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# Factors Affecting Informal Learning Activities of the Millennial Generation

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**Abstract**. The emergence of learner-centred pedagogy and the rise in learners' demands for independence have amplified the importance of informal learning spaces apart from the conventional libraries. Universities, as the providers of physical infrastructure, need to consider a broad spectrum of learning activities and the environment in fulfilling the spatial demands of new generation learners. In line with that, this research seeks to investigate the effects of the physical (comfort, aesthetics, ICT facilities, layout) and social dimensions (privacy, interaction, autonomy) on students' learning activities. Survey questionnaires were administered to 450 undergraduate and postgraduate students at a public university in Malaysia. This study used Smart-PLS to assess both the measurement and structural models. The results indicated that comfort, aesthetics, layout, interaction and autonomy were significant predictors of individual study activities in closed and quiet settings. Individual study activities in open and busy settings were determined by aesthetics and privacy. The interaction was the sole factor that affects collaborative study activities in closed and quiet spaces while the combination of interaction and autonomy significantly explained collaborative study activities in open and busy spaces. The findings revealed that students' voices should be considered as their participation is an important enabler for the blueprint of effective informal learning spaces.

**Keywords:** Informal learning space, millennial generation students, individual study activities, collaborative study activities, physical dimension, social dimension.

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## INTRODUCTION

The education landscape has evolved significantly in the past decade, witnessing the uprising trend towards collaborative and problem-based learning. The changes in pedagogy and the demand for independence from learners have resulted in a higher requirement for informal learning spaces apart from the conventional classrooms and libraries. Today's modern learning practices do not take place solely in the classroom. Millennial generation students prefer to create their own space for learning, thus getting the right kinds of room to accommodate an assortment of learning exercises is crucial. Nonetheless, as most local universities are still following the outdated configurations as far as the campus learning space designs, the shift of learning pedagogies may still be a challenge.Fischer and Newton (2014) suggested that new space designs should go in line with new ways of teaching and learning. Both casual open places and quiet learning zones must be provided parallel to traditional classrooms. Similarly, Bennett (2016) proposed that learning spaces need to be designed by reconsidering the ways of usage by the students ranging from individual to social learning. On the question of how campus learning spaces should be configured and designed, Oblinger (2005) stated that it is essential to acknowledge where students learn and when they use the space. A similar view is shared by Rudd, Gifford, Morrison and Facer (2006) where they believed that learners should be given a greater choice in terms of when they learn, where they learn, what they learn, whom they learn with and how they learn.

In spite of the significant amount of studies on informal learning settings in Malaysia (e.g. Ibrahim & Fadzil, 2013; Maheran, Fadzidah, Nur Fadhilah & Farha, 2017; Munir, Tharim, Mohd & Said, 2018), there are gaps that need to be filled, particularly on the choice and usage of such spaces from the students' perspective. Thus, this research seeks to look at the relationship between the learning environment and learning space preferences among millennial learners. Specifically, the study examines the effects of the physical (comfort, aesthetics, ICT facilities, layout) and social dimensions (privacy, interaction, autonomy) on students' learning activities. As students in each institution are different, the

best way to find out their learning needs is to involve them in the blueprint of informal learning spacesto fulfil their expectations and learning activities. The research framework is depicted in Figure 1.

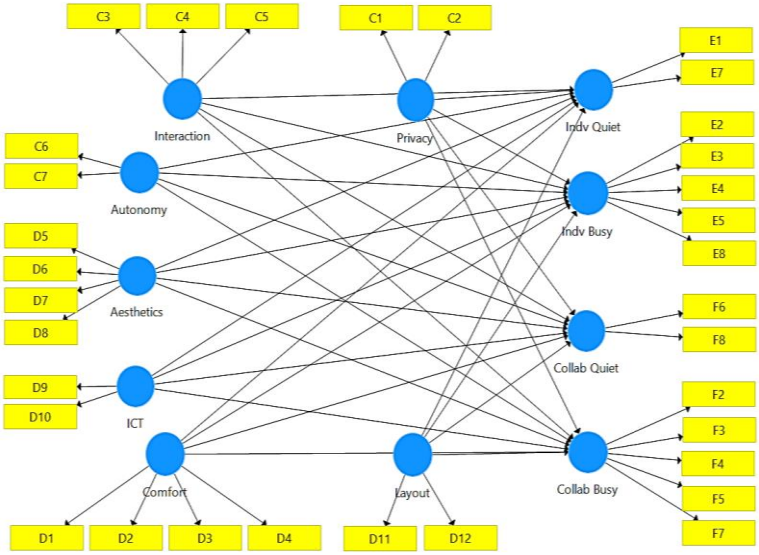


**FIGURE 1**. *Relationship between learning environment and learning space preferences*

## LITERATURE REVIEW

### *Informal Learning Spaces*

Informal learning is defined as course-related activity carried out individually and collaboratively on campus that occurs outside of designated class hour and does not require the involvement of the classroom teacher (Jamieson, 2009). It covers everything from private solitary learning to collaborative task as well as peer socialisation and interaction. Having a quiet, personal space is important for students during intense revision sessions and quiet consultation meetings with peers. It also helps students to meet a strict assignment deadline. However, at other times students actively seek collaboration, interaction and discussions in pair or within a small group of people. Such scenarios illustrate a need for both "social" and "retreat" (Bennett, 2005; Harrop & Turpin, 201). In order to accommodate a diverse range of learning activities, it is necessary to incorporate a wide choice of less structured spaces on campus environments. These are generally termed as informal learning spaces, i.e. "spaces that have been specially designed to facilitate independent and peer learning that is frequently spontaneous" (Keppell, Souter & Riddle, 2012). Harrop and Turpin (2013) specified that such self-direct learning activities could take place within and outside library spaces. Other venues include classroom buildings, common areas and lobbies in hostels, terrace, student cafeterias, cafes, parks as well as a variety of socially-oriented places and public spaces (Anggiani & Heryanto, 2018; Oblinger & Oblinger, 2005; O'Neill, 2013).In their review, Painter et al. (2013) identified three types of informal learning places in tertiary education, which are library (computer banks, alcoves, lobbies and unassigned spaces), gathering spaces(student unions, student centres, and outdoor areas) and corridor spaces (transitional areas, alcoves along walls, unutilised lobby areas, courtyards and plazas).

Hassell (2017) proposed four different informal learning activities along with their spatial characteristics that represent the differences in the way learners grasp, process and reflect information, knowledge and skills (Figure 2). The first activity is focused, individual study in a quiet environment,and the second being arrangement for group discussion between two to six people involving different table sizes. The third activity involves dyadic innovative engagement and sizeable groups of up to twelve students. The final activity is a social gathering that is carried out in places that allow louder conversations with food and beverage options. Beckers, van der Voordt and Dewulf (2016) measured the space preference for self-study and collaborative learning activities using two types of spaces, namely the quiet and busy settings. Likewise, Steelcase Education (2015) created a framework called a "palette of place" to explain how space can support the pattern and flow of learning across a floor, building and campus. The framework (Figure 3) consists of four types of structures, i.e. private/alone (individual focused study without distractions), public/alone (individual work in the presence of others), private/together (group work with privacy) and public/together (open group work with peers). It is believed that space shapes the behaviour of people and creates a sense of ownership, thus it helps in

designing floor plan zoning. Ideally, a university campus should offer a range of setting choices for learners to choose the best surroundings for their learning needs.

| | | | |
|---|---|---|---|
| **Focused**<br>Reflective, individual concentrated study inan enclosed and silent environment. Settings include fixed and flexible setting, single chairs with enclosure at eye level for reading, writing, audio-visual activity with headphone. | **Discussion**<br>Interactive engagement in groups of two to six people. Settings include small and large tables, flexible and fixed seating and lounge areas with screens and writable surfaces. Activities include casual interactions, group meetings, multi-media presentations and brainstorming. | **Doing**<br>Creative engagement in pairs and larger groups of up to twelve. Settings include acoustically separated semi- or fully enclosed spaces (bookable or not), in-the-round lounges with visualisation screens, and maker spaces for work shopping, lab work and drawing. | **Social**<br>Gathering and transitory spaces with permission for louder conversations, and food and beverage options. Settings include lounges, kitchens, cafe seating and tables, games and areas for artistic, political, social events and performances. |

**FIGURE 2**. *Informal learning activities & the spatial characteristics (Hassell, 2017)*

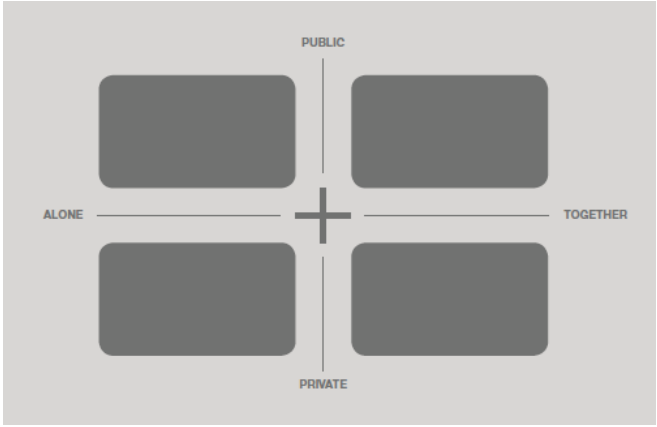


**FIGURE 3**. *A pallete of place (Steelcase, 2015)*

### *Physical Dimension*

Physical learning environments refer to the "spaces which are planned and used as special places where teaching and studying occur" (Tani, p.11). Commonly cited elements of a physical space are its architecture, which denotes the tangible objects inside and outside the area such as structure, design, furnishings, lighting, ventilation as well as other resources and facilities (Harrop & Turpin, 2013; George, Erwin & Barnes, 2009; Yang, Beerik-Gerber & Mino, 2013). Jamieson (2003) categorised the interior design components such as colour, floor finishing and furnishing quality as the aesthetic attributes. On the contrary, Beckers, van der Voordt and Dewulf(2015) termed all these elements as comfort and aesthetics attributes of the learning space, adding other aspects such as air quality, temperature, furniture and colour. All these elements are found to influence active, collaborative and project-based learning.

Yang, Becerik-Gerber and Mino (2013)indicated that learners' impression of elements, particularly air quality and temperature, are largely affected by classroom settings. Fister(2009) claimed that warm colours and comfortable furniture are the essential features of learning space while space/capacity and comfortable furniture are priorities of students as surveyed by Hassell (2017). In addition to comfy furniture, the space must be equipped with large tables or surfaces since students often need ample space to spread out their belongings (May & Swabey, 2015). Correspondingly, in their Model of Zengagement, Hunter and Cox (2014) termed this as the personal zone of a student, and it is the core of

the entire atmosphere of a learning space. They suggested a bigger size for this zone to enable students to spread out their belongings and to sit in a sheltered location. Vo (2015)surveyed the Net Generation at ten informal learning sites and revealed that spreading out the learning materials is a common way to claim territory. In Harrop and Turpin's (2013) study, students were less concerned about temperature but placed higher importance on lighting and natural light. A place near or along windows is considered as a hot spot because most people desire certain regimes of light and visibility. Besides being an important factor to promote reading, natural light was important to make a space more aesthetically pleasing and permit users to follow the progression of time throughout the day (Cox, 2018). Borrowing examples from the workplace to strengthen the idea, 47% of the employees admitted that they feel tired at their office, and 43% of the employees reported they feel gloomy from the absence of natural light or a window. Hence, Thorpe (2014) emphasised that natural light should be used as the primary source of illumination in buildings for health, productivity and sustainability. Besides illumination, windows also offered views that inspire while reducing stress, holding attention and producing better moods (Boyce, Hunter & Howlett, 2003; Felsten, 2009; May & Swabey, 2015).

Research also highlighted the environmental factors such as decorations, carpeting and lighting, which substantially influence students' impressions of a pleasant place to learn (Chism, 2007).Hunter and Cox (2014) revealed the background atmosphere as the best and the worst ground for learning in informal learning spaces. When the background environment is calm and accompanied by the right music, it provides a decent atmosphere for learning. However, if the environment is noisy, too bright, or has inappropriate music, it affects students' concentration and causes stress on their learning. Furthermore, natural elements in the educational setting such as indoor murals (Felsten, 2009) and plants (Bakker, 2010) also determine students' attachment to the venue.Outside-facing windows with a view of natural elements and indoor plants could help in restoring attention and relieving mental fatigue (Quellette, Kaplan & Kaplan, 2005).

Ideal learning spaces should be designed with a high degree of flexibility. Flexibility is an important characteristic because it allows learners to adjust to their physical environments in order to suit individual choices and a range of activities (McDaniel, 2014). This is closely related to the layout, which refers to the physical surrounding that eases students to move through and between study areas and to work within a space, either alone or collaboratively(Beckers, van der Voordt & Dewulf, 2015). Somervile and Collins (2008) highlighted students' preference for open and unconfined learning environments. Students tend to spend a large proportion of time in these spaces where they are able to reconfigure the set-up to suit their preferences.Furniture such as portable boards, low shelving units and temporary storage cabinets can operate as mobile partitions to change room layouts (O'Neill, 2013). In addition, students also prefer spaces with ergonomic furniture, myriad of table sizes, availability of food and drinks as well as a more casual atmosphere (McDaniel, 2014, Wolff, 2003).

Another additional feature of a successful informal learning space relates to the availability of equipment and tools. Resources such as ICT facilities are crucial in students' appraisal of learning space, for instance,desktops, printers, large screens, internet facilities and software (Harrop & Turpin, 2013). A wide choice of technology capabilities, power connecting points and audio-visual equipment facilitate students to engage in their activities immediately (McDaniel, 2014). At these places, students are able to conduct discussion, do readings, complete assignments and search for additional materials via the internet with their laptops. Nonetheless, Cunningham and Walton (2016) reminded planners of learning spaces that providing devices is not sufficient without considering the importance of power and data.

### *Social Dimension*

The place of learning should not only be assessed functionally or based on its objective.The place should also be evaluated according to its psychological and social values.Learning requires an environment that enables students to concentrate and digest information privately. Altman (1975) defined privacy as the dynamic social process to regulate the desired level of interaction that differs in line with personal preferences and contexts over time. Westin (1967)suggested that privacy is one's decision on when, how, and to what degree personal details should be shared with others. Learners prefer spaces that provide privacy and quiet study, which is related to the idea of retreat (Harrop & Turpin, 2013).The idea of privacy is of particular relevance to the design of open space office,and the same principle is applicable in designing learning spaces. As outlined in the application guide, Steelcase (2015) emphasised architectural privacy which is defined as the absence of external acoustical and visual stimuli. Visual privacy refers to the desired degree of visual isolation and does not allow disturbance from unwanted observation while acoustic privacy is related to conversational privacy along with separation from various kinds of noise from the surroundings (Sundstrom, 1986).

Students with a desire for privacy placed great value on personal spaces with no disturbances from other people. While Gurung (2005) and Matthews, Andrews and Adams (2011) found that noise and busyness tend to cast an adverse effect on academic performance and efficiency of students, Yuan (2019) discovered that low visual and acoustic privacy have no significant impact on students' informal learning experience. Indeed, some learners prefer certain background noise when they work. They enjoy being anonymous in a crowd, especially where people are working in different types of way (Cox, 2018).This is particularly true for the Net Gen students who prefer to study in an environment that is free of distractions, but at the same time offers some level of noise and activity (Bennett, 2007). In short, they appreciate a certain degree of privacy within a public space.However,working alongside others induced togetherness and encouragement that push students to discipline them to work.

Apart from preferred privacy, a flexible learning space should encourage interpersonal interaction which arises from learning and socialisation. This is due to the reason that learning atmosphere provides a multi-sensory experience with strong emotional content. Morieson, Murray, Wilson, Clarke and Lukas (2018) highlighted that providing students with a convenient, comfortable and *quiet* learning place should not be equated to providing a *silent* or *anti-social* space. It should be a space where students can fulfil the desire for "community" and "conversations" (Harrop & Turpin, 2013). Students regularly work alongside each other, and this makes certain spaces more preferred as compared to others. This creates a 'domesticated' atmosphere for study as space also enhances social interaction among friends such as creating a sense of community, relaxation, emotional and moral support (Cox, 2018; Harrop & Turpin, 2013). Through friendship and collaboration, students are reported to have higher engagement with activities (Webb, Schaller & Hunley, 2008) and are more motivated to remain and work on campus, often during the long beaks in between classes(Waldock, Rowlett, Cornock, Robinson & Bartholomew, 2017).Crook and Mitchell (2012) proposed a tetrad of social engagement in collaborative studies; focused collaboration (planned intense problem-solving group work), intermittent exchange (independent learning with periodic exchange), serendipitous encounter (unintentional get-together with peers), and ambient sociality (being solitude among the study community).In short, the preference for privacy, communication and interaction are closely connected depending on the level of interaction and nature of learning.

Another construct of the social dimension is learner autonomy. It is a term without a precise definition and is frequently mixed up with independent learning and self-instruction (Little, 2002; Najeeb, 2012). In the literature, learner autonomy is usually used interchangeably with personal control, self-direct learning and learning-to-learn (Hounsell, 1979; Appel-Meulenbroek, Groenen & Janssen, 2011; Mynard & Stevenson, 2017; Smith, 2008).Dam (1995, p.1) defined learner autonomy as "the readiness to take charge of one's own learning in the service of one's needs and purposes, which entails a capacity and willingness to act independently and in cooperation with others, as a socially responsible person". On a similar note, Benson and Voller (1997) elaborated that autonomy is a multifaced construct of capacity for making all the decisions concerned with one's own learning that varies in forms, for different individuals, in different surroundings and at different occassions. In order to develop this capacity, it is of utmost importance that learners must have the discretion in deciding the answers to the questions of what they do, why, how,when, and where. In other words, they must become "shareholders of their own learning" (Rogers, 1969, p. 9). By making learners autonomous, their learning will be optimised, and they will be able to develop higher academic resilience (Little, 2002). Hence, learner autonomy is used to predict academic performance (Benson & Voller, 1997), computer literacy (Sockett, 2014) and second language proficiency (Little et al., 2017).

## METHODOLOGY

### Sample

Survey questionnaires were distributed to a total of 450 undergraduate and postgraduate students to obtain their responses on informal learning spaces at a local university. The questionnaire cover contained a brief description of the intention of the study, and the participants were required to sign the consent form to demonstrate their consent to take part in the study. Prior to conducting the survey, the questionnaire was reviewed by the University Ethics Committee for Research, and later was piloted with 30 students from various faculties. Table 1 shows a description of the study sample, according to which 24.9% are male,75.1% are female, 60.9% are Malay, 29.3% are Chinese,5.1% are Indian and 4.7% are from other races. Majority of the respondents are undergraduate students (83.3%). 45.6% of the students frequently used their hostels for academic studies and followed by the faculty buildings (24.2%) and the library (15.8%).

**TABLE 1** *Sample Profile*

| **Variables** | | **n** | **%** |
|---|---|---|---|
| Gender | Male | 112 | 24.9 |
| | Female | 338 | 75.1 |
| Race | Malay | 274 | 60.9 |
| | Chinese | 132 | 29.3 |
| | Indian | 23 | 5.1 |
| | Others | 21 | 4.7 |
| Type of Study | Undergraduate | 375 | 83.3 |
| | Postgraduate | 75 | 16.7 |
| Most frequently used spaces at UPM for academic studies | Library | 75 | 15.8 |
| | Faculty Buildings | 109 | 24.2 |
| | Classroom Buildings (e.g. Academic Complex) | 40 | 8.9 |
| | Hostels | 205 | 45.6 |
| | Food Service Areas/Cafeterias/Cafes | 4 | 0.9 |
| | Others | 21 | 4.7 |

## Measures

The survey questionnaire was divided into five parts. Part A aimed to capture the general profile and students' choice of learning spaces while Part Baimed to determine the social dimensions of learning spaces.Part C intended to assess the physical conditions of learning spaces. Part D focused on the learning setting preferences and usage for individuals, whereas Part E focussed on the collaborative study activities. The informal learning spaces in this study were listed according to six categories, namely library spaces, faculty spaces, academic complexes, hostels, food service areas/cafeterias and other spaces on campus.

The social and physical dimensions of the learning environment were measured using the scales developed by Beckers, van der Coordt and Dewulf (2015). The social dimension part consisted of 7 statements to which students responded on a 5-point Likert scale from 1 "Strongly Disagree" to 5 "Strongly Agree". The three aspects of the social dimensions were privacy/retreat, interaction/communication and autonomy/control.The physical dimension part contained 12statements, and students rated them using a 5-point Likert scale from 1 "Not Important" to 5 "Very Important". There were four physical dimensions, namely comfort, aesthetics, ICT facilities and layout.

Finally, the learning space preferences for individuals and collaborative study activities were measured using two types of learning settings. The first setting was open, busy spaces in university premises such as the entrance areas with chatty students, atria or corridors with passers-by and catering areas with many customers (a restaurant or a grandcafé in the premise). The second setting was quiet, closed spaces such as project rooms or personal cockpits. For collaborative study activities,personal cockpits were omitted from the choice of quiet, closed spaces.

## Data Analysis

The structural equation modelling using Smart PLS 3.0 was used to analyse the research model. The estimated model was done in two steps as suggested by Hair, Black, Babin, Anderson and Tatham(2010). First,the measurement model was tested for the validity and reliability of the measures. Next, we presented the estimation of the structural model on the hypothesised relationship among the latent constructs. In this study, all constructs were modelled based on a reflective measurement. A bootstrapping method with a subsample size of 1,000 was used to test the significance levels for loadings, weights and path coefficients.

# RESULTS

## Measurement Model

### *Reliability Analysis*

Composite reliability (CR) was employed to test the internal consistency of all reflective measures (Fornell & Larcker, 1981). As shown in Table 2, all the values of CR are greater than the threshold of 0.7 as suggested by Fornell and Larcker (1981). In summary, the measurement model exhibits good reliability.

### *Convergent Validity*

Convergent validity refers to the extend to which various items used to measure the same construct are correlated. It was gauged using two criteria, namely factor loadings and average variance extracted (AVE) (Fornell & Larcker, 1981).As suggested by past research, the common threshold value for all outer loadings should exceed 0.7. However, lower loading values equal to and more than 0.5 are acceptable, if the summation of loadings result in high loading scores and contribute to AVE values of more than 0.5 (Byrne, 2016).Next, the average variance extracted (AVE) of each construct should be beyond the minimum benchmark of 0.50, which denotes the latent construct explains more than half of its indicators' variances. Table 2 depicts loadings for all items over and above the benchmark value of 0.5 while the values of AVE range from 0.55 to 0.88. Therefore, this model fulfils all requirements for convergent validity.

### *Discriminant Validity*

The discriminant validity of constructs is the degree to which the measures do not reflect other variables, and low correlations indicate it with other constructs in the same model. It was assessed through the heterotrait-monotrait ratio of correlations (HTMT). In Table 3, it is evident that none of the values in the matrix exceeds the thresholds of both .90 (Kline, 2016) criterion. In addition, the HTMT inference with bootstrapping technique revealed that the upper limit confidence intervals were all < 1. Thus, it can be concluded that the measures employed in this study are distinct and not correlated to each other.

**Table 2** *Reliability and convergent validity*

| **Construct** | **Item** | **Loading** | **Composite Reliability (CR)** | **Average Variance Extracted (AVE)** |
|---|---|---|---|---|
| Privacy | C1 | .89 | .91 | .83 |
| | C2 | .93 | | |
| Interaction | C3 | .81 | .83 | .61 |
| | C4 | .85 | | |
| | C5 | .68 | | |
| Autonomy | C6 | .94 | .94 | .88 |
| | C7 | .94 | | |
| Aesthetics | D5 | .81 | .90 | .68 |
| | D6 | .86 | | |
| | D7 | .83 | | |
| | D8 | .81 | | |
| ICT | D9 | .78 | .84 | .73 |
| | D10 | .92 | | |
| Comfort | D1 | .54 | .83 | .55 |
| | D2 | .87 | | |
| | D3 | .77 | | |
| | D4 | .76 | | |
| Layout | D11 | .85 | .82 | .69 |
| | D12 | .82 | | |
| Individual Quiet | E1 | .76 | .76 | .61 |
| | E7 | .80 | | |
| Individual Busy | E2 | .84 | .90 | .64 |
| | E3 | .79 | | |
| | E4 | .86 | | |
| | E8 | .69 | | |
| Collaboration Busy | F2 | .79 | .87 | .57 |
| | F3 | .83 | | |
| | F4 | .79 | | |
| | F5 | .68 | | |
| | F7 | .65 | | |
| Collaboration Quiet | F6 | .73 | .71 | .55 |
| | F8 | .76 | | |

**TABLE 3** *Heterotrait-Monotrait (HTMT) ratio*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Privacy | | | | | | | | | | | |
| 2. Interaction | .31 | | | | | | | | | | |
| 3. Autonomy | .14 | .09 | | | | | | | | | |
| 4. Aesthetics | .10 | .27 | .14 | | | | | | | | |
| 5. ICT | .18 | .21 | .16 | .60 | | | | | | | |
| 6. Layout | .07 | .33 | .14 | .71 | .77 | | | | | | |
| 7. Comfort | .20 | .12 | .35 | .53 | .34 | .43 | | | | | |
| 8. Indv Quiet | .40 | .15 | .48 | .29 | .26 | .33 | .45 | | | | |
| 9. Indv Busy | .06 | .36 | .15 | .28 | .24 | .35 | .11 | .10 | | | |
| 10. Collab Busy | .05 | .38 | .05 | .16 | .09 | .23 | .10 | .20 | .73 | | |
| 11. Collab Quiet | .20 | .42 | .51 | .32 | .35 | .41 | .34 | .90 | .41 | .48 | |

## Structural Model

PLS structural model was assessed by observing the results such as collinearity issues, the path coefficients, the explanatory power of constructs ($R^2$), the exogenous variable's incremental explanation of an endogenous variable ($f^2$ effect size) and the model predictive relevance ($Q^2$). In the structural model, collinearity among latent variables was assessed through the Variance Inflated Factor (VIF). Table 4 shows the VIF values of all constructs are under the benchmark of 3.3 (Diamantopoulos & Siguaw, 2006). Thus, the results did not indicate multicollinearity problem among constructs.

Table 5 depicts the standardised path coefficients (β values), path significances, $R^2$ by each path, effect sizes ($f^2$) and Stone-Geisser's$Q^2$ values. The analysis shows that autonomy($\beta$ = 0.21; $t$ = 4.02; $p$< 0.01), privacy($\beta$ = 0.16; $t$ = 3.04; $p$< 0.01) and comfort($\beta$ = 0.11; $t$ = 1.90; $p$< 0.05) have significant effects on individual study activities at quiet, closed settings while autonomy($\beta$ = -0.14; $t$ = 2.95; $p$< 0.01), privacy($\beta$ = 0.09; $t$ = 1.86; $p$< 0.05), comfort($\beta$ = -0.15; $t$ = 2.90; $p$< 0.01), aesthetics($\beta$ = 0.17; $t$ = 3.05; $p$< 0.01), interaction($\beta$ = 0.24; $t$ = 5.13; $p$< 0.01) and layout($\beta$ = 0.14; $t$ = 2.45; $p$< 0.01)have significant effects on individual study activities at busy, open areas. For collaborative studies, autonomy ($\beta$ = 0.17; $t$ = 2.23; $p$< 0.01) and interaction ($\beta$ = 0.15; $t$ = 2.34; $p$< 0.01) predicted study activities at quiet, closed settings while interaction ($\beta$ = 0.28; $t$ = 5.40; $p$< 0.01) and layout ($\beta$ = 0.11; $t$ = 1.83; $p$< 0.05) predicted study activities at busy, open areas. All dependent variables explain more than 10 percent of variances in dependent variables except collaboration activities in quiet, closed areas, which is 8%. Since most percentages are more than the recommended cut-off of 10 percent, therefore, the measurement model has substantive and satisfactory predictive power (Eom, Wen & Ashill, 2006). All the significant relationships showed small effect sizes according to Cohen's guidelines of 0.02, 0.15 and 0.35 to represent small, medium and large effects, respectively (Cohen, 1988).Lastly, blindfolding was used to evaluate the predictive relevance of the model. All CV redundancy ($Q^2$) values are more than 0, suggesting that the structural model has predictive relevance (Hair et al. 2014). This establishes the fact that the exogenous constructs are highly relevant to the endogenous construct.

**TABLE 4** *Variance inflation factors*

| Constructs | VIF |
|---|---|
| Privacy | 1.11 |
| Interaction | 1.13 |
| Autonomy | 1.10 |
| Aesthetics | 1.59 |
| ICT | 1.45 |
| Comfort | 1.27 |
| Layout | 1.51 |

**Table 5***Results of Path Analysis*

| Path | Path coefficient ($\beta$) | $t$-value | $f^2$ | $Q^2$ |
|---|---|---|---|---|
| ***Individual quiet; $R^2$ = 0.15*** | | | | 0.07 |
| Privacy | 0.16** | 3.04 | 0.03 | |
| Interaction | - 0.06 | 1.17 | | |
| Autonomy | 0.21** | 4.02 | 0.05 | |
| Aesthetics | 0.06 | 0.86 | | |

| | | | | |
|---|---|---|---|---|
| ICT | 0.01 | 0.21 | | |
| Comfort | 0.11* | 1.90 | 0.01 | |
| Layout | 0.08 | 1.19 | | |
| ***Individual busy; $R^2$ = 0.18*** | | | | 0.10 |
| Privacy | 0.09* | 1.86 | 0.01 | |
| Interaction | 0.24** | 5.13 | 0.06 | |
| Autonomy | - 0.14** | 2.95 | 0.02 | |
| Aesthetics | 0.17** | 3.05 | 0.02 | |
| ICT | 0.04 | 0.79 | 0 | |
| Comfort | - 0.15** | 2.90 | 0.02 | |
| Layout | 0.14** | 2.45 | 0.02 | |
| ***Collaboration quiet; $R^2$ = 0.08*** | | | | 0.03 |
| Privacy | 0.07 | 1.23 | | |
| Interaction | 0.15** | 2.34 | 0.02 | |
| Autonomy | 0.17** | 2.23 | 0.03 | |
| Aesthetics | - 0.05 | 0.55 | | |
| ICT | 0.06 | 0.87 | | |
| Comfort | 0.06 | 1.00 | | |
| Layout | 0.07 | 0.88 | | |
| ***Collaboration busy; $R^2$ = 0.11*** | | | | 0.05 |
| Privacy | 0.03 | 0.55 | | |
| Interaction | 0.28** | 5.40 | 0.08 | |
| Autonomy | -0.01 | 0.29 | | |
| Aesthetics | 0.08 | 1.21 | | |
| ICT | - 0.05 | 0.90 | | |
| Comfort | - 0.05 | 0.87 | | |
| Layout | 0.11* | 1.83 | 0.01 | |

*$p < 0.05$; **$p < 0.01$

## DISCUSSION AND CONCLUSION

This study aims to explore the relationship between the learning environment and learning space preferences. Specifically, the study investigates the effects of the physical (comfort, aesthetics, ICT facilities, layout) and social dimensions (privacy, interaction, autonomy) on students' individual and collaborative learning activities at quiet and closed as well as busy and open environments.In general, the present study indicates that the students' preferences toward learning spaces are highly affected by the social dimension with most attributes explain the greater significant effect on learning space preferences. Among the social attributes, autonomy and interaction are the most important determinants for the difference in learning space preferences. Autonomy scored the highest variance for individual and collaborative learning activities at quiet and closed locations such as the library, project room and hostel.Benson (2001) stated that achieving autonomy is a very individualised path as well as time and context dependent. Our study shows that students feel more autonomous in an environment that provides visual and acoustical accommodations, regardless of whether it is for individual or group work. When students are in control of their own learning, they experience a greater sense of belonging and satisfaction toward space. This is associated with higher levels of engagement, personal well-being and academic performance.

On the contrary, interaction is the most significant element for students who work alone and with peers in open areas such as vacant tables in the library, corridors, catering areas and cafes. Crook and Mitchell (2012) explained that the Net generation enjoys their presence as participants in social places and community. They gain inspiration and 'pressure' from being among anonymous people, which motivate them to focus on their activities. In addition, these open spaces also catalyse focused collaboration, intermittent exchange and serendipitous conversation that contribute to personal and professional growth.

The findings show that the students perceived ICT facilities as an unimportant physical dimension element in choosing a learning space. This outcome is contradictory with Beckers, van der

Voordt and Dewulf (2016) who found that sound ICT facilities are necessary for students to conduct their learning activities effectively. A local study on internet addiction reported 93% of the undergraduate students own a smartphone, 73.9% possess a laptop and 23.1% own an Ipad or tablet (Rosliza, Ragubathi, Mohamad Yusoff & Shaharuddin, 2018). As predicted by Beagle (2011), an increase in laptop and mobile use will ultimately lowered the demand for public access computers, and this could have explained the current students' low dependence on ICT facilities. Parallel to higher use of laptops and mobile phones, there will be a growing demand for more power outlets, generous broadband connection and flexible space for students to use their device comfortably. In addition, the availability of shops providing printing facilities around the current university could have reduced students' dependence on in-campus printing facilities.

Other physical dimensions attributes such as the preference for aesthetic and layout are ranked second most important after the social attributes. Aspects such as colour palette, quality and type of floor finishing, decoration features and presence of plants are important for students who study individually in busy, public places. This proves that the look and feel of the ambience and buildings positively affect students' overall sensory and learning experience. An environment that elicits positive emotional states will make students feel that they are part of the setting, thus leading to the development of place attachment (Graetz, 2006).On the other hand, students who study together in public spaces deemed layout as secondary to interaction. Collaborative learning spaces that are convenient for students to meet, especially before and after class, configurable to allow students to work in pairs or teams and technologically-integrated, should be an integral component of contemporary campus (Jamieson, 2003; Tibbetts, 2008; Steelcase Education, 2015).

In conclusion, facility managers of higher learning institutions should put more emphasis on social factors (privacy, interaction and autonomy) to meet the learning expectations of students. Learning spaces should be designed based on the spectrum from individual to collaborative study in both private and public environments. In order to acquire a clearer guideline on the design of spaces, a focus group study could be carried out where students are required to share their experiences of using the informal spaces across campus. Based on the themes emerged from the student-driven data, a practical guide for redeveloping or redesigning informal learning spaces on campus will be outlined. Following this, a design layout that corresponds with the elements highlighted in both quantitative and qualitative studies will be produced.

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