light, visibility, temperature, air quality, cleanliness and décor, impact how they learned. Seeing others working helps students concentrate, and a silent room provides pressure. The library is a favourite venue due to companionship with friends. The study suggested design must be flexible, in order to accommodate social interactions and activities, including intense revision, reading, quiet consultations, group work and socialising.

2.2 Studies Related to Single ILS or ILS in General

Several studies focused on development or evaluation of a single ILS, or ILS in general. Lam, Fox and Ho (2009) evaluated a single ILS in a university, based on observation and brief interviews. Anecdotal findings in improvements include adding facilities, such as toilet and vending machines, and the separation of quiet and discussion areas. Suggestions include the addition of furniture, better temperature control, and increasing the awareness of the ILS space. Kumar and Bhatt (2015) found the majority of students use ILS for academic purpose, and

library plays an important role. Chang, Stern, Sondergaard and Hadgraft (2009) conducted surveys with engineering students, and found slightly over half of the respondents agreed that ILS availability would result in more frequent informal and collaborative learning. Close to half of the respondents agreed they used ILS for socialising and collaborative learning.

Some authors used a more interpretive approach. Describing the intervention of a new staff-student shared ILS which includes staff offices and open learning space for students, Waldock, Rowlett, Cornock, Robinson and Bartholomew (2017) used open-ended questions to identify immediate benefits for staff and students. These include improved availability of staff, developing a learning community and facilitating work. Based on observations, computer stations were the most popular, while group working spaces were popular towards the end of the term. Interviews with students suggested students who were actively involved in the design of the space showed increased motivation in usage. This is consistent with the findings of Morieson, Murray, Wilson, Clarke and Lucas (2018) in ILS refurbishment, where they used a co-creation approach to improve engagement and sense of belonging. The action research resulted in a Belonging Narrative Model, with tiered student experience in the three years: develop a sense of belonging, extend to broader interdisciplinary community, and disciplinary and professional gaze to encompass global perspective.

Others attempted to use frameworks to organize the analyses. Riddle and Souter (2012) described how a university converted under-utilized spaces as ILS. Prior to the renovation, 19 students recorded their experience in ILS using paper diary and a camera; focus groups were also conducted. Their experiences suggested lack of library space, insufficient computer access or comfortable private study spaces in the library. The space conversion applied seven key design principles based on outputs from a national project, Spaces for Knowledge Generation (Souter, Riddle, Keppell & Sellers, 2011). These include comfort, aesthetics, flow, equity, blending, affordances and repurposing. Premised upon learning theory, place making and architecture, and employing a mixed-method approach using observational sweeps and photographic mapping exercise, Harrop and Turpin (2013) developed a typology of learning space preferences. The typology includes nine attributes for ILS planning or evaluation: destination, identity, conversations, community, retreat, timely, human factors, resources and refreshment. Localized factors need to be applied, as space design are contingent upon specific learning preferences.

2.3 Studies Related to Multiple ILS with Comparisons

Ibrahim and Fedzil (2013) conducted a survey of 225 university students to identify ILS usage and preferences from a common study room, library common areas, cafeteria, designated study room and partially enclosed learning space between buildings. Cafeteria is the most used with open spaces in-between buildings being least used. Individual learning activities are most frequent, with team discussions being least frequent. Other activities include computer assisted learning, networking and socialising. The study suggested the need for a campus environment that supports individual and collaborative learning. Later, Ibrahim, Fadzil and Saruwono (2018) used walk-through technique to observe whether the existing design can support current learning needs. The findings suggested air-conditioned indoor environment is conducive to

private and group learning. While informal learning is possible in outdoor spaces, provision of seats limits the number and flexibility in group work, whereby screens and whiteboards are essential. Essential technology infrastructure includes computers, screens and printers. The learning environment should allow students to feel a sense of individuality and identity to entice usage.

Investigating three ILS, an open space and two cafés, Hunter and Cox (2014) employed a mixed research design, which included a student survey, on-site observations, and interviews with managing staff. 38% of students use ILS: campers who use the place for long hours as the main study base, some students come between classes, and others work there alone or with friends. Café atmosphere is preferred given it is relaxed. Access to technology support is essential. Sheltered locations, flexible furniture, and the ability to spread their belongings are conducive to an informal atmosphere. The Model of Zengagement was developed to help explain the creation of right atmosphere, whereby students who are in a relaxed frame of mind while being engaged in the background surroundings, would motivate their studies with sense of a personal zone.

2.4 Gaps Identified from Research

The review suggests the research agenda is in an initial developmental stage, without convergence in methods and lacks theoretical underpinning. The general consensus is that ILS usage would result in higher engagement in learning (Matthews et al., 2011; Chang et al., 2009). While students see the library as a destination, they select various ILS, depending on individual versus group setting (e.g., self-study, group study or group discussions). Given library is a well-researched topic, we shall focus on other ILS in this study. Perception on the environment and learning process determines how students behave, form a habit and use ILS (Harrop & Turpin, 2013). Students also use ILS for different use occasions, whether they are a home base, for self-study, group discussions or socialization. ILS allows working alongside, serendipitous meetings, splitting and re-joining (Harrop & Turpin, 2013). This implies the design must be flexible, in order to accommodate different work and discussion, with furniture being regrouped for different purposes. Sensory possibilities to consider include lighting, visibility, temperature and cleanliness (Cox, 2018). The endpoint is to create the right atmosphere for students to better focus and offer flexibility for multiple use occasions (Hunter & Cox, 2014). These entail basic functional support such as air conditioning and technology (Ibrahim et al., 2018) or individual and collaborative learning environments (Ibrahim & Fedzil, 2013). Hence, there is a need to develop a portfolio of interrelated ILS that offers various functionalities and features (Harrop & Turpin, 2013). As well, research suggests early user involvement in the design process would help increase usage in the completed ILS (Waldock, 2017; Morieson, 2018).

However, research findings are inconsistent. For example, in one study, students prefer individual learning areas (Ramsden, 2011), but in another, a quiet environment is preferred, with slightly different findings from different ILS classifications (Cunningham & Walton, 2016) and survey instruments employed. Another reason relates to the contextualization of case studies, with findings from one setting not being applicable to another. Still, there is a lack of

theoretical underpinning. For example, Ramsden (2011) re-categorized ILS areas into silent, group and individual, which begs the question of the potential overlap between “silent” and “individual” space, making it difficult to have apple-to-apple comparison with other research studies. Where Cunningham and Walton (2016) collected data for ILS across a university, there was no side-by-side comparison of ILS, and the focus was confined to comparison between library ILS versus other ILS. Berman (2020) called for more creative qualitative work in drawing insights and learning ILS. Only a handful of studies has attempted to investigate ILS planning or evaluation using a framework (Riddle & Souter, 2012; Harrop & Turpin, 2013; Hunter & Cox, 2014). Given the differences in methodology and definitions, one urgent task is to develop a generic definition of ILS types, and understand user perception and behaviour with each ILS type. This is the starting point of theory building.

A theory is a statement of relationships between concepts observed in the empirical world. Paraphrasing Hempel (1965), Bacharach (1989) noted science serves two functions: to adequately describe events or objects under investigation, and to establish theories whereby the events or objects can be explained and predicted. There are different levels of theory. Grand theory refers to high-level conceptual articulation, providing general understanding of a broad range of phenomena. Coined by Merton (1968), middle range theories (MRT) are below the level of grand theories, but above empirical generalizations framed as hypotheses (Liehr & Smith, 2017; Graighead, Ketchen & Cheng, 2016). MRT constructs are closer to concrete observables, easier to operationalize, have higher level of parsimony and better contextualization. These enable a bottom up, data-driven approach. For an applied research topic such as ILS, MRT in specific ILS types results in propositions that provide guidance on ILS design, through functionalities and features desired based on identified student needs. Hence, a first step toward proposition development is to develop a taxonomy of user-generated ILS type.

3. Methodology

To address the research objectives, a mixed-method approach was employed. In Phase 1, qualitative in-depth interviews and focus groups were conducted to generate ideas and input for ILS categorization, identify use occasions and unmet needs, resulting in four ILS types. This was followed by quantitative validation in Phase 2, to examine usage behaviour, frequency, time spent, and satisfaction for each ILS type. Using The Hong Kong Polytechnic University (PolyU) as the study context, fieldwork was completed at the end of 2018. PolyU is an urban campus, occupying a 9.46-hectare site. In the 2018/2019 academic year, 25,827 students registered, with 79.2% full-time and 20.8% part-time enrolment. The campus offers comprehensive facilities, such as interactive classrooms, laboratories, and other academic buildings and facilities.

3.1 Phase 1 Qualitative Study: Concept Mapping and Sorting Exercise

Phase 1 entailed ten individual in-depth interviews (25 to 50 minutes each), and four focus groups for up to eight participants (52.5 to 82 minutes each), conducted with undergraduate

students. The students were recruited via the University mass emailing effort, under the banner of the Working Group on Innovative Learning Spaces. All interviews were digitally recorded and transcribed for content analysis.

A concept mapping (CM) and sorting exercise was conducted as part of the interviews and focus groups. Individual interviews allow in-depth conversation to explore the perception of and underlying reasons for using the different categories of ILS, while focus groups allow more opportunities to brainstorm based on participants' interaction with others. The objectives of this phase are to: (a) categorize different types of ILS empirically based on a user-driven approach; (b) understand the drivers of categorization; (c) generate a list of usage occasions; and (d) discover any unmet needs and recommendations. The discussions were semi-structured, with planned activity flow as follows:

1. Detailing a typical weekday showing the specific routing and movement around campus.
2. Identifying most frequent and least frequent hangout places outside classroom.
3. Mapping exercise using ILS images.
4. Sorting usage occasions to ILS types.
5. Discovering unmet needs.

CM and sorting exercise was drawn from the theories of classification (Niknazar & Bourgault, 2017), whereby each classification represents a rationale (i.e., a theory) for classification and is domain-specific; and each domain develops its own rules on how objects are grouped. The theories of classification were pioneered in the fields of biology and natural sciences in classifying species, in that the rules on how species are classified are theories in themselves. There are also applications in organization sciences and manufacturing systems (McCarthy & Ridgway, 2000). The classifier's purpose determines a particular classification's value, and the method for classification is dependent upon the classifier's perspectives. For example, if an ILS were classified by its openness and being outdoor, the notion of openness and fresh air must be of some value to the classifier. Concepts and categories are formed in the human mind, and entities are included or excluded based on the cognitive process of classification (Niknazar & Bourgault, 2017).

To elicit respondents' cognitive process of classification in ILS types, a CM process was designed. Anchored in activation theory and network model of memory, CM has been widely used in marketing, education and counselling research (Joiner, 1998; Novak & Gowin, 1984). CM as a qualitative methodology assumes once a structure is activated, a respondent should be able to explain the majority of the structure content. The concept is revealed through the thinking process, as well as relationships between concepts that are being described (Joiner, 1998). This allows the respondent to go through a mind mapping process, which is unconstrained and of free form and, with simple associations (Davies, 2011).

First, respondents were presented with ILS photo images, and asked to group similar ILS into 3 to 5 categories. Twenty-eight A5-size laminated ILS photos were laid out on the table, selected from 38 known ILS on campus, eliminating highly similar images. Each ILS site was

assigned a number. Participants were asked to not group ILS images based on their knowledge of the location proximity, to avoid output being influenced by locales. No other grouping criterion was given to avoid priming the participants.

Second, respondents were presented with sorting cards of ten usage occasions (or purposes), which were developed a priori based on literature review, and were asked to identify the top 3 user occasions for each ILS group. New occasions identified by participants were added to the list, which resulted in 13 usage occasions. Respondents were asked to provide rationale for grouping the ILS into each ILS type, and how and why they would use the ILS (Figure 1). This is based on the premise that how a person perceives the ILS would result in their associated behaviour (Harrop & Turpin, 2013).

An Excel sheet was developed to capture the groupings from each respondent, which contains key information for the ILS type. For example, in Figure 2a, respondent 1 generated five ILS groups, represented by 1.1, to 1.5. For ILS type 1.1, the identified ILS sites are ILS1, ILS2 and ILS9 (marked with “x”), with the top usage occasion as (a), followed by (f) and (g). After the exercise, rows in the Excel sheet with similar patterns were placed adjacent to each other, forming similar clusters (see Figure 2b). Altogether four distinct ILS types were generated.

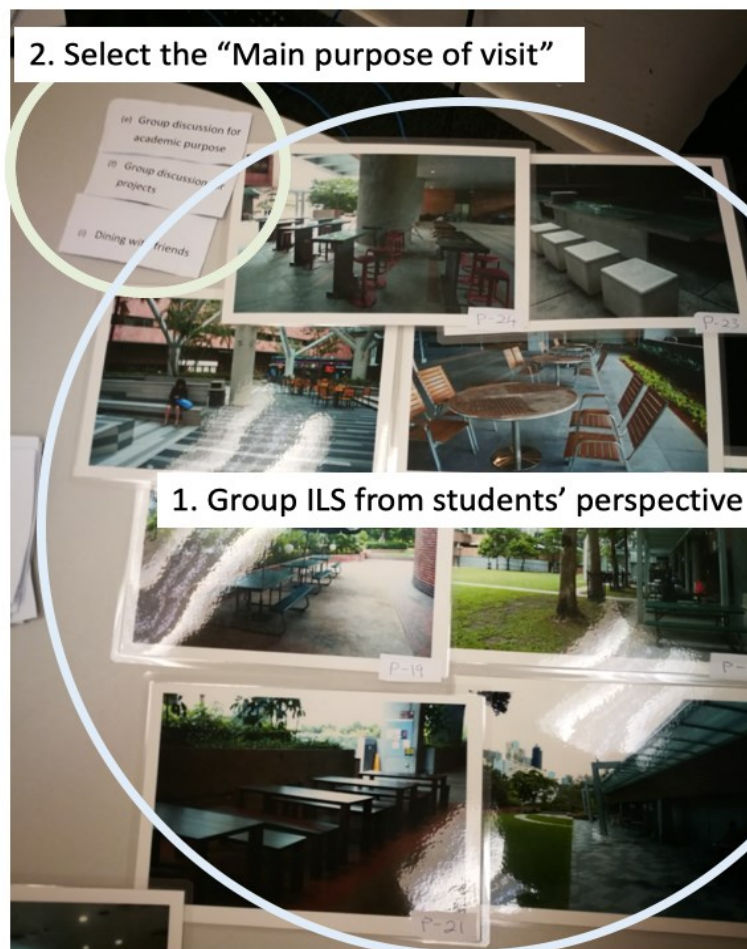


Figure 1. Concept Mapping and Sorting Exercise

		ILS Photos										
P	Reason of grouping		1	2	3	4	5	6	7	8	9	10
1.1	Next to classroom, above podium	a f, g	x	x							x	
1.2	Middle of main campus, outdoor podium	h k, l										
1.3	Above communal building	a c, j								x		
1.4	X, Y, Z core	k l, h			x				x			x
1.5	Others	l a, j				x	x					
4.1	Less familiar, simple and basic setup	g j, h										x
4.2	Outdoor, can eat, no charging, heat	i g, h							x			
4.3	Private, focused, newer, can talk	a b, c	x	x						x	x	
4.4	R & R	i d, k			x	x	x	x				
5.1	Temperature not too cold, tables, outdoors	a j, h								x	x	
5.2	Not more than 20 min, R & R, lower table	k d, j			x	x	x	x				x
5.3	Most not likely to go, lots of traffic	f c, e	x	x					x			
6.1	Outdoor common area, noisy, eat, restaurants	i j, k							x			
6.2	Indoor quieter area, studying, light group discuss	c a, f	x	x								x
6.3	Indoor R & R, socialize	d a, j			x	x	x	x		x	x	
7.1	Productive group projects and discussions	f a, c	x	x						x		
7.2	Less efficiency, noise, distraction, smell	d k, l			x	x	x	x	x			
7.3	Study, quiet, nature (trees and grass)	a d, h		x						x	x	x
LEGEND												
a	Self-study	g	Group discussion for innovative collaboration									
b	Study with boyfriend / girlfriend	h	Dining alone									
c	Study with friends	i	Dining with friends									
d	Socializing with friends	j	Waiting for class									
e	Group discussion for academic purpose	k	Waiting for friends									
f	Group discussion for projects	l	Others please specify									

Figure 2a. ILS Types Concept Mapping and Sorting (Raw Data)

Example: Outdoor ILS		ILS Photos										
P	Reason of grouping		7	12	15	16	17	19	21	23	24	26
4.2	Outdoor, can eat, no charging, heat	i g, h	x	x	x	x	x	x	x	x	x	x
6.1	Outdoor common area, noisy, eat, restaurants	i j, k	x	x	x	x	x	x	x	x	x	
8.2	Outdoor, break, eating, socializing	i d, h	x	x	x	x		x	x	x	x	x
9.2	Outdoor	d a, k	x	x	x	x	x	x	x	x	x	x
10.3	Outdoor	h d, k	x	x	x	x	x	x	x	x	x	x
11.2	Outdoor	e f, i		x	x	x		x	x	x	x	x
LEGEND												
a	Self-study	g	Group discussion for innovative collaboration									
b	Study with boyfriend / girlfriend	h	Dining alone									
c	Study with friends	i	Dining with friends									
d	Socializing with friends	j	Waiting for class									
e	Group discussion for academic purpose	k	Waiting for friends									
f	Group discussion for projects	l	Others please specify									

Figure 2b. ILS Types Concept Mapping and Sorting (Regrouped Data)

3.2 Phase 2 Quantitative on-Site Evaluation Study

Based on the four ILS types generated, seven sites were selected for on-site evaluation survey. Sites selected were not too close to each other to avoid proximity bias. Although there are more outdoor and sofa ILS on campus, one site was selected for each type given the transient usage

learned in Phase 1 and the designs are quite homogenous. For Indoor (quiet) and Indoor (talking allowed), multiple sites were selected to account for potential variation within each type. Student helpers were recruited to execute the study through face-to-face survey. Ten pilot surveys were conducted as part of the training. A target sample of 75 was set across the three-day parts per site (09:00-11:59; 12:00-14:59; 15:00-17:59). Fieldwork ran for four weeks (weekdays only) and concluded on December 6, 2018, when respondents dwindled due to final exam period. Students were approached to evaluate the ILS they were visiting. A systematic procedure was used by choosing every third person encountered, except when a site was not frequented by many users, then everyone at the site was selected.

Survey questions include frequency of visit, purpose of visit (usage occasion), length of stay, satisfaction and contact information. One open-ended question was added to solicit improvement suggestions for the ILS site. Each self-completion survey lasts no more than ten minutes using a mobile device.

4. Research Findings

4.1 Qualitative Findings for ILS Types

Four ILS types were generated from 28 images. Applying the same classification to the 38 sites on campus resulted in: 2 Indoor (quiet), 9 Indoor (talking allowed), 20 Outdoor, and 7 Indoor (sofa) sites (Figure 3) (Table 1).



Figure 3. Derived ILS Types

Table 1. ILS Types Distribution

ILS types	Count	Percent
Indoor (quiet)	2	5.2%
Indoor (talking allowed)	9	23.7%
Outdoor	20	52.6%
Indoor (sofa)	7	18.4%
Total	38	100%

4.1.1 Indoor (quiet) ILS

The quiet setting, particularly with full or semi-partitions, helps one to be more focused. This also provides some level of sound block and physical barrier, allowing the privacy needed. Access to electric charging station is expected. Despite the quiet nature, some respondents would gather in small groups.

4.1.2 Indoor (talking allowed) ILS

Areas that are more open, with flexible tables and chairs for (re)grouping would induce group discussions with an acceptable noise level. Respondents would use this ILS type for both group and individual work. Sometimes, some level of white noise would actually be motivating, given that others are working nearby, and they should do the same. The décor could be designed to help creativity and collaboration, while access to computers and printing facilities would benefit. Large windows, natural light and green plants provide a sense of openness and relaxation.

4.1.3 Outdoor ILS

While Outdoor ILS gives a sense of openness, it is not weather protected. The hot and humid summers and unpredictable spring rains discourage students to stay. For areas close to foodservice outlets, students would naturally use them for dining. It would be difficult to have prolonged discussions, as one cannot layout documents for work. As such, Outdoor ILS are more for eating, socialization and waiting for someone or for class, reflecting its transient nature.

4.1.4 Indoor (sofa) ILS

Indoor (sofa) ILS is unique and becomes a category on its own. Sofa has a connotation of being comfortable. Without a table or desk, sofa area provides a relaxing atmosphere where one would unwind, socialize or wait for classes. Serious work is rarely done. Sofas with lower height are not conducive for formal work. This makes the use occasion transient in nature.

4.2 Quantitative Onsite Evaluation Study

The on-site survey generated 439 valid responses. 4 of the 7 surveyed sites reached the target sample size of 75 or above (Table 2). However, a sample size of 30 or above was considered acceptable (Shavelson, 1996, p.255).

Table 2. Achieved Responses for Each ILS

ILS types	Indoor (Quiet)		Indoor (Talking Allowed)			Outdoor	Sofas
On-site survey location (ILS code)	ILS 28	ILS 25	ILS 2	ILS 8	ILS 10	ILS 24	ILS18
Sample Size (n=439)	45	81	77	45	76	75	40

Year 1 students (Freshmen) account for the biggest share (27.1%), while Year 2 students (Sophomores) account for 22.8% as the minority. Year 3 (Juniors) (24.8%) and Year 4 or above (Seniors) (23.5%) students each contribute close to one-quarter of this sample. Close to 2% of the respondents did not report their year of study.

4.3 Usage Behaviour by ILS Types

4.3.1 Indoor (quiet) ILS

Self-study is the most frequent reason for visit (50 to 70%), followed by waiting for classes, studying with friends, or taking a rest. Given there is no signage for “keep quiet”, a small number of students (less than 7%) also have group discussions there (Table 3). As self-study is the main reason for visit, over three-quarters of respondents (Table 4) visit once a week or more. Besides, nearly 60% of students stay for at least an hour. The routine nature and relatively longer time spent imply a need for higher level of comfort. The top 3 suggested improvements based on open-ended comments are more seats (28.6%), more charging stations (16.7%) and printers (10.7%).

4.3.2 Indoor (talking allowed)

For Indoor (talking allowed) ILS, about one-third of students (Table 3) use the ILS to wait for class, although self-study and studying with friends are quite common. In general, over two-thirds of respondents (Table 4) visit once a week or more, with relatively shorter duration. Less than half of the respondents stay there for over an hour, while most spend between 30 – 60 minutes. This may reflect the waiting-for-class purpose as many gaps between lessons are less than an hour. Top 3 improvement suggestions include more seats (24.1%), more tables and desks (16.8%) and more partitions to block out noises (12.4%).

4.3.3 Outdoor ILS

For Outdoor ILS, dining alone or with friends constitutes over half of the purposes (Table 3). Over a quarter of the purposes relate to waiting (for class or for friends). Over half of the users (Table 4) go there once a week or more, while close to half use this ILS type less than once or twice a month, reflecting polarized usage pattern. Students do not stay for long, demonstrating the transient usage occasions. The physical structure also discourages long stay and is more conducive to activities such as having a quick bite. Top improvement suggestions include better and more frequent cleaning (28.3%), reducing noise (19.6%) and comfort of chairs (13%).

4.3.4 Indoor (sofa) ILS

Waiting for friends or class (40% combined) is the most common purpose, although some students use them for self-study (15%), or for resting (12.5%) and socialising (10%). Users tend to visit less often, as almost 40% (Table 4) visits less than once a month. Nearly half of the respondents stay for 30 minutes or less, reflecting the transient nature and limited provision of sofa ILS. Top 3 improvement suggestions include more tables (28.6%), more chargers (17.9%) and more sofas (17.9%).

To conclude, each ILS type serves different purposes, although self-study seems to be more popular, revealing the general pain point of insufficient study places on campus. Students tend to use indoor ILS more often than outdoor, possibly due to shelter and comfort. As a result, they spend more time in Indoor (quiet) and Indoor (talking allowed) ILS. This is likely due to the usage occasions, comfort or the location itself.

Table 3. Main Purposes (usage occasions) at Each ILS Site

ILS types	Indoor (Quiet)		Indoor (Talking allowed)			Outdoor	Sofas
On-site survey locations (ILS code)	ILS 28	ILS 25	ILS 2	ILS 8	ILS 10	ILS 24	ILS18
Sample Size (n=439)	45	81	77	45	76	75	40
Main Purpose (Top 5)	Self-study (71.1%)	Self-Study (50.6%)	Waiting for class (29.9%)	Self-Study (28.90%) Group discussion for non-academic projects (15.6%) Study with friends (11.1%)	Waiting for class (31.6%)	Dining alone (28.0%) Dining with friends (22.7%) Waiting for class (18.7%) Waiting for friends (8.0%)	Waiting for class (25.0%) Waiting for friends (15.0%) Self-study (15.0%) Rest (12.5%)
	Waiting for class (13.3%)	Waiting for class (17.3%)	Self-Study (28.6%) Study with friends (13.0%)	Study with friends (11.1%)	Self-study (19.7%) Study with friends (19.7%) Group discussion for academic purpose (10.5%)	Waiting for friends (8.0%)	Rest (12.5%)
	Rest (6.7%)	Study with friends (13.6%) Group discussion for academic purpose (6.2%)	Rest (6.5%)	Socializing with friends (11.1%) Group discussion for academic purpose (8.9%)	Waiting for friends (6.6%)	Rest (6.7%)	Socializing with friends (10.0%)
	Alone time (2.2%)	Study with friends (2.2%)	Alone time (5.2%)	Alone time (5.2%)	Waiting for friends (6.6%)	Rest (6.7%)	Socializing with friends (10.0%)

Table 4. Frequency and Time Spent at Each ILS Site

ILS types		Indoor (Quiet)		Indoor (Talking allowed)			Outdoor	Sofas
On-site evaluation locations (ILS code)		ILS 28	ILS 25	ILS 2	ILS 8	ILS 10	ILS 24	ILS18
Sample Size (n=439)		45	81	77	45	76	75	40
How often	Once a week or more	73.4%	79.0%	63.7%	66.7%	86.2%	58.6%	60.0%
	Once or twice a month	22.2%	9.9%	15.6%	17.8%	5.3%	20.0%	2.5%
	Less than once per month	4.4%	11.1%	20.8%	15.6%	7.9%	21.3%	37.5%
Time Spent	Within 30 minutes	6.7%	21.0%	26.0%	6.7%	31.0%	66.7%	47.5%
	Between 31 – 60 minutes	31.1%	21.0%	27.3%	37.8%	43.4%	22.7%	42.5%
	Over 60 minutes	62.3%	58.0%	46.8%	55.5%	35.5%	10.7%	10.0%

4.4 Overall Satisfaction

The overall satisfaction of ILS is 4.94 (Table 5) on a 7-point Likert scale, indicating a moderately positive rating. Indoor (talking allowed) ILS is rated the highest, while Outdoor ILS the lowest. Based on results of the ANOVA test ($p=.051$), differences in satisfaction of various ILS types are nearly statistically significant. The environment, atmosphere, and comfort may be contributing factors.

ANOVA test of differences in satisfaction among the different ILS sites reveals significant results, $F(6,432) = 2.269$, $p = .036$ (Table 5). Tukey post hoc test shows a difference in satisfaction between ILS 24 (Outdoor) and ILS 25 (Indoor – quiet). ILS 25 is air-conditioned, with facilities (e.g., vending machines, water) and is proximate to washrooms. On the other hand, ILS24 only has simple furniture, without the above amenities, and is outdoor. Despite the lowest rating for Outdoor ILS, it is still fairly positive at 4.68 on a 7-point scale.

Table 5. Overall Satisfaction among Various ILS Types and Sites

ILS types	Indoor (Quiet)		Indoor (Talking allowed)			Outdoor	Sofas	Total	F value
Sample size (n)	126		198			75	40	439	/
Overall satisfaction ^a	4.99		5.02			4.68	4.85	4.94	2.604 [#]
ILS sites	ILS 28	ILS 25	ILS 2	ILS 8	ILS 10	ILS 24	ILS 18	/	/
Sample Size (n)	45	81	77	45	76	75	40	439	/
Overall satisfaction ^a	4.76	5.12 ^b	4.92	5.07	5.08	4.68 ^b	4.85	4.94	2.269*

^a Scale: 1 = Extremely dissatisfied to 7 = Extremely satisfied

^b Means in the same row followed by the same superscript are significantly different at $p < .05$.

[#] $p=.051$, * $p<.05$

5. Discussion

This study employed a mixed approach, using a qualitative methodology based on concept mapping and sorting, and developed a taxonomy of four user-generated ILS types outside the library: Indoor (quiet), Indoor (talking allowed), Outdoor, and Indoor (sofa). This was followed by quantitative validation using an on-site evaluation survey to deepen our understanding of each ILS type, by examining usage behaviour, frequency, time spent and satisfaction.

Echoing with other studies, convenience and proximity permeate through student traffic behaviour and ILS usage (Ramsden, 2011; Harrop & Turpin, 2013). Our on-site evaluation findings suggest Indoor ILS are visited more frequently with longer stays. This suggests more attention is needed on the design of Indoor ILS in terms of comfort. When indoor environment is of quiet nature, self-study becomes more relevant; this can be strengthened with signage and partitions which give a sense of privacy. In line with the camper mentality, students put their belongings on the chair to occupy the space (Hunter & Cox, 2014; Riddle & Souter, 2012), indicating demand exceeded supply in the current scenario.

When talking is allowed, use occasions tend to be more versatile, including self-study, collaborative work and socialising with friends. More lively designs such as flexibility in furniture, fixture, natural light, creative decors and tools, are needed to cultivate discussion and creativity. Access to electronic charging, food and drinks are preferred, as food can induce discussions and create a home-like atmosphere. These convey feelings of being relaxed, cosy and comfortable, which could stimulate positive feelings among students (Harrop & Turpin, 2013). For outdoor and sofa areas, the frequency and length of use tend to be less than other ILS types with transient usage. For Outdoor ILS, given it is not weather protected, students tend to use the space for dining, waiting for class or friends. The outdoor design means it should be easily cleaned and weather-proof. With technology, more could be explored to offer partial shades that does not violate building codes, with fixtures that include cooling fans and anti-mosquito devices. The sofa areas are the least used but perhaps this is due to the scattered nature of such ILS on campus. Given sofa areas are mainly used for waiting or resting with shorter duration, more could be explored by redesigning the furniture for studying and discussions; or repurposing them altogether to become Indoor (talking allowed) type ILS to increase utilization.

While different ILS types seem to serve their varied purposes, overall satisfaction is moderate. Perhaps this is a function of students not knowing the purposes of each ILS type as well as the availability. A plausible next step is to conduct in-depth qualitative work to solicit suggestions for improvement of each ILS type, and build improved prototypes. As well, to understand usage on a university-wide basis, a usage and needs assessment study should be conducted for all ILS within the University, by surveying a wider audience of students to establish baseline data. With the gaps in performance identified, there can be more in-depth understanding on what works and what does not work, to identify unmet needs for current and future users.

A goal of the current study is to develop a taxonomy of ILS types which drives propositions. These are explained through associated design principles in the form of functionality and feature (Table 6). The methodology leading to this taxonomy could be used by other

universities with propositions on design principles to be adopted.

Table 6. A Taxonomy of ILS with Associated Design Principles

ILS Types	Indoor (quiet)	Indoor (talking allowed)	Outdoor ILS	Indoor (sofa) ILS
Needs	Quiet, longer stay	Collaboration	Taking a break from indoors	Taking short breaks
Current primary use occasions	Self-study, study with friends	Waiting for friends, self-study, studying and socializing with friends	Dining and waiting with friends / alone	Waiting for class / friends, self-study, rest
Functionalities	Privacy and comfort for long stay	Collaboration, creativity	Eating, protection from outdoor elements	Relaxing
Features	Full or half partitions, signage for being quiet, comfortable chairs	Flexible furniture for regrouping, sound barrier to allow discussion, computers, writable surfaces, printers	Easy to clean and frequent cleaning, partial shade, increased ventilation and mosquito repelling machines	Redesign furniture such as with higher chairs and tables

6. Conclusion and Limitation

This study contributes to the knowledge of ILS by introducing a methodology using a mixed method approach, based on qualitative concept mapping and sorting to generate ideas and develop a taxonomy of user-generated ILS types. This was followed by quantitative validation using onsite assessment of seven selected ILS sites to examine usage behaviour and satisfaction. The taxonomy of ILS types provides practical, associated design principles based on functionalities and features by each ILS type that are concrete, observable and implementable; propositions which lend themselves to further ILS improvements and generalization of results.

As users are ultimate decision makers on what each ILS means to them and how they use the space, this systematic, data-driven approach is recommended for each university as part of the standard procedure for developing ILS types qualitatively, followed by quantitative validation. The findings accumulate from the ILS categorization using a systematic method as such could be shared with designers, policy makers and different institutions to facilitate the learning and knowledge transfer. The end point is to develop generalized learnings for designing and evaluating ILS, which are applicable to the theory building process. Conceivably, the next steps include in-depth qualitative work for each ILS types, to solicit improvements suggestions to

upgraded version prototype development. An ILS usage and needs assessment study with a broader audience at university-wide level would help develop quantitative baseline data for action.

This study has several limitations. For the on-site evaluation study, only seven ILS sites were used due to practicality with limited sample sizes. More sites and larger sample sizes for onsite evaluation would be beneficial. From a university ILS portfolio perspective, an ILS needs assessment and usage study with a wider audience would help measure preference and behaviour for all ILS, as well as establishing baseline information for future reference. The current study is confined to the context of one university; conducting similar studies in other universities using the same methodology would strengthen consistency and validity of the taxonomy developed, providing more data points and taking into consideration of geographic and cultural differences. An update of this study with more datapoints is currently not possible due to the Covid-19 pandemic in Hong Kong; it is hoped that subject to available funding, a further update of the study would be possible in the near future when the pandemic subsides.

Acknowledgements

The work described in this paper was fully supported by a grant from The Hong Kong Polytechnic University, Hong Kong SAR, China (Work Program: 9A5B).

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