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Observing Spatial Change in Malaysian Terraced House Design Through the Context of Working from Home

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ABSTRACT

The COVID-19 pandemic has forced many individuals and families to work from home (WFH), a condition where employees perform their role from home instead of in an office environment, hence increasing the need for appropriate home workspaces and improved work-life balance. In Malaysia, the terrace house represents the most prevalent housing type for Malaysian middle-income families, but its space limitation, lack of natural lighting and ventilation, and rigid planning provide challenges for accommodating WFH requirements. This study intends to investigate the impact of working from home (WFH) on the spatial design of Malaysian terraced houses. By using qualitative case study method, this study explores such an impact on nine double-storey terraced houses located in Shah Alam and Puncak Alam townships. The terraced type of selection involved modified and unmodified conditions ranging from the link, intermediate, end lot and corner units. Further, the respondents are the homeowners, characterized as a nuclear family which belongs to a middle-class group of higher educational sectors that is compatible with the nature of WFH. Through interview and house observation, this study applied content analysis and comparative study as analytical methods. The findings suggest that the success of WFH in terraced houses is determined by the notion of 'dedicated shared workspace', which is influenced by lifestyle preferences, spatial perception and spatial proximity. Such a condition indicates a reconciliation between dedicated and shared spaces, where it provides specificity within an integrated space and promotes commonality in individuality, which is beneficial for the development of a particular organization, in this case, household growth.

1.0 INTRODUCTION

The prevailing housing design trend emphasises integrating work culture into living spaces, illustrated by typologies like SOHO, SOFO, and SOVO (PropertyGuru Editorial Team, 2021). Pandemics, including COVID-19, accelerated this convergence, impacting households beyond just workers, including school-age children and those pursuing higher education. This dynamic necessitates an adaptable living environment where homes serve multiple functions, encompassing working, living, learning, and leisure activities. However, this blurring of boundaries between work and home life often leads to conflicts and disruptions, necessitating flexible boundaries to mitigate work-family conflict (Van der Lippe & Lippenyi, 2018). As organisations increasingly adopt hybrid working arrangements post-pandemic, flexibility emerges as a crucial component in reconciling productivity with quality of life (Crawford, 2022).

The rapid adoption of WFH in Malaysia has spurred adaptive changes in home design, particularly in terraced houses (Leng, 2021; Chee Hung & Yu Hoe, 2021). In Malaysia, the terraced house resembles a "row house," built in a repetitive nature and standardized in planning (Ioannidis, 2005). Segregated by party wall, the terraced is arranged in a mirror image with defined boundaries (Hashim & Rahim, 2008) and a uniform façade. The unit ranged from 20ft x 60ft to 20ft x 70ft or higher and is relatively narrow and deep planning with only two minimal façades at the front and rear parts (Chandler et al., 2005). The spaces consist of a porch or front yard, living, dining, kitchen, and backyard with three bedrooms normally located next to a living area in the case of a single-storey terrace. For a double story unit, bedrooms are positioned at the upstairs level with an additional family area in between the rooms (Omar et al., 2016). While terraced houses have seen minimal modifications by developers, the homeowner's intervention acts as the driving force for changes, hence the renovation culture (Powell, 2021, Omar et al., 2012). This phenomenon underscores the growing recognition of the terraced house towards perpetual adaptation and modification, which is critical during the pandemic period where WFH is a necessity.

This study intends to comprehensively investigate the impact of working from home (WFH) on the spatial design of Malaysian terraced houses particularly the double-story house which has predominantly shaped the local housing market. Firstly, it seeks to understand how WFH practices influence space utilisation and household dynamics in Malaysian terraced houses, considering the intricate relationship between work and domestic life. Secondly, it evaluates the adaptability of terraced house designs in accommodating the evolving needs and preferences associated with WFH, emphasising the integration of WFH considerations into the spatial design process. Lastly, the study endeavours to analyse the reciprocal relationship between WFH-induced changes in living patterns and spatial design modifications within terraced houses, aiming to identify key aspects shaping the symbiotic evolution of work and home spaces. Through these objectives, the research shall propose a spatial design strategy for terraced houses in Malaysia amidst the growing prevalence of WFH arrangements.

2.0 LITERATURE REVIEW

2.1. Terraced House Design

Terraced houses in Malaysia typically adhere to a standardised layout, with dimensions of approximately 20ft x 70ft and featuring multiple bedrooms, bathrooms, a combined dining and living area, and a rear kitchen connected to a small backyard (Omar et al., 2016). This conventional design often results in a boxy, room-oriented layout, where the middle section of the house experiences challenges related to inadequate natural light and ventilation due to limited fenestration and a deep, narrow arrangement (Chee Hung & Yu Hoe, 2021).

Research indicates that renovation plays a significant role in Malaysian housing culture, with homeowners frequently undertaking modifications to enhance the congruence and functionality of their living spaces (Saji, 2012) While kitchen renovations have historically been popular, recent trends suggest a growing emphasis on improving study and family spaces (Mohit & Mahfoud, 2015), particularly exacerbated by the COVID-19 pandemic and associated movement control orders (MCO) in 2020.

Powell's (2021) comprehensive case study analysis further illustrates this shift. Many terraced houses have been modified to facilitate working from home (WFH) through various design interventions. These interventions encompass material culture, spatial planning adjustments, and environmental enhancements to create conducive WFH environments within the home.

2.2. The Operation of Working from Home (WFH)

The integration of work into the domestic environment is profoundly influenced by the dynamics of working from home (WFH). Patton (2020) elucidated the WFH context to reconcile the dichotomy between the traditionally masculine nature of work and the femininity associated with privacy and leisure. WFH fosters a sense of togetherness by uniting families at home while maintaining individual spaces and schedules, as exemplified by creating home offices for men and adapting kitchen nooks for women to manage domestic responsibilities. However, it is important to note that this discussion primarily pertains to middle-class American families living in suburban areas. The term "middle class" carries specific professional connotations, as only 37% of US jobs were conducive to WFH during the global movement control order of the COVID-19 pandemic, primarily in sectors such as finance, corporate management, professional and scientific services, and education. This trend correlated positively with median housing income, homeownership rates, and higher educational levels (Dingel & Neiman, 2020; Deng et al., 2020; Gottlieb et al., 2020; Paul, 2022), leaving lower-income and less educated groups disproportionately affected by the WFH divide.

The availability of telework technology plays a crucial role in enabling WFH operations, with three-quarters of households reportedly lacking adequate facilities (Cuerdo-Vilches et al., 2021), necessitating significant investments (Beck & Hensher, 2021). While technology enhances WFH potential, it also fosters a culture of remote work within organisations, reducing the need for commuting and prompting residential relocation to low-density rural areas (Delventhal et al., 2021; Beck & Hensher, 2021; Stefaniec et al., 2022). However, this shift has been associated with feelings of loneliness and strained trust between employers and workers due to unreasonable expectations, impacting employee well-being and effectiveness (Beck & Hensher, 2021).

Moreover, WFH has revealed gender biases, with men experiencing less disruption in performance due to domestic obligations compared to women, who often shoulder a disproportionate burden of unpaid work, leading to increased workloads and life schedules (Van der Lippe & Lippenyi, 2018; Cuerdo-Vilches et al., 2021; Paul, 2022; Chauhan, 2022). The outcomes of WFH on employees can be assessed through conceptual frameworks such as the Perceived Control and Autonomy Framework, which examines job satisfaction and organisational support; the Work-Life Balance Framework, which explores the boundary between work and non-work commitments; and the Relational Impoverishment Framework, which highlights negative implications of WFH such as social isolation, trust issues, and communication challenges (Chauhan, 2022).

2.3. Home Working Environment

The relationship between working from home (WFH) and the spatial environment is inherently interconnected, influencing the design of the built environment and individuals' WFH experiences (Mayer & Boston, 2022). Individuals are naturally drawn to work environments that align with their beliefs and values (Beck & Hensher, 2021), which extends to their preferences for home workspaces.

An effective WFH workspace should be dedicated and tailored to employees' needs, focusing on ergonomic design and privacy considerations to promote productivity (Van der Lippe & Lippenyi, 2018; Peters & Halleran, 2020; Mayer & Boston, 2022). Additionally, the home environment plays a crucial role in enhancing working spaces through building design elements that minimise distractions such as thermal discomfort, noise, and household interruptions (Bergefurt et al., 2022). Adequate daylighting and ventilation are essential, achieved through large openings and direct or indirect access to nature, such as greenery or sky views (Cuerdo-Vilches et al., 2021).

Indoor Environment Quality (IEQ) significantly impacts WFH performance and productivity levels, supporting stress recovery and restoration, as proposed by the Restorative Environmental Design Theory (RED) and reducing fatigue through attention restoration (ART) (Peters & Halleran, 2020). Features like open spaces, balconies, indoor and outdoor gardens, and bedroom designs promoting good circadian regulation contribute to the enhanced well-being of WFH individuals. These considerations align with the concept of Pandemic-Resilient Homes, reflecting the shift from the 'paralysed plan' to a new living machine system that prioritises a healthy spatial environment (Corbusier, 1991; Elrayies, 2022). By integrating these principles into built environment design, homes can better support the needs and well-being of individuals working from home.

2.4. Spatial Change Through Adaptive Home

Despite persistent challenges such as housing shortages and high property costs (Mayer & Boston, 2022), there is a growing opportunity for change through adaptation and rethinking the concept of home. Elrayies (2022) emphasises the importance of reorganising and redesigning existing spaces to meet evolving needs, proving more feasible than new construction. Spatial flexibility is crucial, allowing spaces to adapt to changing user requirements (Schneider & Till, 2007), and is feasible in practice, particularly proven during the Covid experience (Blanc & Scanlon, 2022). Concepts like adaptable layouts and modular systems have led to functionally non-determinant spaces, encouraging spontaneous occupancy and fostering a model of enhanced spatial cohabitation that supports various actions, needs, and behaviours (Gausa, 1999).

This adaptability is particularly relevant to the future uptake of working from home (WFH), as it redefines spatial boundaries and rituals, promoting the creation of dedicated shared workspaces through material culture (Ozaki & Lewis, 2006). Material culture serves as a means of personal engagement with the domestic environment, emphasising reorganisation over mere decoration (Garvey, 2021). In the context of WFH, furniture reorganisation brings a sense of novelty and self-expression, enhancing the feeling of newness within the home, hence its spatial change (Garvey, 2021). Furniture can be viewed as an organisational system or "equipment," logically classifying household components to optimise practicality (Guáqueta, 2021; Corbusier, 1991; Gausa, 1999).

Moreover, technological advancements offer new avenues for adaptation, with smart homes and devices increasingly enhancing living experiences (Aiswarya et al., 2021). By integrating these adaptive strategies and embracing technological innovations, homes can better meet the evolving needs of occupants, particularly in the context of remote work and changing lifestyles.

2.5. Lifestyle-Oriented Living

The burgeoning trends of working from home (WFH) are heralding significant shifts in lifestyles (Beck & Hensher, 2021; Mayer & Boston, 2022; Bergefurt et al., 2022). Despite exacerbating work-family conflicts during lockdowns, WFH has emerged as an ideal lifestyle choice for those adept at balancing work and personal life (Galanti et al., 2021). This trend suggests a dual lifestyle combination of living and working or working and living interchangeably. Live-work units, designed with consideration for residents' and neighbours' quiet enjoyment, prioritise work as a secondary or equal use, while work-live units prioritise work activities over residential needs (Dolan, 2012). The rise of live-work units is attributed to the flexibility they offer and the growing demand for unique, personalised spaces (Hollis, 2015).

Hollis (2015) contextualises this trend into a 'Workhome' typology, which understands the dominant function of Workhomes as either home-dominated, work-dominated, or of equal status. This results in three basic degrees of spatial separation patterns between work and living: none, some, or total separation (Hollis, 2015). The 'none' separation implies living with work, 'some' involves living adjacent to work, and 'total' separation leans towards living nearby while the workplace remains detached.

Dolan (2012), advocating for 'Zero-Commute Housing,' discusses proximity patterns defined by three types: living with, living near, and living nearby. Both studies emphasise the relative distance between work and living spaces, highlighting the importance of flexible boundaries in mitigating conflicts between work and personal life (Van der Lippe & Lippenyi, 2018). The term 'proximity' accurately captures contextual cues for adapting attention, as discussed by the Gestalt principle of spatial proximity, which suggests that visual stimuli closer to each other are mentally grouped (Diede & Bugg, 2016). Spatial proximity can significantly impact WFH lifestyles through major modifications, as demonstrated by Powell (2021), or minor adaptations, as commonly observed in typical terraced houses. This phenomenon has the potential to enhance the WFH lifestyle in Malaysian terraced houses.

3.0 METHODOLOGY

This research applied the qualitative method through a case study analysis. In this study, nine (9) case studies are selected based on their location, terraced attributes encompassing the nature of modified and unmodified conditions, and the typological attributes of the intermediate unit, the link unit, the end lot and the corner unit. The analysis is conducted through content analysis and comparative study demonstrated by a series of architectural planning, mapping and diagrams. Consecutively, the research framework was designed based

on four (4) methodological stages which correspond to the process of housing and household selection, interview and house observation, coding process, and determination of spatial pattern and theme related to WFH spatial context.

3.1. First Stage – Household Sampling and Housing Criteria

The selection of suitable jobs for remote work (WFH), as proposed by Dingel et al. (2020), underscores the importance of considering the unique challenges inherent in each profession, especially within the household context and daily routines. To ascertain the suitability of jobs for WFH, alignment with relevant living attributes is crucial. By focusing specifically on the higher education sector, this study identified nine families where the head of the household was affiliated with an academic institution. These households included nuclear family members from infants and children in lower to higher education, excluding elderly members. This selective approach aimed to mitigate potential conflicts and ensure accurate interpretations of findings.

Regarding housing, the terraced house emerged as a pivotal element, representing the preferred housing type among Malaysian middle-income families. Characterized by a compact layout bordered by two walls and typically found in double-storey configurations, the terraced house presented a common yet nuanced living environment. Recognizing the inherent conflict between the terraced house layout and the demands of WFH, this study intentionally selected families residing in such homes. Criteria for selection encompassed considerations of location, features, modifications, and spatial planning tailored to the terraced housing context.

Given the prevalence of standardized layouts within terraced housing developments, efforts were made to include variations in design typologies among the selected case studies. This approach facilitated a more nuanced understanding of the WFH dynamics of household spatial activities. The nine chosen case studies, labelled H1 to H9, exhibited distinct features detailed in Table 1.

Table 1. Housing Sampling and Townships.
(Source: Author)

Code	Terraced House Features	Occupational Year	Township – PA / SA
H01	Link type terraced house	2020	PA
H02	Intermediate type terraced house	2018	SA
H03	Corner type terraced house	2020	PA
H04	Front yard modification type terraced house	2019	PA
H05	End lot type terraced house	2021	PA
H06	1980s type terraced house	2012	SA
H07	Extended modification type terraced house	2016	PA
H08	Internal modification type terraced house	2020	SA
H09	2 ½ story courtyard type terraced house	2017	SA

PA*: Puncak Alam / SA*: Shah Alam

Moreover, to enhance data collection efficiency, the study targeted two townships within a 25-kilometer radius, guided by the regional WFH map proposed by Rahman et al. (2020). These townships, namely Bandar Puncak Alam (PA) under the jurisdiction of Kuala Selangor Municipality and Bandaraya Shah Alam (SA) under the Shah Alam City Council, were chosen strategically. Recognized as satellite cities, they have witnessed substantial development in terraced housing and are conducive environments for WFH due to their distance from Kuala Lumpur. This geographical positioning helps mitigate issues associated with heavy traffic and commuter congestion, making them optimal locations for the study.

3.2. Second Stage - Documenting Current Operation of Working from Home (WFH): Interview and House Observation

During this stage, the selected households participated in interview sessions, focusing on gathering basic demographic information and understanding their WFH practices. Participants were offered flexibility in scheduling their sessions, which took place between February and June 2022 and lasted approximately an hour each, depending on the topics discussed. All interviews were recorded for thorough analysis. Tables 2 and 3 outline the deductive codes involved and the questions posed during the interviews, respectively.

We conducted guided house tours throughout the sessions to gain deeper insights into the participants' current WFH setups and conditions. Each tour lasted around an hour, during which participants were encouraged to share their perspectives on their workspaces and other living areas. Detailed observations were documented through photographs and architectural sketches, which were subsequently translated into comprehensive architectural drawings of floor plans and sections using Revit and SketchUp software.

3.3. Third Stage – Defining Spatial Attributes of Working from Home (WFH) in Terraced Houses: Keywords and Code Categories

Content analysis was conducted through conceptual investigation to discern spatial attribute categories from the interviews. The process unfolded as follows:

a) The findings from interview sessions held with participants from H01 to H09 were meticulously transcribed verbatim. Keywords associated with the WFH experience were then identified to comprehend both the operation of WFH and the participants' perspectives. These keywords were determined based on the following criteria:

   i. Keywords reflecting spatial preferences, encompassing home experience, social connections, and natural environments conducive to WFH and daily activities.
   ii. Keywords reflecting spatial motivation encompassing extrinsic and intrinsic aspects influencing WFH tasks, such as atmospheric or task-driven motivations.

b) The occurrence for each keyword was analyzed to establish code categories of spatial attributes. Higher occurrences of keywords denoted significant preferences and motivations for specific spaces and activity coding, whereas lower occurrences indicated fewer common desires influenced by lifestyle aspects. Mapping exercises illustrated the relationships between keywords and the established code categories.

3.4. Fourth Stage – Determining Spatial Pattern and Theme of Working from Home (WFH) in Terraced House: Space Organization Analysis and Comparative Analysis

Content analysis, conducted through a spatial organisation study, was utilised to uncover WFH's spatial patterns and themes within a terraced house. This process involved leveraging descriptive spatial attributes established in stage 3 to evaluate the documented layout obtained during the house tour. By juxtaposing both datasets, correlations indicative of WFH patterns and themes were discerned. This process unfolded as follows:

a) The existing working area was scrutinised within its contextual framework. Questions such as "Why do participants choose this specific spot to work?", “How is WFH practised?" and "How do other spaces contribute to WFH?" were revisited and reevaluated during the analysis.

b) The spatial relationships between different areas were examined based on the following principles:

   i. Relational working spaces were identified by analysing the primary working area, furniture layout, condition of surrounding walls, and positioning of openings.
   ii. The observation radius is extended from the main working space to explore potential alternative areas without confining the process to specific rooms or workspaces.
   iii. Organisations were determined by identifying the visibility of shapes, characterised by precise size, distance, position, and orientation, establishing an organisational pattern.

c) The relationship between the working zone and its spatial context was translated into the layout through a colour-coding method (1st interpretation). This step was essential for recognising the diverse spatial zoning that emerged during the WFH operation. The colour coding red denotes the main working zone, orange for the first-degree support zone, and green for the second-degree support zone. Arrows were used to signify connections between zones, depicting flow, orientation, and the relationship between indoor and outdoor environments.

d) The projected organisation was then compared with the spatial attributes identified in stage 3, integrating space relational proximity (2nd interpretation) to discern potential patterns and themes. This comparative analysis adhered to the same colour-coding convention in the initial interpretation.

Table 2. Analytical framework (Source: Author)

Research Question	Research Objectives	Deductive code		Aspect to be Focus	Exclusion Aspect	Strategy of Inquiry
RQ1: How does the current practice of WFH affect households living in terraced houses in Malaysia?	RO1: To understand how Malaysian households living in terraced houses currently practice WFH	**Jobs Suitability to WFH**	**Working Level:** Executive Management / Middle Management / Lower Management	Profession Sector: Educational, Professional & Managerial Sector	(1) **Jobs required specific working place, technology and tools**: Real Estate/ Rental / Leasing, Arts / Entertainment / Recreation, Utilities, Administrative & Support / Waste Management / Remediation, Other Services (Except Public Administration), Health Care / Social assistance, Transportation & Warehousing, Mining / Quarrying / Oil & Gas Extraction, Retail Trade, Manufacturing, Construction, Accommodation / Food Services, Agriculture / Farming / Fishing, (2) **Jobs beyond managerial & professional fields.**	**Interview Session 1 (Refer to Interview Question Set 1)**
			Technology tools: Internet access, Email, Phone, Computer, Printer, Fax, Scanner			
			Demographic: Age Group / Gender / Educational Level			
		Household Unit	**Household members:** Minimum of 1-2 / 3-4 / 5-6 / 7-8 / more than 8	Household income: M40: 4,851-10,970	Single Household, Disabled Person, Pensioner, Senior Citizen, Minor groups	
			Household employment and / or educational status.			
		WFH Productivity	**Occurrence of WFH task (per week):** at least 5 days working / at least 3 days per week / at most 1 day per week	WFH Task and skills.		
			Duration of WFH task (per day, by hour): 1-2 / 3-4 / 5-6 / 7-8 / more than 8			
			Duration of Daily routine other than work: Family Time			
			Duration of Daily routine other than work: Own Leisure			
			Satisfaction of current WFH: Yes / Mid-Range / No			

RQ2: How can the context of WFH be considered in the spatial design of terraced houses in Malaysia?	RO2: To investigate how the spatial design of terraced houses can support WFH	**Diversified Home Experience**	**Space Flexibility**: Soft (indeterminant), Hard (Determinant)	Living Locality, Terrace House type, Intermediate Unit, Multi Levelling Space Planning Radius, Developers As Built Design	Multi-Level Dwelling (Apartments, Flats, etc.), Single Family House, Authority Local Plan, Feasibility Study, Medical treatment related to working fatigue	**Observation through Guided House Tour**
			Space Transition: Coherent, Incoherent			
			Space Accessibility: Open, Partially Framed, Enclosed			
			Space Engagement: Active, Passive			
			Data Specification: Built Year/Completion Date, Built Up Area, Land Area, Volumes			
		Social Connectivity Enhancement	**Degree of Outdoor Visual Complexity:** Open, Partially Framed, Enclosed			
			Degree of Mediator Space: Semi Private Space, Semi Public Space			
			Permeability Aspect: Housing Block Configuration, Open Space Venue, Street Pattern			
		Natural Environment for Mitigating Working Fatigue	**Created Elements:** Tangible Types - Water/ Stones/Soil/Greenery, Spatial Planning - Fix/ Temporary			
			Captures Elements: Intangible Types - Sky/Air/Light, Spatial Experience - Direct Exposure/Indirect Exposure			
RQ3: How does WFH impact living patterns, and how can these changes be reflected in the spatial design of terraced houses in Malaysia?	RO3: To determine how the living patterns resulting from WFH can affect the spatial design of terraced houses	**WFH Space**	**Spatial Perceptions:** Exteroceptive (Space Emotions), Interoceptive (Space Organization) - Related to Housing Design Aspects	Terrace House Space & Context	Medical and psychological advice on behaviorology	**Interview Session 2 (Refer to Interview Question Set 2)**
			Spatial Preferences: Potency Aspects, Activity Aspects, Evaluation Aspects - Related to WFH Aspects			
			Spatial Motivation: Intrinsic aspects - Atmosphere driven, Extrinsic aspects - Work Driven			

Table 3. The interview questions (Source: Author)

Set	Deductive code	Interview Question
SET 1	**Jobs Suitability to WFH**	1. Please state your age, gender, and education level. 2. What technology tools or devices do you use to implement WFH tasks? 3. What are the problems that you usually encounter while working from home? 4. Do you encounter any issues with your family using home spaces for WFH? E.g., conflicting schedules to use this space, convenience, privacy, noise control/buffer, etc. 5. Describe your daily routine when you WFH – including work and family commitments/distractions.
	Household Unit	1. How many people are there in your household (living together full time)? 2. How many of your household members are working full-time? 3. How many of your household members are full-time students? Please state their current education level.
	WFH Productivity	1. How frequently do you WFH? For how long at a time? 2. What are the tasks that you do when WFH (your job scope)? 3. In a day that you WFH, how much time do you spend working, and how much time do you dedicate to family commitments and leisure activities? 4. Were there ever conflicting moments or activities between your WFH, family and leisure times? Please explain further. 5. How do you manage being productive while WFH? 6. What do you do to stay productive while WFH? 7. Identify moments/activities that use spaces in the house as productivity boosters (rest area, space change that encourages accelerated work, etc.) 8. On a scale of 1 (Very dissatisfied) to 5 (Very satisfied), how do you rate your working space at home and the WFH experience?
SET 2	**WFH Space**	1. Why did you select this space for WFH? 2. Besides your dedicated working space, do you use other areas/spaces in the house to work? If yes, - What are these other spaces? - How are these spaces practical for what you need to do? *(Spatial Preference: Identify the relationship between space and activity/task (includes working, leisure, and family commitments), circulation, limitations due to conflicting activities, etc.)* 3. What made you choose these spaces? How do they make you feel? *(Spatial Motivation: Identify the relationship between space and mood/atmosphere; values associated with the space)* 4. Do you feel that your current working space is conducive for WFH in the future? Please explain your answer. 5. What would you change to improve your working condition in this space/ when WFH? 6. Thinking about your WFH situation right now – how important is it for you to have a dedicated space at home for WFH? *(Perception of productivity, i.e. The right condition to work productively, prospects)* 7. Do you think there is a possibility of WFH becoming a norm in the future for you and your household? Are you prepared for it? - If no, why? - If yes, how would it integrate with your and your household's daily routine?

4.0 FINDINGS

a) Demographic Data and the current practice of WFH

Results from the interview were documented in Table 4. Generally, the households recorded at H01 to H09 were between 2 and 6 persons with 2 to 4 children, including infants. Regarding working-from-home activity, each household demonstrates 2 to 6-person WFH. Note that these data include occupational-related tasks involving adults and school or higher learning tasks for children. In addition, all types of work are crucial in determining WFH conflicts amongst members. Regarding time consumption, most households recorded 5 to 8 hours of WFH during workdays, suggesting intense negotiation of work-life balance. This is reflected in the WFH congruence rating given by the households whereby out of 9 case studies, only two were rated as five stars (H01, H08), four were ranked at four stars (H05, H07, H09, H02), two were scored at three stars (H02, H06) and one counted as two stars (H04).

b) Documenting WFH-related keywords for terraced house

The interview established 21 keywords related to WFH (Table 4). These keywords denote the existing condition of WFH, including activity, terraced house context, workspace preference, and working motivation. It is in our argument that the keyword criteria could be changed should the housing type differ.

i. K1 – K6: Workspaces

The first keyword discussed the 'spacious and open space' (K1) attributes, which referred to the need for more space out of the congested terraced cell. Follow suit by the 'sharing space' (K2) condition indicating shared WFH activities between families or in a home office with workers currently running official businesses. Keywords 3 to 6 are related to a workspace with a different implication. In the case of 'privacy' (K3), it denotes the preference for working space between enclosed or open workspaces. This strongly brings the motivational awareness of having 'separated working and living' (K4) and justifies the preferential attributes in defining a 'dedicated workspace' (K5) by highlighting the need for soundproof, individual task space or casual designated working space. This space is further stressed by the need for 'good ergonomics' (K6) of home furniture to improve working performance.

ii. K7 – K13: Environmental Condition

Keywords 7 to 13 described environmental conditions that enhanced WFH. Participants shared common preferences on demand for natural light (K7) and natural ventilation (K8). Furthermore, the need for landscape elements (K9) that form indoor, semi-outdoor and backyard gardens help escape from hectic work. Water features (K10) are an additional quality for the superior terraced unit while getting a good view (K11) that distracts from screen fatigue. There is also a preference towards a cool environment (K12) with the aid of an HVAC system. After all, in adapting to WFH, all households believe that the key element is the ‘casual atmosphere’ (K13) which distinguishes formal and informal working conditions.

iii. K14 – K21: Operation and Activities

The operation and activities of WFH are explained through keywords K14 to K21. In the extension of casual living, most households agreed to the need for a 'timed-out session' (K14) in the daily WFH period. This condition is defined by a short break time, probably for coffee or leisure activity, or a change in environment from one space to another. In fulfilling this attribute, some of the samples displayed an integration between WFH space with the hobby area (K15) or intended to be merged with leisure and relaxing space (K16). Despite the attempt, there are other unique attributes of WFH operation probed by the participants. In one case, it is believed that WFH could enhance children's learning environment (K17) through working examples practised by the parents.

It is also mentioned that WFH is characterised by its distinctive background character (K18) projected during the teleworking session. Background scene that displays bookshelves set up, painting, and artistic home corners with green indoor plants and a plain white background is preferable to the participants. In another scenario, as WFH is always associated with a solitary setting, well-being and safety must be prioritised by creating a neighbourhood-linked working space (K19). Regarding kids' surveillance (K20), the households suggest that WFH space should be the focal point, internally and externally, whereby the adults could observe their children in any circumstances. The final remark of the keywords brings forward the perpetual issues of a

technicality involving interrupted telework or low internet connections (K21) faced by the households, particularly in the new Puncak Alam (PA) Township.

c) Categories of spatial attributes related to WFH

Data in Figure 1 shows the relationship between keywords, occurrence rate and the established six (6) categories of spatial attributes of WFH in a terraced house. Note that the number of keywords within each category is subject to its nature, hence unequal. Furthermore, the keywords for each category are arranged in slanted order due to the occurrence rate. As such, the first category demonstrates a higher occurrence of keywords than the final. This condition signifies the hierarchy of spatial attributes for WFH in a terraced house.

i. Flexible Home Experience

The first spatial attribute of WFH is the provision of a "flexible home experience." Five keywords are highlighted in which casual atmosphere (K13, Freq 9) is rated as the most significant, followed by the timed-out session (K14, Freq 7).

ii. Captured and Created Natural Elements

The second spatial attribute emphasised the need for "captured and created natural elements." Six keywords are parked under this umbrella, highlighting the need to capture natural light (K7, Freq 7) due to a limited fenestration condition resulting from a deep terraced layout.

iii. Dynamic Workspace

The third spatial attribute is revolutionary, proposing a new "dynamic context of workspace." Within its five keywords, redefining the concept of working living (K4, Freq 6) and introducing a new way for a dedicated workspace (K5, Freq 6) are the most important.

iv. Shared Living

Interestingly, this idea of redefinition is further enhanced into the fourth spatial attribute of WFH, which intends to reevaluate the notion of "Shared Living." Under this category, three keywords are found to be interrelated, especially due to sharing space condition (K2, Freq 5) that must consider kids' surveillance aspects (K20, Freq 4) and privacy needs (K3, Freq 4).

v. Good Infrastructure

The fifth spatial attribute emphasised the "good infrastructure," specifically low internet connection (K21, Freq 2). This common problem is considered a third-party issue, hence its minimal impact on the investigation objectives.

vi. Good Social Support

A twisted preference is demonstrated by the sixth spatial attribute, which focuses on "good social support." In this case, most terraced households have shown less interest in neighbourhood-friendly aspects (K19, Freq 1) in WFH, contrary to the literature evidence of post-pandemic life.

In this research, the spatial attributes with higher occurrence keywords implied adequate consistency in defining WFH spatially. As such, the fifth and sixth attributes required external parties and were excluded from discussion, as we intend to focus more on the interiority of the terraced layout.

d) Spatial operation of WFH in a terraced house

Table 5 shows nine observed terraced house layouts (H01 – H09) concerning the current operation of WFH practised by respective households. Three colour-coding techniques are used to differentiate working zoning from other support zones; red indicates the main working zone, orange is the first-degree support zone, and green denotes the second-degree support zone. The different degrees of zoning are acquired by detailed demonstrations from participants during the house tour session. Note that the order of coding represents multiple processions of WFH whereby it involved the entire house and not only concentrated in a working area or study room since participants need to manage multiple house chores during working. Some samples also show double working zones in a particular area. Furthermore, the orange code could also be another working

area as participants tend to differentiate between two working conditions, either a formal with total concentration or a casual working space which leaves some freedom to be creative.

i. H01: Link Type Terraced House

The working zone is concentrated within the dining area due to the need to observe children. This area is parked between two sliding doors that allow for cross ventilation, natural light and a view towards water features or landscape, besides being supported by a kitchen.

ii. H02: Intermediate Type Terraced House

This house displays a slightly different organisation than H01, as the owner preferred a separate working nook closer to the dining table where the children are doing their school tasks. In addition, by abutting the walls underneath the staircase, the working station creates a sort of privacy, with a plain white wall background should a telecast be needed.

iii. H03: Corner Type Terraced House

For the H03, the working zone is conventional, as it has its own room. However, the interesting part is that the room has multiple supporting programs as the owner placed a home-workout space between two working zones and effectively differentiated a deep game corner to a window-attached green lover nook.

iv. H04: Front Yard Modification Type Terraced House

The separation between formal and informal workspace was evidenced in H04, as the formal workstation is positioned on the first floor, and the dining area shares the informal work at the ground. Fascinatingly, in this case, the notion of informality is further enhanced by two other programs, the music alcove marked by the keyboard instrument with an abstract painting on the wall and the reading area denoted by the existence of two huge scale bookshelves. Aligning both programs to the short-end side of a rectangular-shaped table creates two focal background points, which are important during the telecast. Meanwhile, during WFH, the long end side of the table allows the participants to have a direct view towards a private green front court covered in a ventilation block as features.

v. H05: End Lot Type Terraced House

The H05 creates a series of WFH stations inside a dedicated working room or through the entire flow towards the kitchen. In this situation, the owner transforms the first-floor bedroom into a study area with multiple programs consisting of a painting corner and a small reading lounge that is further extended into the family area next to it. Note that the working and supporting area is positioned according to the window. A similar pattern of utilising the dining table as the working area is shown on the ground floor.

Table 4. Keywords of WFH in Terraced House (Source: Author)

Code / Name	No.of household	No. of Person WFH	Spaces for WFH	Duration of WFH & Self-Assessment Rating (5 star or below)	K1 Spacious / Open Plan	K2 Sharing Space	K3 Need of Privacy	K4 Need separation working /	K5 Need of dedicated workspace	K6 Good ergonomics	K7 Need of natural lighting	K8 Need of natural ventilation	K9 Landscape Elements	K10 Water Features	K11 Good view	K12 Cool Temperature	K13 Casual Atmosphere	K14 Time Out session	K15 Integrated hobby area	K16 Required relaxing / leisure area	K17 Appreciate good learning environment	K18 Appreciate distinguished background character	K19 Neighbourhood Friendly	K20 Kids Surveillance	K21 Telework / Internet condition
H01 Eco Grandeur	4 person including: 1 baby 1 minor	2 WFH	Bedroom Dining	7-8 Hours 5*	✓						✓	✓ Cross Vent	✓	✓			✓						✓	✓	
H02 Denai Alam	5 person including: 1 baby 2 minor	3 WFH	Bedroom Dining, Study-Spot	8 Hours 3*	✓	✓	✓	✓	✓ Sound-proof	✓ Chair					✓ Distraction	✓	✓	✓				✓ Blank Wall		✓	
H03	4 person	2 WFH	Study room	8 Hours 4*				✓	✓ Multi-purpose space								✓	✓ Leisure at ground level	✓ Resting within the workspace			✓ Special Features			✓ Slow Internet

Eco Grandeur	including: 2 minor																							
H04 Seri Pristana	5 person including: 1 baby 2 minor	5 WFH	Study spot, Dining	7 – 8 Hours 4*	✓	✓ With kids	✓ Designated area	✓	✓ 2 Types: Normal & Leisure	✓ Flexible table	✓	✓			✓		✓	✓ Outdoor break	✓ Piano			✓ Painting & bookshelves, Eclectic Style		✓	
H05 Puncak Bestari	2 person	2 WFH	Study Room, Family area, Dining	5 – 6 Hours 5*		✓		✓	✓		✓	✓ Calm	✓ Indoor Garden		✓		✓	✓ Change environment							✓
H06 Seksyen 8, Shah Alam	4 person	4 WFH	Workstation	8 Hours 5*		✓ Working office at home		✓	✓	✓ Office furniture	✓	✓	✓ Backyard garden		✓ Direct view to backyard		✓	✓ Gardening, TV, foods			✓ Transparency as learning process				
H07 Alam Suria	5 person including: 3 minor	5 WFH	Workstation, Living	8 Hours 4*	✓						✓		✓				✓	✓							
H08 U12 Shah Alam	6 person including: 4 minor	4 WFH	Dining, Study-spot,	6 Hours 2*		✓ With kids	✓ Through landscape						✓ Privacy		✓ Garden / Backyard		✓	✓ Depends on task						✓	
H09 Cahaya Alam	6 person including: 1 minor	5 WFH	Workstation	7 – 8 Hours 4*			✓ Individual work station	✓			✓		✓ Indoor plant / Outdoor plant				✓		✓ Sewing	✓					
X / 9					4	5	4	6	5	3	6	4	6	1	5	1	9	7	3	1	1	3	1	4	2

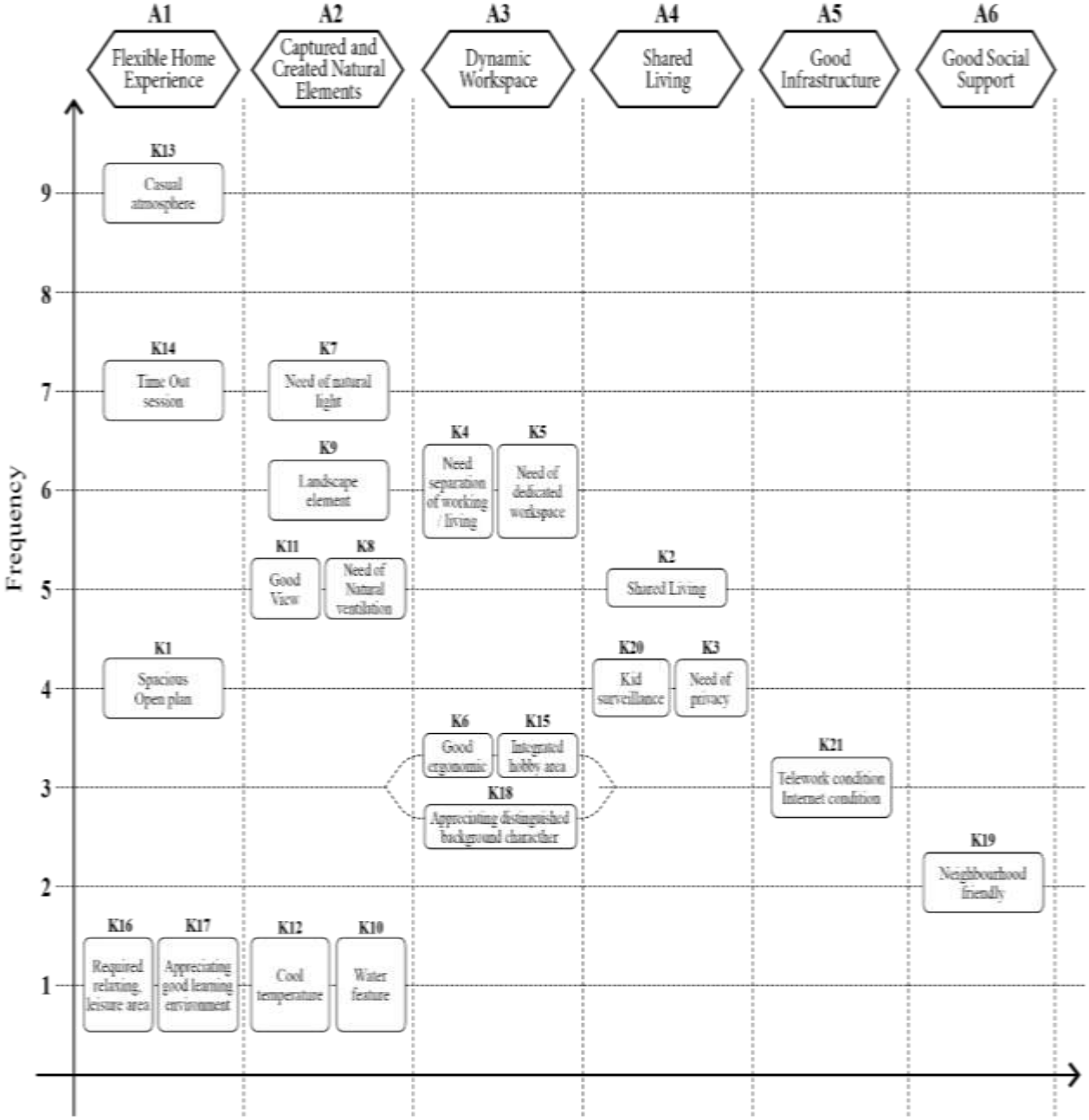


Figure 1. Categories of Spatial Attributes Related to WFH (Source: Author)

Table 5. Spatial operation of WFH in the terraced house (Source: Author)

Code / Name	Observed House Layout	Code / Name	Observed House Layout
H01 Ecp Greendest		-	-
H02 Denai Alam		**H06** Seksyen 8 Shah Alam	
H03 Ecp Greendest		**H07** Alam Sutra	
H04 Seri Pristana		**H08** U12 Shah Alam	
H05 Puncak Bestari		**H09** Cahaya Alam	

i. H06: 1980s Type Terraced House

This notion of series in assisting WFH practice has been deliberately enhanced in the case of H06. This case study is unique as it is a home office by nature where the households work on the ground and live upstairs. Considering its business in the creative industry, this house applied five sectional series based on the conventional layout of a terraced house starting from the lounging zone at the front garden court into working zone A consisting of 3 workstations, a central creative hub as the library and indoor lounge or discussion area, moving on to the manager's workspace, and finally, end at a more private backyard garden for refreshment, hence its proximity to the kitchen.

ii. H07: Extended Modification Type Terraced House

Organisation of homely objects helps to determine WFH space within the open-plan terraced layout. This is evidenced in H07, as the owner utilised most of the existing furniture for work-related functions or separation of working and living. The main working zone is distinguished by multiple enclosed circles of furniture with plant pots in between, allowing the work routine to be concentrated and adapted within. Furthermore, the working space is arranged between two sliding doors, allowing for cross ventilation, natural lighting, and view, like H01. The lower and upper front court and the backyard are extended with a ventilation block screen, and lush greenery is arranged to provide privacy to the ground working area and the upper working balcony. This condition reduces glare and provides better comfort during WFH.

iii. H08: Internal Modification Type Terraced House

As for H08, the internal layout is enhanced by a modified void, improving the penetration of wind and natural light into WFH spaces. Note that the ground level WFH space cum, the dining table, aligns to the upper void and the cross openings between the front and rear facade. On the first floor, a small single casement window is placed at the bedroom's workspace, allowing the owner to oversee the void and receive natural light and air.

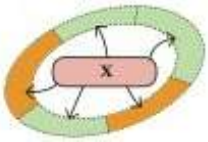
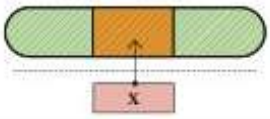
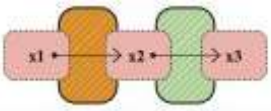
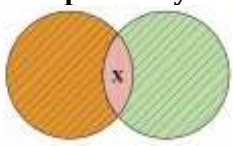
iv. H09: 2 ½ Story Courtyard Type Terraced House

In the case of H09, the main working zone is concentrated entirely at the third level due to renovation. Once a family area, this space was converted into a studio with an attached washroom and balcony for privacy and comfort. Originally intended to be a full-scale mini office, it is now being adapted with multiple leisure activities, particularly as an entertainment room with a sofa bed or facilitating sewing craftwork. This has made the workstation consume only one-third of its space. The second workspace at the bedroom level is positioned next to a courtyard air well to gain natural light and ventilation. By principle, this condition reflected H08 void yet differed by size and function.

a) Spatial Pattern and Themes of WFH in a Terraced House

The spatial operation of WFH established by the case studies demonstrated nine specific organisations between workspaces, home objects, building enclosures and openings depending on the layout variations. Although the terraced house has its own limitations, mainly due to its deep longitudinal floor plan and short facades at the front and rear end, all samples display certain organisational similarities that could be further gathered into patterns. In this situation, the similarity pattern could be decoded by comparing the spatial operations to the spatial attributes of WFH. Note that a coherent WFH operation must show a strong correlation towards the four main attributes of WFH, particularly on applying flexible home experience, captured and created natural elements, dynamic workspace, and shared living. In this research, as the degree of application is relative, we demonstrate the correlation through the improvised theory of proximity of live work introduced by Thomas Dolan (2012). Thus, out of nine organisations of WFH, we deduced four spatial patterns and themes through relational proximity that are commonly practised in Malaysian terraced houses (Table 6).

Table 6. Spatial Pattern and Themes of WFH in the terraced house (Source: Author)

No	Pattern of Proximity	Description	Manipulated Elements	Case Study	Related Perception
1	**Centralised proximity** 	• Concentrated WFH within open plan area • Good in surveillance	Use of main table/ dining table	H01 H04 H08	WFH is about spacious and casual
2	**Parallel proximity** 	• Creating good demarcation and separation of working / living • Ensure privacy during WFH	Finding nooks	H02 H03 H09	WFH is about privacy, clear demarcation of working and living
3	**Sequential proximity** 	• Series of working space	Use of natural ambience	H05 H06 H07a	WFH is about indulging with calmness and serenity
4	**Crossed proximity** 	• Intersect working space • WFH space directly relate to surrounding support programmes	Use of home furniture	H03a H09a H06a H04a H05a H07	WFH allow working culture to be blend with escapism of personal retreat

i. Centralised Proximity Pattern

In this pattern, the main WFH space acts as the epicentre for a terraced house by manipulating the dual function of a dining table, as shown in case studies H01, H04 and H08. Furthermore, the proximity measured between the central workspace and surrounded spaces (either first or second-degree supported zones) is arranged in a circle, suggesting casual 'in-and-out' operations during WFH. Together, it provides utilisation of timed-out breaks, hence improving working performance. In this context, it is agreed that this pattern enhanced shared living through simultaneous control of the housing environment during WFH and improved surveillance of household members, particularly kids. Moreover, the centrality aspect requires spaciousness and fits well into the open-plan concept of a terraced house.

ii. Parallel Proximity Pattern

Aiming to create a demarcation of working and living, this pattern secured privacy by acknowledging potential nooks around the terraced house. The proximity between the main WFH space to others indicates hierarchal order of working as the first-degree supported zone acts in transitional mode between formal and informal space or, to a certain extent, as a buffer. In the case of H02, the dining area becomes transitional to WFH space or a game corner that splits the working desk in H03 to the integrated hobby area that pushes the workspace to the end in H09. It is agreed that the parallel proximity redefines the dynamism of the workspace beyond its typical confinement, suggesting a co-existence concept for a formal working environment. Likewise, a work-driven person is deeply attached to this kind of setting, as it allows for better productivity during WFH.

iii. Sequential Proximity Pattern

Represented by a series of working spaces corresponding to the natural ambience, this pattern suggests that a general working culture could be divided into multiple sub-tasks according to the specific spatial setting. In the context of WFH, one may associate writing at a desk with an outside view, reading to an alcove of the bay window, thinking next to water features, or indulging in an eclectic lounge nook. Accumulating to this task-related environment required procession and hierarchal order, hence the sequence. Case studies H05 and H06, or part of H07, demonstrate interesting sequences that suit specific needs and lifestyles. Concerning the

terraced layout, the sequence is majorly arranged in a line connecting the front to the rear or vice versa. The individual who chose this arrangement shows affection towards calmness and serenity as part of their WFH practice.

iv. Crossed Proximity Pattern

The crossed proximity pattern is considered the most flexible and uses the surrounding culture for WFH, hence the crossed trait. By rejecting any direct association with the working environment, this pattern propagates a tendency to seek distraction and relief from working realities through engaging in the imaginary realm of home. WFH, in this context, has been made to blend with routine rather than the intended function. Here, in the case of H07, one may find that the working spot (which is more accurate rather than referring to a workspace or workstation) is made up of piles of soft cushions on the couch for a short nap, with a coffee table as a work surface, partitioned by self-nurtured pots of plants for privacy, and positioned at the living area should a TV break be needed. This flexible arrangement could be transformed into other configurations out of similar furniture. The routine could also generate programmatic evidence, suggesting crossed-blended programs in a mono-functional space. As integration is a concern, this pattern attracts people with favour in the escapism of personal retreat, justifying the casual and timed-out need during WFH.

5.0 DISCUSSION

The COVID-19 pandemic has caused a significant shift towards working from home (WFH) for individuals and families. This study confirms that those in the educational sector possess work flexibility and access to nature-oriented environments, making WFH more common in this field. However, materialising WFH requires high tolerance to manage family and gender conflicts. Our study has also found that this situation has led to the redefinition of a workspace, confirming Powell's (2021) observation on the creative formation of home-office spatiality and Galanti et al. (2021) on balance between working and living through a dual combination of lifestyle living. While having a dedicated workspace, such as a designated study room, can enhance productivity and minimise distractions, being confined to a single room can lead to feelings of loneliness and an urge to do other domestic tasks. On the other hand, sharing workspaces provides an opportunity to act as a teaching or motivational tool for other household members, promoting learning from each other and observing how work is done. Therefore, there is a need for an act of reconciliation between a dedicated and a shared workspace.

While Blanc and Scanlon (2022) emphasis that a dedicated workspace is ideal, this study suggests that a 'dedicated shared workspace' – a hybrid typology of the working environment – is crucially essential, particularly in a small home context such as a terraced house, in reference to the benefits of material culture to home operation (Guáqueta, 2021). In this context, each household member could be designated to an individual working space within a collective area, signifying a higher tolerance between gender and household roles. The concept of togetherness and apartness is highly seen, with the collective area promoting a sense of togetherness and the designated individual working space defining the act of apartness. This arrangement confirms Patton's (2020) study, which states that WFH enhances the idea of togetherness by uniting families at home through the concept of apartness.

Following this line of arguments, this finding should be interpreted cautiously given the limitation of a terraced cell that merely accentuates the typical deep narrowed layout, restraining the view and minimising integration of the natural environment. In overcoming this congestion, emphasis should be given to its unique spatial preferences as it involves the balance between human emotions within multiple stages of potential spaces organised along the cell. While creating a proper workspace is essential for WFH, stages of a well-designed workspace in a terraced cell could improve spatial perception, enhance productivity, reduce distractions, and increase overall comfort. In such cases, various working spaces are crafted based on spatial flexibility inferred by spaciousness and open spaces, well integrated into the building envelope of decent lighting and ventilation. Note that 'openings' – through wall and floor – play essential roles in justifying specific locations for working. Furthermore, incorporating voids of landscape elements and water features within the terraced cell helps to boost mood and productivity, improving cognitive function. On the same note, the notion of 'timed-out' during the working session through certain hobbies and leisure activities helps to diversify the working experience, thus improving focus and working quality.

In addition to spatial preference, the provision of a workplace and the dynamism of workplace design is also defined by spatial proximity. This study suggests that furniture arrangement plays a crucial role in defining multiple stages of workspaces, creating a procession that affects the alignment of furniture concerning the potential features of the terraced house. Furthermore, the proximity between each furniture item is crucial in defining the spatial zones of the working area's main, first, and support degrees, highlighting the importance of a thoughtful and intentional approach to workspace design.

6.0 CONCLUSION

The COVID-19 pandemic has led to significant changes in how people work, with many adopting working from home (WFH). The success of WFH depends on the provision of suitable workspaces, which are influenced by aspects such as profession, household unit, lifestyle, spatial perception, and spatial proximity. Among professionals in the educational sector, WFH has become more common due to the flexibility of their work and access to nature-oriented environments.

In achieving a successful WFH environment, it is crucial to strike a balance between shared workspace and dedicated workspace through dedicated shared workspaces that can promote a balance between living and working. However, in the context of terrace houses where space congestion and deep plan layouts are common, creating flexible open spaces with sufficient natural light and ventilation and integrating workspace with leisure can overcome these limitations. Furthermore, the provision of workplaces and workplace design is also influenced by spatial proximity, with furniture arrangement important in defining multiple stages of workspaces.

The post-pandemic era will likely bring about a hybrid work environment that reflects the changing status quo of WFH and the focus on optimal arrangements for WFH in the future. With the increasing number of adults working from home with children, the need for equal, shared spaces has become more pressing. The COVID-19 pandemic has changed the status quo of WFH and has made it a part of life, with a high potential for WFH in the future.

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