

## Bridging multisensory and ud towards compassionate design in Malaysia interior design industry

Choy Jia Yi, Muhammad Firzan Abdul Aziz\* 

BSc Hons in Interior Architecture, School of Housing, Building and Planning, University Sains Malaysia, 11800, Minden, Penang, Malaysia



ARTICLE INFO	ABSTRACT
<p><i>Article history:</i> Received July 05, 2024 Received in revised form Sept. 18, 2024 Accepted January 12, 2025 Available online April 01, 2025</p> <p><i>Keywords:</i> Accessibility Inclusivity Interior design Multisensory Universal design</p> <p>*Corresponding author: Muhammad Firzan Abdul Aziz BSc Hons in Interior Architecture, School of Housing, Building and Planning, University Sains Malaysia, Penang, Malaysia Email: <a href="mailto:firzan@usm.my">firzan@usm.my</a> ORCID: <a href="https://orcid.org/0000-0003-0866-9123">https://orcid.org/0000-0003-0866-9123</a></p>	<p><i>In the field of interior design, creating inclusive and engaging spaces is crucial. Universal Design (UD) and multisensory are supportive approaches that can work together to achieve this, however there is a lack of studies on the importance of universal design within the Malaysian interior design industry and its relationship with multisensory in buildings. UD emphasizes building environments that are practical and accessible to everyone, while multisensory highlights the significance of engaging all senses according to the principles of sensory design. Hence, the impact of multisensory on universal design in creating inclusive and accessible interior design will be discussed in this research. While compassionate design practices mediate the relationship between the principles of universal design and the principles of sensory design, this study has two objectives: To identify the necessity of implementing universal design in different types of buildings; and, to investigate the interaction between multisensory and universal design to promote compassionate design practices. Data was gathered through questionnaires given to people in the built environment industry. It is expected that different types of buildings have varying priorities for sensory aspects, and the integration of UD and multisensory design is both important and impactful.</i></p>

### Introduction

The field of interior design nowadays is no longer only about aesthetics and utility, instead it has evolved to incorporate a more holistic approach that considers the various needs and experiences of individuals in today's rapidly evolving environment (Mba et al. 2024; Spence 2020; Tabassum and Park 2024). Universal Design (UD) refers to “the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design” (Persson et al. 2015). On the other hand, multisensory defines as the impressions that result from occurrences, where the sensory elements have been deliberately created according to principles

guiding how our brains perceive data from different senses (Velasco and Obrist 2021). Both UD and multisensory are two supportive approaches that can work together to create inclusive and engaging interior environments.

### Problem statement

In the Malaysian interior design industry, there is a lack of consensus on the importance of universal design, leading to differing perspectives and a constrained adoption of inclusive initiatives (Dawodu et al. 2022). In the absence of a common understanding and commitment to universal design principles, there exists a possibility of sustaining exclusive environments that are unable to meet a range of user requirements, such as those of the elderly and disabled. This will require

teamwork to address this problem by creating localized guidelines, raising awareness, offering training, and making sure interior spaces are inclusive and accessible to all.

Moreover, the limited understanding on the relationship between multisensory and universal design in Malaysian buildings hinders the development of comprehensive and tranquil spaces. In contrast to universal design, which emphasizes accessibility and inclusivity, multisensory design improves user experiences through sensory engagement. Unlocking creative design solutions that satisfy a range of user needs and produce emotionally compelling settings requires an understanding of how these paradigms interact and complement one another. In Malaysian interior projects, interdisciplinary research, cooperation, and case studies can shed light on integration techniques, guiding design practices and developing inclusive and compassionate design standards.

#### Research objectives

There are two main objectives in this research, which are (1) to identify the necessity of implementing universal design to different types of building, and (2) to investigate the interaction between multisensory and universal design to promote compassionate design practices.

#### Literature review

##### Universal Design

The term “Universal Design” was first created by Ronald L. Mace, who was an architect, product designer, educator, and consultant (Null 2013; Erdtman, Rasmus-Gröhn, and Hedvall 2021). His idea of the concept of universal design was that all buildings and products should be made as aesthetically pleasing and as functional as possible for all people, regardless of their age, ability, or situations (Persson et al. 2015). The goals of universal design are to remove barriers and fulfil a range of needs and preferences. These values place an emphasis on adaptability, simplicity, and intuitive use (Navaitienė and Stasiūnaitienė 2021).

In the Disability Act 2005, universal design defines as:

- (i) An environment's structure and design allow for access, awareness, and use:
  - a. To the greatest level feasible.
  - b. As independently and naturally possible.
  - c. In the greatest variety of circumstances.

- d. Without requiring any special improvements, assistive technology, or adaptations for people of any age or size or with any specific physical, sensory, mental, or intellectual ability or impairment, and

- (ii) Any electronics-based technique utilized in the creation of products, services, or systems that are designed to be used by everyone.

Moreover, there are seven principles that can further elaborate the concept of universal design. The principles are intended to be used as a guide for designing spaces, products, and communications. According to a statement by the NCSU Centre for Universal Design, the Principles "may be applied to evaluate existing designs, guide the design process and educate both designers and consumers about the characteristics of more usable products and environments."

The seven principles of universal design are:

- (i) Equitable Use: Individuals with diverse abilities can utilize and access the design.
- (ii) Flexibility in Use: A broad range of personal preferences and levels of expertise are supported in this design.
- (iii) Simple and Intuitive Use: The design is simple for anyone to understand and utilize regardless of the user's background, level of subject matter, language proficiency, or expertise.
- (iv) Perceptible Information: Regardless of the user's sensory capacities, the design effectively delivers information to individuals.
- (v) Tolerance for Error: The design reduces risks and the negative effects of unintentional or accidentally performed acts.
- (vi) Low Physical Effort: The design requires minimum physical work and can be used effectively and comfortably.
- (vii) Size and Space for Approach and Use: Regardless of their body type, posture, or usage of mobility support, users can approach, reach, handle, and use design features with adequate room and clearances (Centre for Excellence in Universal Design n.d.)

##### Multisensory

Multisensory experience can be defined as “impressions formed by specific events, whose sensory elements have been carefully crafted by someone” (Velasco and Obrist 2021). Multisensory experiences are also perceptions

derived from specific experiences in which the sensory elements have been deliberately created according to principles guiding how our brains perceive information from different senses (Velasco, Vargas, and Petit 2024; Cimier et al. 2025; Krüger, Hegele, and Rieger 2024). There are a few examples of multisensory experiences where certain situations or environments engage more than one sense:

- (i) Learning Environment: To improve learning and retention, multisensory teaching techniques in education include tactile materials, auditory messages, visual support, and even movement.
- (ii) Art and Design: Multisensory-appealing artwork or designs to produce richer experiences. For example, art pieces and installations that may consist of visuals, sound, and tactile elements.
- (iii) Culinary Experience: Food and drink can be a highly multisensory experience, such as perceiving the information of the flavor from its taste, smell and even its visual aspect.
- (iv) Marketing and Branding: Multisensory branding and marketing methods are being used by companies for creating lasting impressions, such as interesting visuals, sounds, and scents to trigger user perceptions and emotions

Classification of interior design buildings under categories of complexity

The Malaysian Institute of Interior Designers (MIID) have classified a list of interior design building types into two different categories of complexity (MIID 2020), which are:

- (i) Category 1: Interior Design Building Types of Exceptional Character and Complexity, and
- (ii) Category 2: Interior Design Building Types of Average Complexity Requiring a Moderate Degree of Design and Detailing.

**Table 1.** List of ID building types for category 1

Category 1: Interior design building types of exceptional character and complexity	
Aquaria	Heritage buildings

Category 1: Interior design building types of exceptional character and complexity	
Art galleries	Hospitals, medical and health clinic
Auditoriums	Legislative buildings
Boutique hotels	Mausoleums
Casinos	Memorials
Chancery buildings	Monuments
Cinemas	Museums
Conservation works	Nursing homes
Concert halls	Observatories
Convention halls and facilities	Palaces
Court houses	Preservation and restoration
Embassy buildings	Research facilities
Entertainment centres	Theatres
Experiential and interactive centre	Transportation hubs
Food and beverage (restaurants, bars, bakeries etc.)	Vehicles (coaches, yacht, buses, trains, planes)

**Table 2.** List of ID building types for category 2

Category 2: Interior design building types of average complexity requiring a moderate degree of design and detailing	
Assembly halls	Police stations
Banks	Post offices
Community centres	Prisons
Canteens	Recording studios
Corporate office spaces	Religious buildings
Departmental stores	Residentials
Educational facilities (school, universities, colleges, kindergartens)	Retails and kiosks
Exhibition and exposition spaces	Shopping centres / complexes
Fitness centre	Showrooms, sales gallery, show units
Laboratories	Skating rinks (covered, ice/roller skating)
Libraries	Spa and wellness centre
Marinas	Supermarkets
Markets	Veterinary clinics
Petrol station spaces	And others not listed in Category 1

Source: MIID 2020

Based on previous studies, it is shown that most research studied on the concept of universal design and how does universal design give accessibility and impact towards the users (Persson et al. 2015). There is also research that studied on how multisensory influences the way people perceive and understand information (Velasco and Obrist 2021). However, it is still an inquiry on the fact that there is a lack of studies about how multisensory can be impactful towards universal design in creating inclusive and accessible designs.

## Methods

The research will be conducted qualitatively to obtain the relevant findings. A list of

questionnaires will be prepared, which will be divided into two sections:

(i) Section A: The Priority of Five Human Senses in Building Design

In this section, respondents are required rank the five human senses (sight, sound, smell, taste, touch) based on their importance in building design. A few factors such as safety, comfort, functionality, and overall user experience may be considered when determining the importance of each sense. Respondents are required to assign each sense with a rank, based on a ranking scale that will be given in the questionnaire form. Moreover, respondents are also required to provide a justification for the rankings that they chose to understand their reasoning.

(ii) Section B: Necessity of Universal Design Application in Interior Design Building Types

Next, respondents will be asked to rate various types of interior design buildings, that are listed and classified by The Malaysian Institutes of Interior Designers (MIID), on their necessity for applying Universal Design principles. A rating scale will be given to allow respondents to refer to before rating.

To obtain findings that are relevant, the target respondents will be individuals that are highly educated in interior design, UD, and multisensory aspects. Moreover, to obtain stronger data findings, the individuals would have to be from a professional field who are more experienced and knowledgeable. Hence, the selected target respondents are individuals that are from the built environment industry such as interior designers, architects, students and more for this research.

#### Case study

In this research, the study will specifically focus on the domain of Malaysian interior design industry. Interior design continues to devote more consideration to universal design principles in Malaysia, a multicultural country with diverse societies.

The Malaysian Institute of Interior Design (MIID) is an institute where their goal is to create an educated Malaysian population that is knowledgeable about and appreciative of the creative field of interior design. The institute consists of professional members who contribute for the MIID Council. From providing lectures, organizing workshops and competitions, to actively engaging with international professional design bodies, MIID continues to educate, encourage, and cultivate stronger connections

between members of the public and professionals (MIID 2024).

While universal design is being widely used in various fields, such as product design, information technology (IT), transportation, and more, universal design is also an important consideration to be applied in the field of built environment, particularly, in this research, the interior design field (González-Alonso and González-Lozano 2024; Zallio and Clarkson 2024; Szaszák and Kecskés 2020). In designing an interior space, the seven universal design principles will be the guide of appliance, creating a space that is accessible for all. Other than that, there are a few key aspects of universal design that can be considered in interior design: (i) Sensory considerations: addressing tactile design features, acoustics, and lighting levels, as well as other sensory needs; (ii) Ergonomic furniture: choosing comfortable furniture that encourages proper posture for people with different levels of physical capability; (iii) Colour and contrast: utilising colour schemes and contrasts to enhance visibility and navigation, particularly for those with low vision or colour vision impairments; (iv) Safety features: Including safety elements like non-slip flooring, grab bars for bathrooms, and easily accessible lighting, heating, and cooling controls to provide a safe space for all users.

Multisensory design engages people on a sensory and experiential level, going beyond simple accessibility and practicality. It takes into consideration the various ways that senses including sight, sound, touch, smell, and even taste contribute to the whole impression of a place. Comfort, satisfaction, and overall well-being can all be improved by using multisensory elements of design. Some examples of key aspects of multisensory interior design are: (i) Lighting design: the process of generating atmosphere and evoking feelings using dynamic lighting systems, natural light sources, and lighting effects (Kim and Mansfield 2021). Various colour temperatures and illumination levels can affect how people feel and how productive they are (Sarialioglu 2025; Frutos, Pellizzari, and Hvass 2024); (ii) Texture and Materials: Choosing tactile finishes, materials, and textures that stimulate the sense of touch promote engagement (Zeng et al. 2024). Richness and interest are added to a place by using features such as different finishes, textured walls, soft fabrics, and natural wood (Faucheu et al. 2019); (iii) Soundscapes: Using sound design and acoustics to regulate

noise levels, minimise echoes, and provide pleasing auditory effects (Hong and Chong 2023). Conducive materials, sound-masking gadgets, and strategically situated audio sources all help create a pleasant auditory experience (Rachman, Aletta, and Kang 2024); (iv) Aromatherapy and Scents: Adding natural fragrances or aromatherapy components can enhance focus, mood regulation, or relaxation. Aromas that are soothing or energising, such as citrus or lavender, can be incorporated into interior spaces through diffusers, natural materials, or greenery (Yildirim et al. 2024).

By integrating multisensory design approaches with universal design principles, interior designers can create environments that are not just practical and accessible but also interesting, entertaining, and conducive to wellbeing (Finnigan 2024; Firmansyah, Cardiah, and Retno Palupi 2021; Ghamari et al. 2025). By incorporating these ideas, spaces could become more inclusive and suit a wide range of user demands and preferences.

## Results and discussion

The survey was completed by 50 respondents with different backgrounds. table 3, 4 and 5 shows the demographic background of the respondents.

**Table 3.** Demographic of respondents (Age)

Age	
18 - 25	26 and above
30	20

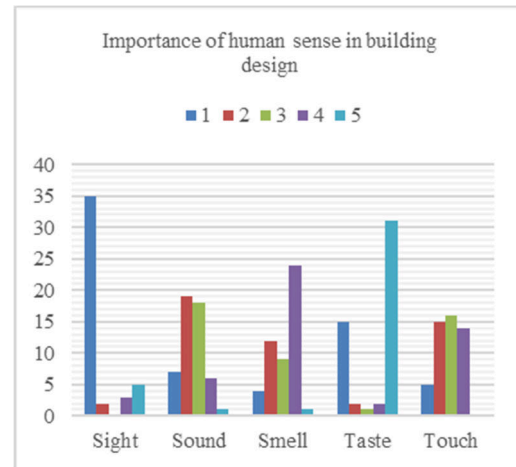
**Table 4.** Demographic of respondents (Occupation)

Occupation		
Interior designer/interior architect	Architect	Student
24	1	25

**Table 5.** Demographic of respondents (Years of experience/years of study)

Years of experience/years of study		
1 - 5	5 - 10	11 and above
40	8	2

Figure 1 summarizes the rankings of five human senses based on their importance in building design.



**Figure 1.** Results for section A question 1

From the results above, it was found that 70% of the respondents (35 people) chose sight as the most important human sense in building design. This choice emphasises how important visual components are to creating surroundings that are engaging and unique. Respondents provided a variety of reasons for emphasizing the importance of sight in building design. The most common themes included the ability to perceive information, human’s first impression, visual impact or impression, and the ability to navigate and identify danger. For instance, several respondents pointed out that visual aspects of design tend to be the first thing that people see in a building, which makes them essential for creating a strong first impression.

On the other hand, 62% of the respondents (31 people) ranked taste as the least important human sense in building design. This finding suggests that taste is not typically associated with the sensory experience of a built environment. Respondents also provided justifications for their choice. The most often mentioned themes are the practical irrelevance of taste in non-food environments and lack of an apparent connection between taste and architectural elements. For example, some respondents highlighted that building design can not be tasted and is less crucial in terms of building design.

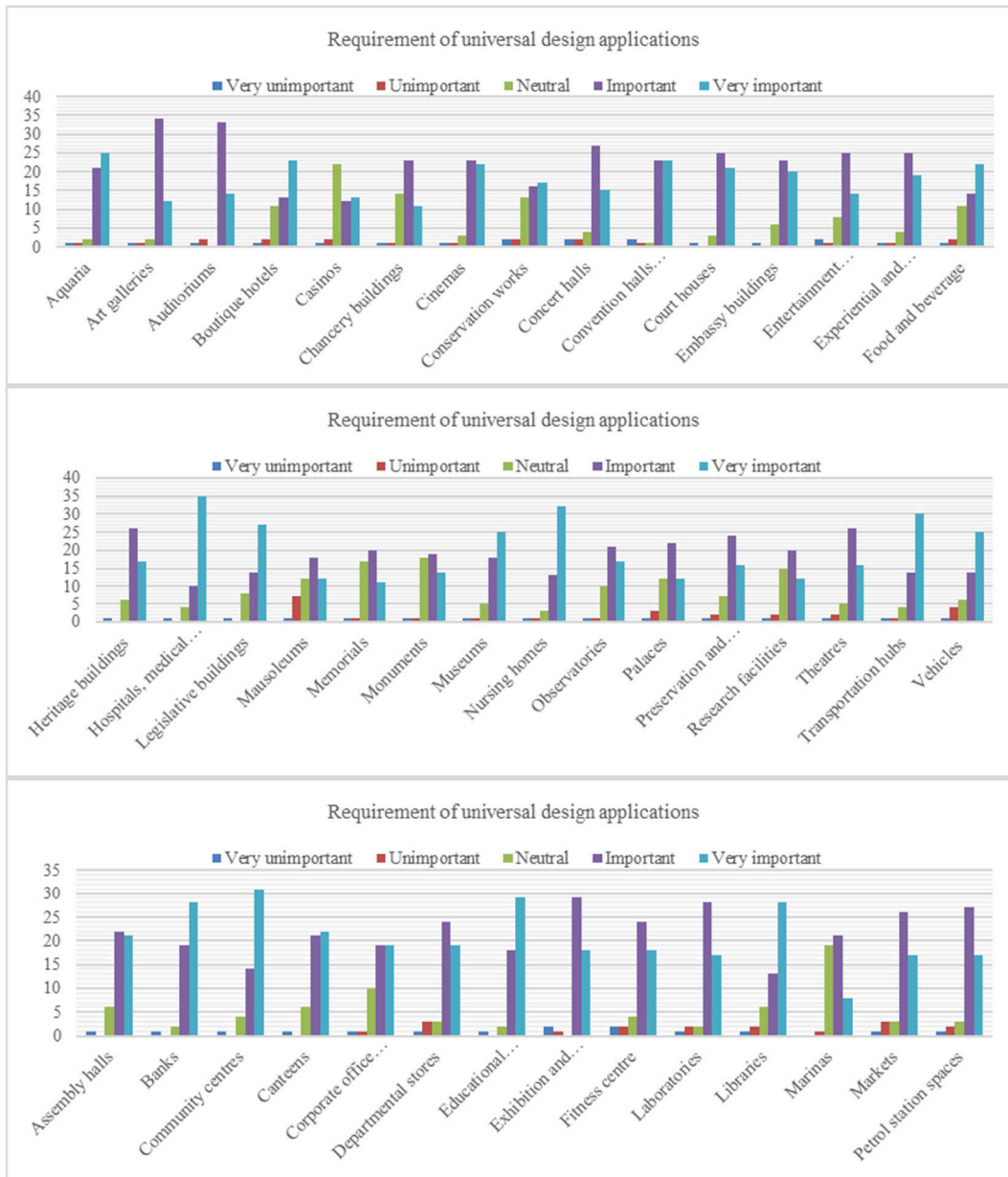
### Representation quotes

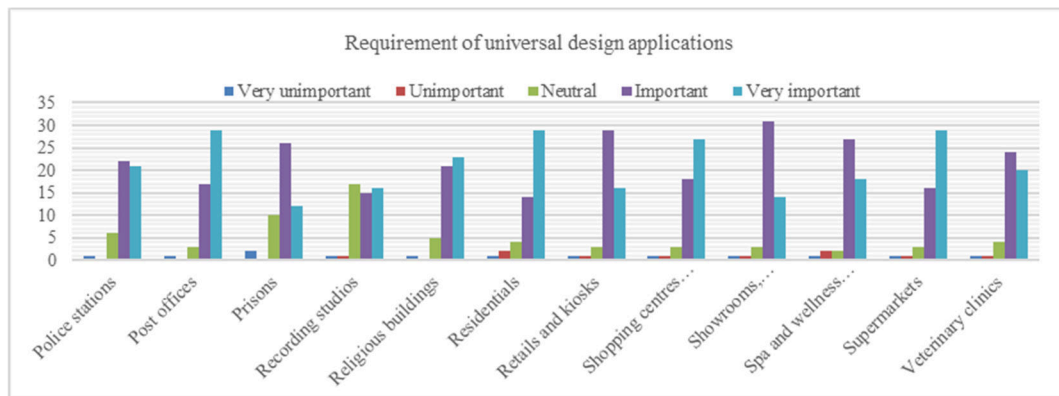
- (i) “Vision always comes first as compared to other senses. With visuals, people can appreciate the building design at their first impression.”

- (ii) "Sight is most important sense in building design because it influences how we perceive space, light, colour, and form."
- (iii) "Visual impression is important."
- (iv) "Not every building required us to taste something unless it is a F&B building."
- (v) "Taste is not a common activity involving direct interaction with building materials or architectural elements."

- (vi) "It is impractical to incorporate taste into the design elements of most buildings, as it does not contribute to the functionality or aesthetics of the structure."

Next, [figure 2](#) summarizes the results of section B (necessity of universal design application in interior design building types).





**Figure 2.** Results for section B

The respondents' views on the importance of universal design across 56 different building types are shown in a bar chart. The data shows that certain building types, such as hospitals, medical and health clinics, nursing homes, transportation hubs, and community centres, were consistently rated as “Very Important.” Building types that generally qualify as “Neutral” or “Unimportant,” such as mausoleums, casinos and marinas, on the other hand, were given lower importance ratings.

Hospitals, medical and health clinics were rated as “Very Important” by 70% of respondents, followed by nursing homes, with 64% of respondents, transportation hubs with 60% of respondents, and community centres with 62% of respondents rated as “Very Important.” The results have greatly shown and reflected the significance of the need of inclusive and accessible design in these building types. On the other hand, mausoleums were ranked as “Unimportant” by 14% of respondents, who gave them a lower importance level. This could be due to individuals believe that such spaces are primarily utilised for functional purposes and are not often visited by the general public. Ratings for casinos and marinas were rated by 44% and 38% of respondents respectively, classifying them as “Neutral,” indicating differing views on the necessity of universal design in such areas.

For one to create inclusive and compassionate environments, recognising the relationship between multisensory and universal design is essential. The goal of universal design is to create surroundings that are useable and accessible to everyone, irrespective of age, disability, or other characteristics. By appealing to a variety of senses, multisensory design enhances this and can increase a space's overall usability and satisfaction.

A greater range of abilities and preferences can be met by universal design through multisensory aspects. In the context of education, for example, offering knowledge via tactile, audio, and visual channels can accommodate a variety of learning demands and styles. By providing repeated indications that strengthen understanding and orientation, this method benefits all users as well as those with sensory impairments.

In universally designed environments, multisensory design could significantly enhance the user experience by creating more interesting and engaging experiences. For example, in public transport hubs, individuals with different sensory preferences and needs often find it simpler to navigate the area when clear visual signage is accompanied with auditory announcements and tactile guide paths. By ensuring that everyone has access to vital information, this multimodal strategy reduces anxiety and enhances the experience overall.

## Conclusions

This research aims to an approach to study the relationship between universal design and multisensory towards the compassionate design in the interior design industry of Malaysia. Across different researches that discussed about universal design and multisensory, there is still lack of studies on how multisensory can be impactful towards universal design in creating various interior designs. Through engaging individuals from built environment industry, opinions and perspectives were gathered on the necessity and priority of applying UD principles across different building types, as well as the prioritization of

multisensory aspects in interior design. Based on the findings, it can be seen that applying universal design is necessary in buildings such as hospitals, nursing homes and community centres, as inclusive design is essential in these buildings. Other than that, the findings also showed that the level of priority of five senses varies with each building types, with sight as the most prioritized human sense in designing these buildings due to visual aspects in a building gives away a strong impact to people. The outcome of this study hopes to provide clear and useful insights for future studies that are relevant to the relationship between universal design and multisensory in the domain of interior design industry.

## References

- Cimier, Amandine, Beatrice Biancardi, Jérôme Guegan, Frédéric Segonds, Fabrice Mantelet, Camille Jean, Claude Gazo, and Stéphanie Buisine. 2025. 'Multisensory Objects' Role on Creativity'. *Journal of Creativity* 35 (1): 100092.  
<https://doi.org/10.1016/j.yjoc.2024.100092>.
- Dawodu, Ayotunde, Haoyue Dai, Tong Zou, Hongjie Zhou, Wenhan Lian, Jumoke Oladejo, and Felix Osebor. 2022. 'Campus Sustainability Research: Indicators and Dimensions to Consider for the Design and Assessment of a Sustainable Campus'. *Heliyon* 8 (12): e11864.  
<https://doi.org/10.1016/j.heliyon.2022.e11864>.
- Erdtman, Emil, Kirsten Rasmus-Gröhn, and Per-Olof Hedvall. 2021. 'Universal Design as Guiding, Striving and Unifying: A Qualitative Study about How Universal Design Is Understood, Practised and Realised in Contemporary Sweden'. *Scandinavian Journal of Disability Research* 23 (1): 158–68.  
<https://doi.org/10.16993/sjdr.770>.
- Faucheu, Jenny, Benjamin Weiland, Mihaela Juganaru-Mathieu, Arnaud Witt, and Pierre-Henri Cornuault. 2019. 'Tactile Aesthetics: Textures That We like or Hate to Touch'. *Acta Psychologica* 201 (October): 102950.  
<https://doi.org/10.1016/j.actpsy.2019.102950>.
- Finnigan, Kathryn Angela. 2024. 'Sensory Responsive Environments: A Qualitative Study on Perceived Relationships between Outdoor Built Environments and Sensory Sensitivities'. *Land* 13 (5): 636.  
<https://doi.org/10.3390/land13050636>.
- Firmansyah, Rangga, Tita Cardiah, and Fajarsani Retno Palupi. 2021. 'THE ASPECTS OF UNIVERSAL DESIGN IN INTERIOR DESIGNING'. *Pendhapa* 11 (1): 39–45.  
<https://doi.org/10.33153/pendhapa.v11i1.3431>.
- Frutos, Laura de, Luca Pellizzari, and Mette Hvass. 2024. 'The Influence of Urban Lighting on the Sense of Belonging'. *IOP Conference Series: Earth and Environmental Science* 1320 (1): 012011.  
<https://doi.org/10.1088/1755-1315/1320/1/012011>.
- Ghamari, Mehrdad, Suvish, Agaah Ashrafi Dehkordi, Chan Hwang See, Ashkan Sami, Hongnian Yu, and Senthilarasu Sundaram. 2025. 'Dementia Friendly Buildings—Approach on Architectures'. *Buildings* 15 (3): 385.  
<https://doi.org/10.3390/buildings15030385>.
- González-Alonso, María Yolanda, and Beatriz González-Lozano. 2024. 'Challenges in Housing Accessibility Towards Universal Design'. *Architecture* 4 (4): 917–29.  
<https://doi.org/10.3390/architecture4040048>.
- Hong, Joo-Young, and Keng Hua Chong. 2023. 'Designing Public Soundscapes through Social Architecture and Soundscape Approaches: Reflective Review of Architectural Design Studio'. *Sustainability* 15 (16): 12399.  
<https://doi.org/10.3390/su151612399>.
- Kim, Dong Hyun, and Kevin Mansfield. 2021. 'Creating Positive Atmosphere and Emotion in an Office-like Environment: A Methodology for the Lit Environment'. *Building and Environment* 194 (May): 107686.  
<https://doi.org/10.1016/j.buildenv.2021.107686>.
- Krüger, Britta, Mathias Hegele, and Martina Rieger. 2024. 'The Multisensory Nature of Human Action Imagery'. *Psychological Research* 88 (6): 1870–82.  
<https://doi.org/10.1007/s00426-022-01771-y>.
- Mba, Emeka J., Francis O. Okeke, Ajuluchukwu E. Igwe, Chinelo A. Ozigbo, Peter I. Oforji, and Ikechukwu W. Ozigbo. 2024. 'Evolving Trends and Challenges in Sustainable Architectural Design; a Practice Perspective'. *Heliyon* 10 (20): e39400.

- <https://doi.org/10.1016/j.heliyon.2024.e39400>.
- MIID. 2024. “The Malaysian Institute of Interior Designers (MIID) or Pertubuhan Perekabentuk Dalaman Malaysia (PPDM) Is the National Institute Representing the Interior Design Profession in Malaysia. It Is an Amalgamation of Two Previous Bodies Namely, Interior Designers Institute of Malaysia (Institut Perekabentuk Dalaman Malaysia or IPDM) and the Malaysian Society of Interior Designers (MSID).” <https://miid.org.my/about-miid/>. 2024.
- Navaitienė, Julita, and Eglė Stasiūnaitienė. 2021. ‘The Goal of the Universal Design for Learning: Development of All to Expert Learners’. In , 23–57. [https://doi.org/10.1007/978-3-030-80658-3\\_2](https://doi.org/10.1007/978-3-030-80658-3_2).
- Null, Roberta, ed. 2013. *Universal Design*. CRC Press. <https://doi.org/10.1201/b15580>.
- Persson, Hans, Henrik Åhman, Alexander Arvei Yngling, and Jan Gulliksen. 2015. “Universal Design, Inclusive Design, Accessible Design, Design for All: Different Concepts—One Goal? On the Concept of Accessibility—Historical, Methodological and Philosophical Aspects.” *Universal Access in the Information Society* 14 (4): 505–26. <https://doi.org/10.1007/s10209-014-0358-z>.
- Rachman, Zulfi, Francesco Aletta, and Jian Kang. 2024. ‘Exploring Soundscape Assessment Methods in Office Environments: A Systematic Review’. *Buildings* 14 (11): 3408. <https://doi.org/10.3390/buildings14113408>.
- Sarialioglu, Sinem. 2025. ‘ENHANCING COGNITIVE PROCESSES’. *Lighting Design + Application* 55 (2): 42–45. <https://doi.org/10.1177/03606325251318553>.
- Spence, Charles. 2020. ‘Senses of Place: Architectural Design for the Multisensory Mind’. *Cognitive Research: Principles and Implications* 5 (1): 46. <https://doi.org/10.1186/s41235-020-00243-4>.
- Szaszák, Gabriella, and Tibor Kecskés. 2020. ‘Universal Open Space Design to Inform Digital Technologies for a Disability-Inclusive Place-Making on the Example of Hungary’. *Smart Cities* 3 (4): 1293–1333. <https://doi.org/10.3390/smartcities3040063>.
- Tabassum, Rafa Ramisha, and Jihyun Park. 2024. ‘Development of a Building Evaluation Framework for Biophilic Design in Architecture’. *Buildings* 14 (10): 3254. <https://doi.org/10.3390/buildings14103254>.
- Velasco, Carlos, Jessica Vargas, and Olivia Petit. 2024. ‘Multisensory Experiences and Technology in the Context of Wine Experiences’. *Journal of Wine Research* 35 (2): 85–100. <https://doi.org/10.1080/09571264.2024.2310304>.
- Velasco, Carlos, and Marianna Obrist. 2021. “Multisensory Experiences: A Primer.” *Frontiers in Computer Science* 3 (March). <https://doi.org/10.3389/fcomp.2021.614524>.
- Yildirim, Muhammed, Anastasia Globa, Ozgur Gocer, and Arianna Brambilla. 2024. ‘Multisensory Nature Exposure in the Workplace: Exploring the Restorative Benefits of Smell Experiences’. *Building and Environment* 262 (August): 111841. <https://doi.org/10.1016/j.buildenv.2024.111841>.
- Zallio, Matteo, and P. John Clarkson. 2024. ‘A Study to Depict Challenges and Opportunities Building Industry Professionals Face When Designing Inclusive and Accessible Buildings’. *Architectural Science Review* 67 (3): 268–79. <https://doi.org/10.1080/00038628.2023.2270983>.
- Zeng, Fangmeng, Guanghua Wang, Jie Qiao, Qicai Wang, Meiqin Wu, Xiangsong Zeng, and Xinghua Hong. 2024. ‘Modeling the Relationship between Fabric Textures and the Evoked Emotions through Different Sensory Perceptions’. *Journal of Engineered Fibers and Fabrics* 19 (January). <https://doi.org/10.1177/15589250241248761>.

#### Author(s) contribution

**Choy Jia Yi** contributed to the research concepts preparation, methodologies, investigations, data analysis, visualization, articles drafting and revisions.

**Muhammad Firzan Abdul Aziz** contribute to the research concepts preparation and literature reviews, data analysis, of article drafts preparation and validation.

This page is intentionally left blank