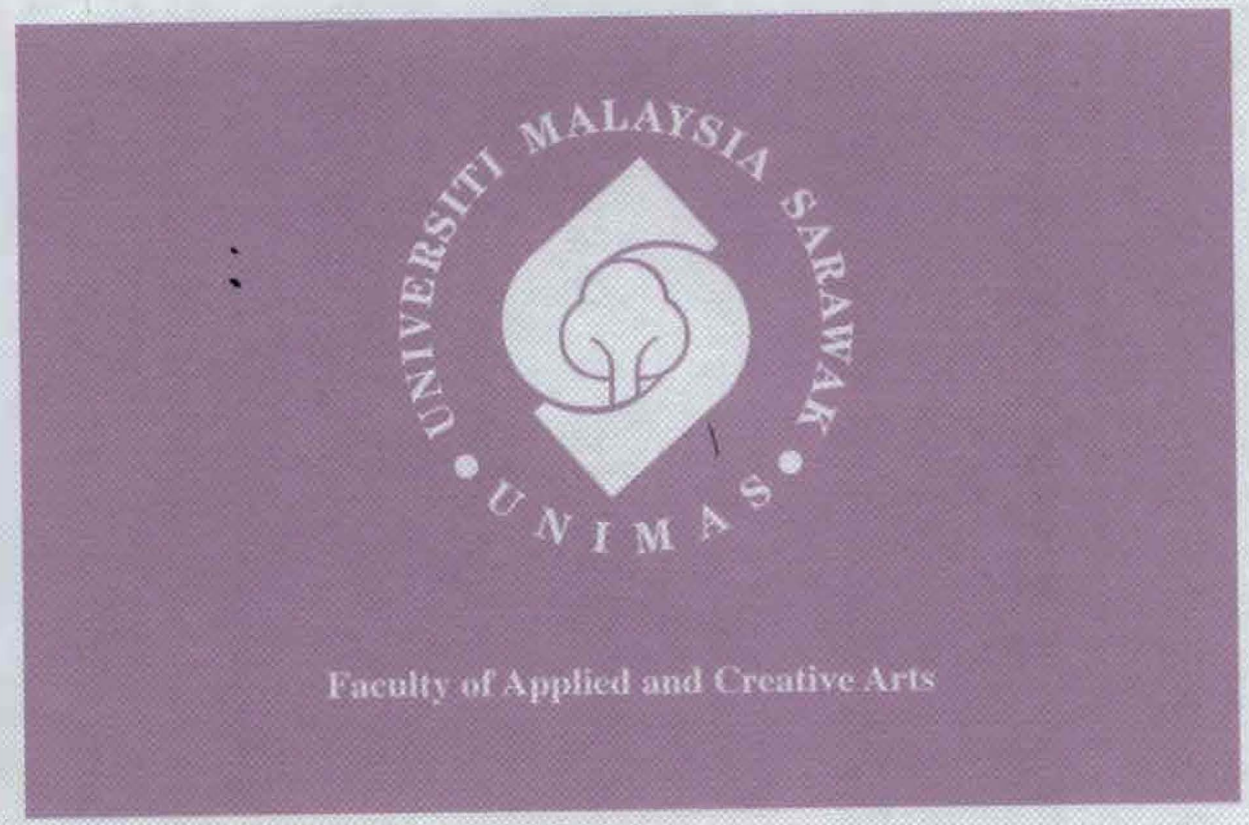


THE SITTING POSTURE AND BEHAVIOUR FOR FLOOR-SITTING FURNITURE DESIGN IN MALAYSIA

Mohd Najib Abdullah Sani

Doctor of Philosophy
(Industrial Design)
2015

THE SITTING POSTURE AND BEHAVIOUR FOR FLOOR-SITTING FURNITURE DESIGN IN MALAYSIA

MOHD NAJIB ABDULLAH SANI

A thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

Faculty of Applied and Creative Arts

Universiti Malaysia Sarawak

2015

To my Mother and Father, and my wife Zyafydah for their love, constant support and prayers;

and

to my firstborn descendant, Sabri Mursyidi – You are Allah's gift to me and this work is my gift to you.

ACKNOWLEDGEMENTS

In the name of Allah, the Most Gracious, the Most Merciful. All praises and thanks are due to Allah the Almighty, the Giver of magnanimous blessings and gifts towards the success, and completion of this thesis. Also, to all those who have helped and contributed along the way in its completion, I sincerely thank you with the utmost of gratefulness.

Above all, a notable gratitude is dedicated to my supervisor, Dr. Saiful Bahari Mohd Yusoff, for his guidance, mateship, time, advice, and encouragement he has provided me throughout my study years. Additionally, as a person, through his care, attention, and support both emotionally and spiritually he has helped further motivate me to pursue this research, and encouraged me to stay persistent along the way. I am also thankful to my second supervisor Mr. Firdaus Abong Abdullah for his thought provoking discussions, kindness, and for allowing me to have the opportunity to explore my research capabilities extensively. To my mentor, Associate Professor Dato' Dr. Sharifuddin Zainuddin at the University of Malaya, for his critical thoughts, and profound remarks on many aspects pertaining to life from whence invariably fuelled and cultivated my critical thinking. For this, I am eternally grateful and highly appreciative.

My appreciation also extends to Professor Dr. Syed Ahmad Iskandar Syed Ariffin at the Centre For The Studies of Malay Built Environment [KALAM] in the Universiti Teknologi Malaysia [UTM] whose very own research has sparked and inspired this present research endeavour. I sincerely thank Dr. Sabrizaa Abd Rashid at the Centre For Knowledge And Understanding of Tropical Architecture and Interior [KUTAI] Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA [UiTM] in Perak and Associate Professor Datu Dr. Hj. Sanib Hj. Said at the Faculty of Social Sciences Universiti Malaysia

Sarawak [UNIMAS] for their insightful discussions in assembling the fragments of cultural and technical knowledge towards the trajectory of this research foundation.

Special thanks to my generous sponsors the Government of Malaysia and the Universiti Sains Malaysia [USM] for the belief and opportunities given to pursue this study, and the gracious allowance support that has enabled this thesis possible. To Mr. Joe Norton for the proofreading of every text in this thesis, I sincerely thank and appreciate your time and meticulousness.

I am deeply grateful for the help emitted by Dato Haji Fadillah Haji Yusof the Member of the Parliament of Malaysia for the Petra Jaya constituency in Sarawak for his kindness, and hospitality in helping my family, and I settle in Samarahan for the past three years.

At the Faculty of Medicine and Health Sciences UNIMAS, I am greatly indebted to Professor Dr. Ahmad Hata for his expertise in treating my son's *Congenital Talipes Equino Varus* [CTEV] along with the emotional support given to my wife and I in order for us to overcome our fear and worries in facing the challenges undertaken.

Penultimately to my resident parents in Australia Dr. Michael Powell, Edwina Powell and the family for their love, kindness, thoughtfulness, and countless support through my ups and downs. My deepest and utmost gratitude is due to my parents, wife, and family for their constant prayers, patience, understanding, and for supporting me in numerous ways with tremendous amounts of effort to overcome the challenges and obstacles faced over the years. Finally, for my son Sabri Mursyidi, the apple of my eye, for him I will do anything and die for, and through this he has helped facilitate this effort to keep moving.

Mohd Najib Abdullah Sani

ABSTRACT

The intertwining of the cross-discipline studies forms the influence for novel oeuvre in the study of anthropology, ethnography, sociology, history and literary studies that are often conducted in fragments. With reference to the subject of floor-sitting, and tapered into the Malaysian practice, this phenomenon was investigated within the verge of furniture design that is integrated within the ergonomics signification. This thesis presents the study of floor-sitting behaviour within the ergonomics' science context for the development of floor-sitting furniture designs. This study was conducted by observing floor-sitting behaviours using the video surveillance method, synchronizing the time and event sampling method within the perimeters of the home environment. The floor-sitting furniture prototype was used as the auxiliary tool to manifest the dwellers' postural dynamics. Data collection was gathered over a 6-month period in order to identify the frequency of various floor-sitting postures, based on the synthesis of the ergonomics science elements signification. These include: physics, psychology, anatomy, physiology, and engineering, which are mellifluously engaged and articulated within the ergonomics' ergosystems. The prototype of the floor-sitting furniture contemporaneously exhibits the significant context of objects used as perching mechanisms; where through this engagement to floor-sitting posture expressions, the dwellers form another dimension to the extensive sitting comfort definition. This study has successfully produced a detailed illustration of the different floor-sitting postures that are idyllically practiced by Malaysians at home. The majority of houses used in this study were fully furnished. However, it was identified that the majority of Malaysians observed in this study typically preferred sitting on the floor with their bodies perched against objects used for resting. A compilation of floor-sitting data was obtained, and the designed prototype demonstrates the capability of

the culturally linked subject's extension within the explication of the ergonomics, and creative design contexts.

Keywords: cross discipline studies, floor-sitting behaviour, ergonomics, ergosystems, ergonomics science elements, furniture design.

ABSTRAK

Hubung jalin daripada pengajian rentas-bidang memberi pengaruh terhadap penghasilan karya baru dalam bidang antropologi, etnografi, sosiologi, sejarah dan kesusteraan, yang lazimnya dijalankan secara fragmen. Dengan merujuk subjek yang duduk di lantai, yang menjadi amalan orang Malaysia, maka fenomena ini dikaji dari sudut reka bentuk perabot yang disepadukan mengikut kesignifikan ergonomik. Tesis ini memaparkan kajian tingkah laku duduk di lantai dalam konteks sains ergonomik untuk pembangunan reka bentuk perabot duduk di lantai. Kajian ini mengamati tingkah laku duduk di lantai dengan menggunakan kaedah pengawasan video, penyegerakan kaedah pensampelan masa dan peristiwa dalam perimeter persekitaran rumah. Prototaip perabot duduk di lantai digunakan sebagai alat sokongan untuk melihat kedinamikan postur badan pengguna perabot tersebut. Data dikumpul dalam tempoh 6 bulan untuk mengenal pasti kekerapan pelbagai postur duduk di lantai, berdasarkan sintesis kesignifikanan elemen sains ergonomik. Elemen tersebut termasuk: fizik, psikologi, anatomi, fisiologi dan kejuruteraan yang disepadukan secara harmoni dalam ergosistem ergonomik. Prototaip perabot duduk di lantai juga mempamerkan kesignifikanan konteks objek yang digunakan sebagai mekanisme untuk merehatkan badan. Justeru, pengguna membentuk suatu dimensi lain bagi definisi keselesaan duduk yang luas melalui hubungan dengan ekspresi postur duduk di lantai. Kajian ini berjaya menghasilkan suatu ilustrasi yang terperinci tentang perbezaan postur duduk di lantai, yang biasanya diamalkan di rumah oleh orang Malaysia. Majoriti rumah yang terlibat dalam kajian ini mempunyai perabot yang lengkap. Walau bagaimanapun, berdasarkan pengamatan kajian ini, majoriti orang Malaysia cenderung duduk di lantai bersandarkan objek yang diguna untuk beristirahat. Satu kompilasi data duduk di lantai diperoleh dan rekaan prototaip

menunjukkan keupayaan subjek yang dikaitkan dengan budaya diperkembangkan dalam ruang lingkup penjelasan ergonomik, dan konteks reka bentuk yang kreatif.

Kata kunci: *Pengajian rentas-bidang, tingkah laku duduk di lantai, ergonomik, ergosistem, elemen sains ergonomik, reka bentuk perabot.*

CONTENT **PAGE**

3.0 CHAPTER 3: THE COHERENCY OF THE SOURCES

5.0 CHAPTER 5: DATA ANALYSIS

List of Tables

List of Figures

List of Plates

Chapter 1.0
INTRODUCTION

1.1 Introduction

While Western society does not customarily exercise and accept ground-based sitting [except in some regions of South America according to Hewes (1955)], it is nevertheless, a common custom that is symbolically practiced in Malaysia, and many other Asian countries. The sitting position that is favourably associated with the legs crossed is commonly recognized for its association to cultural traditions, and religious implications. As a common alternative posture to universal chair sitting, and by viewing this phenomenon into wider perspectives; ground-based sitting has the capacity to be explored, and understood within the biomechanical articulation of ergonomics justifications. Floor sitting is culturally anchored, and that was established; on the contrary, due to its biomechanical variegated characteristics, this phenomenology and the subject's exploration could potentially contribute to another level of knowledge beyond its cultural recognitions. The sitting position is often irregular with the posture tending to change incontrovertibly. This is the result of floor sitting being practiced within ample ground space, and varying postures such as: sitting with the legs folded to the side, sitting with one knee up and the other stretched, and sitting with legs stretched out. This natural tendency has been called *free posturising* (Kroemer, 1994) and has been observed as another branch of an extensive definition of comfort while sitting. Such postural behaviour can be categorised as *habits*; a bodily intent to assimilate to the environment (Hewes, 1955). The floor-sitting posture establishes the human kinaesthetic experience within the seated environment that subsequently engages emotions and physical routines.

Plate 1.1. Knoll's's postural studies. Reprinted from *The Future of Ergonomic Office Seating*, by T. Springer, 2009, Knoll Inc. Copyright 2009 by Knoll Inc.

The environment provides a 'free stage' for unrestricted postural expressions. These complementary reactions of the psychological and physiological phenomenon are concomitantly predominant in understanding floor-sitting behaviour in clearer ergonomics manifestation, and subsequently flourish as the contribution to the development of the floor-sitting furniture design. Knoll and Herman Miller's Aeron office chair design, [see *Plate 1.1*, *Plate 1.2*] demonstrates this significance where the sitting behaviour within the office environment is centred. However, in relation to the residing seating where floor-sitting is normally practice with the coherency to the cultural characteristics and behaviour of regional society, Kenji Fujimori's 1961 *Zaisu* chair [Plate 1.3] appears legitimate to describe such engagement to seating design. With the focus on Malaysian context, individual's sitting behaviour in the home environment was researched.

Plate 1.2. Herman Miller's Aeron office chair design. Reprinted from 10 Task Chairs For Your Office, by Carla Turk, 2012, Retrieved from http://finishboard.com/10-task-chairs-for-your-office/. Copyright [2013] by finishboard.com.

Plate 1.3. Zaisu chair. Reprinted from arenot Yahoo! store, by Yahoo Japan, 2008, Retrieved from http://store.shopping.yahoo.co.jp/arenot/-08295.html. Copyright [2013] by yahoo.co.jp.

Similarly, Wayne Hudson's (2000) PhD research titled *Props For Social Discourse*, connects postural behaviour signification to the breadth of furniture design, in which he induced the discussion of the relationship between the space within objects that people sit or lean against, and the connections to sitting behaviours of the Tasmanians. He encoded such relationship into a series of sitting and leaning furniture designs [see *Plate 1.4*]. Consequently, the environment, or space constituted the essential elements incorporating the human behavioural system in order to design the extension of the comfort sitting definition in the context furniture design. The availability of the designed floor-sitting concept furniture in the market demonstrates the expendability of a cultural stamp into a universal cognizance for user centric production; thus, directing the concept exploration to fit into the context of

Plate 1.4. Hudson's Body Hug [leaning furniture]. Reprinted from *Props for Social Discourse*, by W. Z. Hudson, 2000, Hobart, AUS: University of Tasmania. Copyright 2000 by W. Z. Hudson.

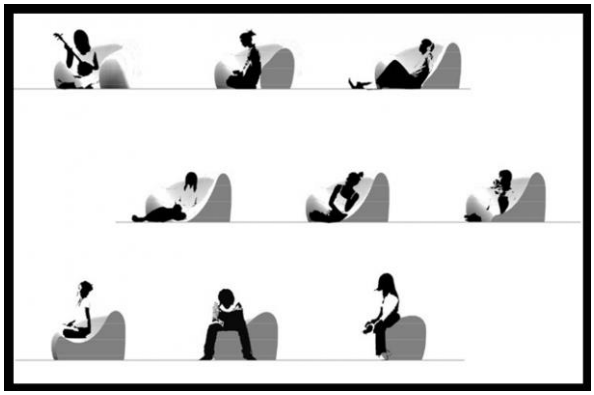


Plate 1.5. Cheungvogl's Umarmung Yatzer . Reprinted from Umarmung, Japan by Cheungvogl, by Costas Voyatzis, 2009, Retrieved from http://www.yatzer.com/Umarmung-Japan-by-Cheungvogl.html. Copyright [2013] by Yatzer.

contemporary furnishing. The work of Cheungvogl (2009), and Cho Hyung Suk (2009) are few to be named [see *Plate 1.5, Plate 1.6*] that demonstrate such concept exploration. This researcher's research is not an attempt to repudiate the existing universal seating height concept, but to explore the culturally linked sitting subject further in twofold. First, to synchronize the floor-sitting subject by integrating ergonomics science elements, architectural theories, and philosophies of form and behaviour to be cognizant of the embodiment of sitting behaviour. Secondly, to establish connections to the development of the floor-sitting furniture design, and enrich the definition of comfort in sitting.

Plate 1.6. Cho Hyung Suk's Magic Rug. Reprinted from A "Magic Rug" Which Can Transform Itself Into Useful Furniture Units, by The Design Home: Design and Architecture Magazine, 2010, Retrieved from http://thedesignhome.com/2010/11/magic-rug-transform-into-furniture/. Copyright [2013] by The Design Home.

The research starts with the explanation to the topic's background by elucidating the fundamentals of ground-sitting, and the connection to the cultural significance. It also illustrates the basic ergonomics concept, and the coherency to the context of furniture design. As well as the justification of significant literatures that are linked to the philosophical, theoretical, and contextual elements that are reviewed in Chapter 2 and Chapter 3. This evidence comprehensively solidifies the justifications taken towards developing research activities. Chapter 4 explicates the research methodology that illustrates the investigation processes within structured phases aiming to validate the rose research questions based on the delineated research problems and objectives. The assembled research questions and theoretical framework structured the main body of research activities, and it is elaborated and established from Chapter 5 onwards. The overall structure of this thesis is described at the end of this chapter.

1.2 Research Significance

Cultural studies have never been explored from its niche, which consequently causes a stagnant development in its body of knowledge. Further exploration is needed in order to succumb to this phenomenon so that it may grow simultaneously with other fields of research that are growing rapidly in continuum. With the integration to the field of architecture, ergonomics, and design it is hoped that this will provide better manoeuvres to the understanding of cultural linked significances within the bigger picture. The knowledge contributed within this research should cover the following outcome:

a. The Malaysian anthropometric data applied in the seating prototype that combines traditional sitting concept and ergonomics signification into designed product features in this research should guide product designers, and design educators when attempting to design, or teach furniture design subjects based on the Malaysian standards measurement.

b. The ergonomics context broadens the cultural linked perspective into detailed technical aspects of the embodiment of the floor-sitting practice within the academia level of design field research.

The findings also validate and reinvigorate the western anthropology scholars' postural habits typological data, synchronizing to the Malaysian context that predominantly weaves the technical and philosophical ergonomics context.

1.3 The Need for Research

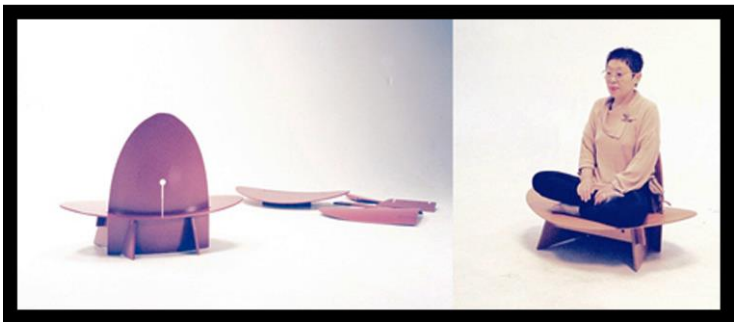
"…There is no universal chair. The idea of a chair is only present in examples." Aristotle, 384-322 B.C.

(Baird, 2010)

Leuder (2003), the author of *Rethinking Sitting*, clarified this signification by citing Baird's (2010) *Philosophic Classics: From Plato to Derrida* that, in order to understand the property of the [designed] chair, there must be a presence of a subject as an example to the context. In other words, without a user that carries the subject and context of usability, a product would not exist. To signify this within this researcher's research context, Wilson's (2000) suggestion in *Fundamentals of Ergonomics in Theory and Practice*, at which the need to integrate the ergonomics spectrum within the breadth of multi-, inter- and cross-disciplinary studies is certainly necessary in order to accommodate the diversity of people's needs, and flourish the quintessence of modern ergonomics within the 21st century. The concept of ground-sitting is frequently associated to the field of anthropology; and by complementing the ergonomics comprehensions it is observed as being a pertinent enterprise seeing that the subject of floor-sitting has subtle connections to ergonomics in many aspects pertaining to the physical, anatomical, physiological, and psychological coherencies. Furthermore, with ergonomics literature typically concentrating only on office seats, passenger seats in public transport, operator seats in cars, busses, and harvesting machines, this research aims to focus on the niche of residential space and the amalgamation of cross-disciplinary research that generates and diversifies the human-system, human-environment, and human-human interaction based research.

In addition, the author of *The Future Of Ergonomic Office Seating*; Springer (2009) specified that current research on seating has acknowledged that there is not a defined concept of correct posture, or an established proper way to sit. He added as to strengthen Kroemer's (1994) signification that leading researchers now acknowledge many postures at which individuals may be comfortable depending upon their preference, and various work activities they may be engaged in. However, the awareness to this perspective is not universal; therefore, it forms the pattern of seating research monotony. The applications of design principles are still at production standards where Springer (2009) added in his writing that the belief of ergonomic seating design is still needed to support a limited few postures. These conditions have nourished this research to be appropriately ameliorated, and deviated into an extensive exploration of sitting concepts beyond the research of 'normal sitting' found ubiquitous. For this reason, this research amalgamated those significances by synchronizing to influential factors, and characteristics of elements within the strand of ergonomics that influence the expression of the floor-sittings in varieties to the issues of comfort – the issues that incontrovertibly embedded in ergonomics-linked researches. The underlying issues regarding comfort that have never been discussed or debated, and is observed as being potential research to be brought forward, and expanded upon within this researcher's research, as de Looze (2003) also raised in *Sitting Comfort and Discomfort and The Relationship With Objective Measures*; (a) Comfort as a construct of a subjectively defined personal nature, (b) Comfort is affected by factors of a various nature [physical, physiological, psychological] and (c) Comfort is a reaction to the environment (p. 986).

1.4 Background to the Problem



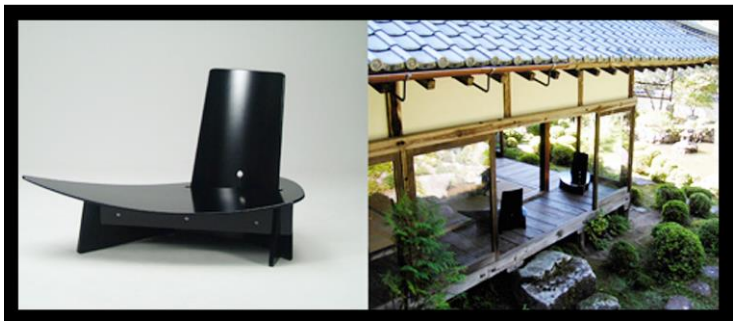


Plate 1.7-1.8. T.Murakami's Ittkyu chair and Saigyo chair. Reprinted from Ittkyu & Saigyo:Chair Design for Traditional Japanese Space, by Faculty of Arts, University of Brighton. 2012. Retrieved from http://arts.brighton.ac.uk/projects/inter-cultural-chair-project/ittkyu-and-saigyo-chair-design-for-traditional-japanese-space. Copyright [2012] by University of Brighton.

Murakami in research carried out at the University of Brighton in 2012, elucidates the expansion of cultural linked research reaching the peripheral of design and architecture disciplines by endorsing the *Ittkyu* and *Saigyo* [see *Plate 1.7, Plate 1.8*] chair design connecting the traditional Japanese space design significance. Just as important, and becoming increasingly better understood within the creative department, is the adoption of traditional concepts as manifested by Murakami and other furniture designers designing floor-sitting based furniture design is observed as the designers' continuous attempt to explore the widely defined concept of comfort by exploring the ground as the medium of sitting. Hideyuki Hayashi's *Agra Stool* and Vladimir Kagan's (1960) *Omnibus Back* design are two examples [see *Plate 1.9, Plate 1.10*] that demonstrate the ground-sitting or low sitting concept richness within the Asian and European perspectives into contemporary seating design and living relevancy. The blooming of seating design is based on a similar sitting concept that has been directed mainly towards the expression of form; and, because there is a lack of design research within the context of

Plate 1.9. Hideyuki Hayashi's *Agra* stool. Reprinted from Agra Stool, by Rakuten Global Market. 2012. Retrieved from http://global.rakuten.com/en/store/2han/item/eedia-583-3685. Copyright [2012] by Rakuten Inc.

Plate 1.10. Vladimir Kagan's *Omnibus Back.* Reprinted from Vladimir Kagan Couture, Vladimir Kagan, 2013, Retrieved from http://www.vladimirkagancouture.com/omnibusBack.php Copyright [2013] by Vladimir Kagan Couture.

academia as to the extent of this research is conducted, the production of floor-seating design is predominantly constituted within the niche of commercialization. The interest to weave cultural significance harmoniously with the biomechanical and philosophical aspects of human sitting behaviour in a designed space is less explored. This research aims to unfold a deeper understanding on the ergonomics context that leads to the embodiment of the floor-sitting postures apart from its recognition for the customary code of conduct in one's culture. It is also hoped from the articulation of design within this research, that it will generate a continuous development of creative designs within the academia field research. This thesis is set to unveil the connections of ergonomics to the embodiment of floor-sitting postures within the concept of sitting behaviour in the residential environment.

1.5 Problem Statement

The need for exhilarating cultural behaviour research in an interdisciplinary field is observe as important in diversifying body of knowledge. Even though there are proliferation numbers of significant cultural behaviour research since Irizawa (1920-21), Kroeber (1925), Mauss (1935), Mead and Macgregor (1951), Hewes (1955), and Bailey (1989), this set of cultural research needs to be tackled in an invigorated approach, and lengthened into a broader perspective that is connected and aligned to an individual's continuous need for life improvement. In association to the context of furniture design, the Malaysian practice needs to be explored extensively, weaving to the anthropometry coherency that is subtly articulated. The ubiquitousness of other regions' anthropometric database that mainly referred to the British and the American standards, accompanies the universal seating research in the earlier 1.1 precedents which could be the underlying factor that overshadowed or restricted the awareness and interest among other researchers to explore and develop floor-sitting, based on Malaysian significance further. The anthropometric database for the Malaysian population remains on paper, and is not applied to tangible seating design to the stage of this research is conducted. Furthermore, based on these situations, it is reasonable to state that the need to demonstrate cross discipline studies is immanent in order to expand the cultural linked research further. For example, Syed (2001) in the *Order in Traditional Malay House Form* demonstrates such relevancy where the study of Malay floor-sitting etiquette, the anthropometric significance and architecture design studies intertwine mellifluously. Weinstock (2010), like Hewes (1955), believed that human behavioural characteristics are associated to the space design/environmental significance. Hence, the relationship of the study of floor-sitting behaviour to space-form-behaviour led a philosophy that is articulated

within the study of architecture, and by weaving to the ergonomics context towards the development of furniture design is set to synchronise in the research framework.

1.6 Research Objective

a. [RO.1] To identify the feature within the floor-sitting behaviour concept that is generally associated with the study of anthropology to the research of furniture design.

b. [RO.2] To analyse the technical, theoretical and philosophical context of form and human behaviour within the study of human floor-sitting behaviour.

c. [RO.3] To propose a floor-sitting furniture design based on point [b] significance.

d. [RO.4] To validate the postural behaviour data within the Malaysian sitting perspectives through the synchronization of furniture design attributes that simultaneously works as a research instrument in analysing the embodiment of the floor-sitting behaviour.

1.7 The Research Questions

In relation to this research, the research problem, and the research objective it outlines the basic idea that requires further elucidation through the articulation of sequential and progressive research questions. The association of the floor-sitting subject to ergonomics are the most vital concepts in this study, where the coherency of the ergonomics elements of science and the philosophical context associated within, forms the foundation to the whole of enquiries made in relation to the embodiment of the floor-sitting behaviour. These elements embedded within the ergosystems are the impetuses that can only be understood in its

interaction and operation [discussed further in the connection of Chapter 2 and 3] through exploratory inquisition. What animates the floor-sitting behaviour?

To answer this key enquiry, and fulfil the aims of the connecting research problem and objectives, the research questions are sub-divided into four main enquiries in order to manoeuvre and steer the research activities. They are:

a. [RQ.1] What are the features accentuated from the study of anthropology that engaged to the floor-sitting behaviour and in coherency to the context of furniture design?
b. [RQ.2] How does the technical framework articulate the embodiment of the floor-sitting behaviour and what steers this context?
c. [RQ.3] What is the relevance of designing the floor-sitting furniture?
d. [RQ.4] Is there difference between the Malaysian floor-sitting behaviour to the postural data compiled by the western scholars and how significant is the design of the floor-sitting furniture affecting the floor-sitting behaviour compared to the same sittings seated without designed furniture?

These questions steers the research activities towards validating the floor-sitting behaviour data.

1.8 Scope of Research

To keep the research at a manageable task, the subjects of research are confined from the larger spectrum, and address the context within specific width. This section elucidates the connection to that significance. The detail of significant factors listed as below and can be found in Chapter 2. The following aspects focused in this chapter include:

1.8.1 Modular seating prototype

> When a design leaves the page, or the computer screen, and becomes solid and three-dimensional, it enters the realm of the prototype. As its name suggests, the prototype is the first of its kind: a little rough and imperfect perhaps, but the first clear example of its type nonetheless. The implication is that there will be more to follow. It is what Augustin Scott de Martinville from Big-game calls *'the materialisation of an idea'*. Everything else that follows can be called refinement or compromise – depending on how you want to look at it. (Lovell, 2009, p. 31)

A *modular* according to Macquarie Dictionary; sections for easy construction or flexible arrangement: *a modular home, modular furniture* (Yallop, 2006). By adopting the floor-sitting subject and applying the Malaysian anthropometric data, a seating prototype is developed [Chapter 5 onwards]. In fulfilment of the research objectives, the articulation of the ergonomics elements into the development of the floor-seating design simultaneously validated Big-game studio's Augustin Scott de Martinville's et. al (2004) propagation of *"the materialisation of an idea"* as cited by Lovell (2009). This researcher sees this significance by exploring the *modular* concept into the development of the furniture design due to the

simplicity characteristic of the floor-sittings, based on the study of the floor-sitting behaviour and the relationships to the sitting environment.

1.8.2 Unused space

The research activity focuses into the niche of residential interior where two intimately associated definitions are explored; [1] the unused space, which sets as the primary factor igniting the relationships of the postural behaviour to the floor-seating design. It foremost refers to the human body kinaesthete reacting to the *unfurnished space* where the floor, a free space functioned as the medium of sitting. In other architectural elements including the wall, in most cases people preferred to be in a perched position. [2] Concerning the *under-utilized area* of the furnished space where for example, people used the floor to sit and perch at either end of the sofa. These, by observations are the phenomenon of the Malaysian sitting habits within the residing space.

1.9 Conceptual Framework

As the basis to the research of the floor-sitting behaviour, and its coherency to the design significance, the conceptual model framework presented the understanding, insight, and abstraction of the whole articulation of this thesis. The framework consists of the connection cycle of attributes that mellifluously connects the ‘systems’, ‘elements’, and ‘designed form/objects’, that steer the whole interaction of the human behaviour within the ‘spatial significance’ [see *Plate 1.11*].

The ‘elements’ comprised of the ergonomics science elements are finely influent throughout the interaction system defined as ergosystems. The ‘system’ articulation with the ‘elements’ moulds and projects the bodily interactions of people responding, or utilizing the ‘machines’ [in accordance to the ergonomics justification, and refers to the designed form/objects within this research] within the work system of the ergosystems. For ergonomics, people are part of the system; hence, the integration of the human factor is fundamental and is coherent to the projection of postural behaviour when responding to the environment [spatial significances] is observed. This illuminates the relevancy of the ergosystems to research its connection to the embodiment of the floor-sitting behaviour, and subsequently towards the development of the context of design. These interconnections are elucidated further in Chapter 2 and Chapter 3 with the supplementation of the theoretical and philosophical aspects steering towards the research process further.

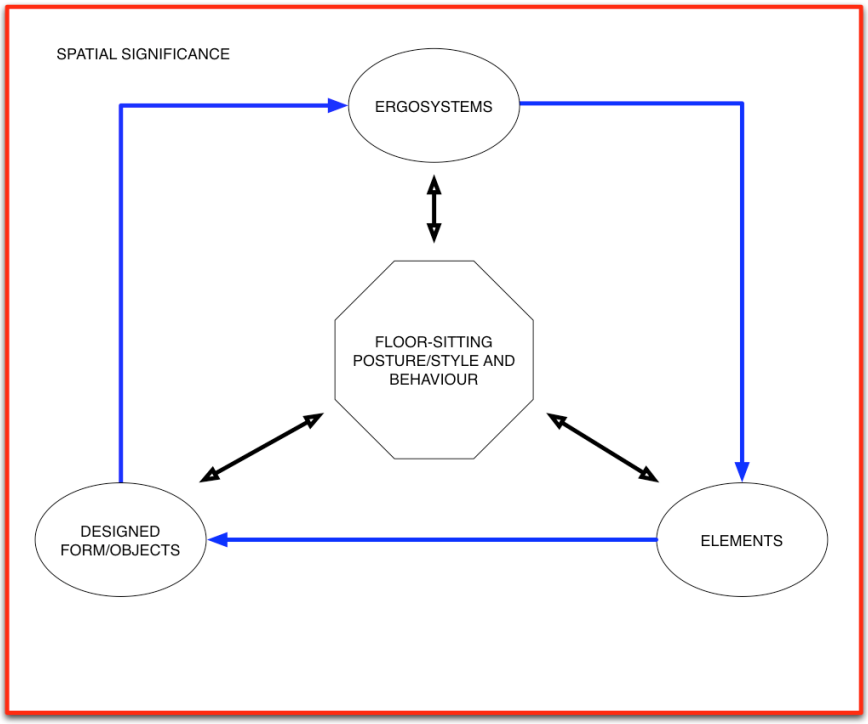


Plate 1.11. The research conceptual framework. [Note that the relationships is explicated in Chapter 2 and Chapter 3 literary context]. [Self-creation].

1.10 Thesis Structure

This thesis consists of seven chapters. Chapter 1 includes the introduction and background to the issue as well as the justification to the research problems. A delineation of research objectives and the scope of research are given in this chapter.

Chapter 2 presents the overview of the literature as major sources of reference and the review of the most significant and relevant works to this research. Particular emphasis is placed on the aspects of cultural and technical epistemologies followed by the explanation to some of the keywords used throughout the research activities for reader's better understanding when going deeper into this research.

Chapter 3 further reviews the literatures in the context of development, as well as the application of the theories and philosophies appropriated to this research. This chapter also delineates the effects of the floor-sitting to design, and reviews previous design work by designers that prompted this research.

Chapter 4 describes the Explanatory Design approach applied within the research, and the implementation of the mixed method of quantitative and qualitative strands. The research activities are explained in phases, as it will help towards readers' understanding of the applied methods relevancy to the whole research, in addition to the complementation of Chapter 5 data analysis, and the validation of test findings that are interpreted in Chapter 6.

Finally, Chapter 7 reviews the whole research processes relating to the research findings, and concludes the thesis with suggestions to future research work.

Chapter 2.0
JUSTIFICATION OF SOURCES

2.1 Introduction

The main difficulty faced when sourcing the information of a society's postural behaviour is its paucity of reference. Specifically in sourcing Malaysian's postural data, its dearth of information is identified as adverse when wanting to connect to the philosophical and technical aspects of the floor-sitting behaviour to the furniture design research. Therefore, the articulation of cross-disciplinary fields is coherently immanent, as the cultural subject cannot be adequately understood from a single disciplinary perspective especially in deliberation of this researcher's research context. This chapter begins with an overview of published materials on cultural behaviours, by citing significant works of the Western and Asian ethnographers that are related to the ground-sitting subject. Thus, it encompasses the discussion of space, architecture, and ergonomics relationships to the subject. The assessment of these published materials brings together the convergence of common subjects of interest, which then unfolds the areas where common ideas could be found in agreement. It also reveals items for further development, highlighting the least explored parts of the subject. The amalgamation of cross-disciplinary fields subsequently presents the need for research in related subjects explicating the expansion of limitations and potentials. The elaboration of literature contents consists of existing information that consequently forms the foundation to the acceleration of research activities, aiming to achieve the research objectives within the guidelines of the theoretical framework.

2.2 Sources Recognition and the Assessment

This section outlines an overview of the significant literatures on human behaviour derived from the perspectives of Asian and Western ethnographers. In conjunction to this research, the human behaviour is discussed within the scope of technical floor-sitting techniques that has long been observed in its association with cultural significances. This researcher has identified and traced down sittings and cultural coherency from Irizawa (1920-21), and is followed significantly by Mauss (1935), and Hewes (1955). Their epistemologies are intrinsically crucial and up to this time, being use as reference in other ergonomics and design research. This establishment have steered the foundation to the understanding of this researcher's research concept as he looks at the synchronization of the ergonomics involving the influence of the architectural space design philosophy to the context of furniture design. At the beginning of the sourcing process, problems regarding the document translation were encountered when translating the key documents of Irizawa's (1920-21) original *Nihonjin no Suwari-kata ni Tsuite* as it was written in old Japanese language; and Mauss' (1935) *Les Techniques du Corps* is written in French. The documents however, were able to be translated and interpreted within reasonable requirements for this researcher's fundamental understanding to the enquired phenomena, if not to its fullest detail. Another obstacle faced was the dearth of the written references regarding technical Malaysian postural behaviour literatures, unlike other available human behaviour researches conducted on the Tasmanian, the Navaho of the South-western United States, and India's Indians. There was not any exact information documented regarding technical Malaysian postural behaviour at the athenaeums, nor Malaysia's higher learning institution databases. The least one could look at are literatures such as by Raffles' (2009) *Sejarah Melayu* or *the Malay Annals*, Abdullah's (2005) on *Adat Resam & Etiket Masyarakat Malaysia: Buku Panduan Yang Praktikal* [*The Custom and*

Etiquette of the Malaysian Society : A Practical Guide], Adil's (1971, 1972) *Sejarah Johor* [*History of Johor*] and *Sejarah Perak* [*History of Perak*] and Ahmad's (1979) the *Sulalatus salatin* [*The Malay History*] which nevertheless view the floor-sitting within the insubstantial scope of cross-legged sitting as the customary code of conduct within the ethnic Malay household, as well as in the traditional Malay-palace throne room etiquette. The mentioning of floor-sitting behaviour is limited in these texts, and it is rather incidental in nature touching only the surface.

2.3 The Ethnographic Researches to Sitting Behaviour

In the book titled *Nihonjin no Suwari-kata ni Tsuite*, the renown Japanese ethnographer Tatsukishi Irizawa (1920-21) has drilled back to the Japanese ancient period from the *Muromachi* era [1392-1573] to explain the connections of customary contexts within the floor-sitting etiquette [see *Plate 2.1*]. In those 74 pages of the Japanese postural behaviour manuscript, he outlines the fundamentals towards the embodiment of the biomechanical routine, regardless the socio-stratum history, which comprises the influence of both the architectonic and geographical factors. The *seiza, wariza*, *agura* and *yoko zuwari* [see *Plate 2.2*] are examples of such sitting etiquette that articulates these two factors of embodiment. He furthermore distinguishes the Northern Japanese, who did not practice the floor-sitting life when compared to other Japanese in the region. At which he suspects, may due to the extreme cold temperatures in northern Japan that consequently inhibited such a practice. On that note, one would enquire the relevancy of such dissimilarity considering the same geographical location; typically, the types of housing-construction influenced the Japanese sitting postures.

Plate 2.1. Ancient illustrations of the Japanese floor cultures. Adapted from Nihonjin nosuwari-kata ni tsuite, by Irizawa, 1920-21, Shigaku-zasshi, 31(8). Copyright 1920-21 by Shigaku-zasshi.

According to Nishi and Hozumi (2012) most of the constructed houses in the north are different to the north-central of Japan, due to the building rooms accessibility during heavy winter and becoming a threshold, transporting silkworms to sprout within the house. Thus, the houses in the north were built with earth-floored areas. Unlike in the north-central, both earth-floored and tatami-matted areas were furnished separately, which subsequently draws the postural behaviours to the significant interrelationship between the geographical and climatic factors linking the architectural space design elements. Other literatures that significantly researches similar subjects are Syed Ahmad Iskandar (2001) *Order in Traditional Malay House Form* and Lim Jim Yuan (1984, 2008) *The Traditional Malay House* and *Under one Roof: The Traditional Malay House*. Mohd Tajuddin et al (2005) in the studies of *The Architectural Heritage of the Malay World: The Traditional Houses*, relates the embodiment of the floor-sittings to the ergonomics articulation within the

construction of the vernacular Malay house. The design of the vernacular Malay house has a strong relationship to the local climatic significances. Pre-historically the Malays were the native inhabitants of the Peninsula (Braddell, 1989) thus making the research of Malay architecture abundant, and more than often the floor-sitting custom is mentioned in associating those researches which thus made the practice synonym to the ethnicity. Despite the modernization of today's Malaysian society, the traditions of floor-sitting is still immanent today, and is viably exercised within the formal and informal etiquettes in spite of the existence of modern residential spaces. It was learnt that the proper design of ventilated spaces has a direct influence on the postural behaviour within the home environment besides the sitting that has been taught since infancy. The space design-postural behaviour significances are also highlighted by Cranz (2000), the Professor of Architecture at the University of California Berkeley. On the contrary, her perspective of the chair design in the western society is influenced by the relationships of the window opening heights, and due to the fact that of Westerners' sitting about 45 centimetres off the floor. It is also recorded in Irizawa's (1920-21) findings that the Japanese continuously sat on the floor although the room or space at which they occupied was furnished, and interestingly to find that they also sat within the agura posture [see *Plate 2.2*] on the chair when it was made convenient. Thus, similar to what this researcher observed in the overall Malaysian sitting habits. This is the juncture, where the Malaysians are observed posing the identical sitting behaviour to the Japanese but contextually different, as they are the closest examples documented when linked to the sitting culture whether in a formal or informal situation. The relationship of such a practice to the space design significance has yet to be found within current literature. This researcher's research explores the idea that spatial relevancy to the embodiment of the floor-sitting behaviours subsequently illuminates the goal towards expanding the postural

behaviour research within the Malaysian informal floor-sitting etiquettes in the home environment.

Plate 2.2. Examples of the Japanese floor-sittings: From left to right: Seiza, Waiza, Agura and Yoko Zuwari, by Sitting Straight Institute, 2003, Retrieved from http://xn--xxt76z.seesaa.net/category/5665254-1.html. Copyright [2003] by seesaa.net.

2.3.1 The Western Perspectives

Mauss (1935) in *Les Techniques du Corps*, where Hewes (1955) cited the content significance in the *World Distribution of Certain Postural Habits* and Crary and Kwinter (1992) edited such version in the *Techniques of the Body*, engages the postural behaviour to the connections of the surrounding environment. Mauss (1935), according to Hewes (1955), mainly focused upon the out-of-door factors on how from society to society man and women used their bodies in socially defined poses and sitting postures. In his observation, each society has its own special postural behaviour. From his research, a question arose pertaining to the factors that animate postural behaviour. He as Irizawa (1920-21), came to the finding's convergence within the niche of space/environmental signification, where the postural behaviour is determined by geographical and climatic factors. For example, in some regions with hot-humid or tropical climates sitting down or squatting is practical, while the cooler continental climates of certain regions clearly inhibits sitting down on the floor**.** In that sense of climatic deterrence, artificial supports such as rocks, logs, stools, benches or chairs were ideally

introduced. The sitting down etiquette that is either shown through ground-sitting, or floor sitting is precisely termed in this research. The sitting down etiquette has become widespread in its practice, and it surpasses religious and cultural niches. Furthermore, there is no evidence linking the floor-sitting proprietorship to certain society cultural practices. The cultural significance sensibly links Weinstock's (2010) propagation of the development of social practices, and is accelerated within populations that also involved other physical activities including speech and tool making. Such social practices influenced the adaptive cultural variations, and were localised into ones society during according to what Weinstock (2010) added, as humans began to migrate out of Africa into Asia and Europe between 60,000 to 70,000 years ago. Hobsbawm (1983) defines, the juncture of invention towards the formalization and ritualization, establishing one society cultural practice; hence the routine is inherited as seen today. The embodiment of the social behaviour mainly connects the climatic relevancy where the human thermoregulatory climatic context as mentioned above is articulated. Weinstock (2010) states, "The flexibility of behaviour is actually the ability to adapt a variety of climates and habitat" (p. 168).

Some other studies relating to the human postural behaviour are Kroeber's (1925) *Handbook of the Indians of California* shown through the investigation of the Mohave tribe and Bailey's (1942) *Navaho Motor Habits* where she also observed the American natives' gestures and moves, including sitting on the ground. Macgregor's et al (1951) stretches the ethnographic research into Asian significance by looking at the Balinese growth in the *Growth and Culture*.

2.4 The Foundation of the Floor-Sitting Behaviour to Ergonomics

This section delineates the key concepts applied within this research. The description of these concepts is essential, as well as the terminologies used that set the foundation and understanding of this researcher's research scope and context. The concepts in general, cover a broad spectrum that this research cannot conceal entirely. The synchronization to the floor-sitting subject, the *raison d'être* tried to create the understanding on how these concepts come into convergence to this researcher's research on the context of floor-seating design. To set a clear understanding of the concept applications to the research, the delineation of the concept's technical relationship will be reviewed in Chapter 3. The concepts and terminologies used in relation to this research are:

2.4.1 Ergonomics

Bridger (2009) defines ergonomics as the study of the interaction between people, machines and the factors that affect the interaction. Its purpose is to improve the performance of systems by improving the human-machine interaction. The study according to Wilson (2000, p. 560) engaged a fundamental understanding of human behaviour, the performance in purposeful interacting socio-technical systems, and the application of that understanding to the design of interactions in the context of real setting. The ergonomics fundamental guiding philosophy underpins the theory and concept practice of fitting the job to the man [FJM]. The concept defines the fundamentals of human engineering and workspace designs which attempts to design tasks, or usable products to suit the characteristics of the worker and user (Bridger, 2009, pp. 14-15). The weaving of floor-sitting significance within the architectural and space philosophy of form, and behaviour integrates the FJM basis into ergonomic product

design for the users centric. The influence of the surrounding space or environment [as also described in cultural researches, but has never justified the technical justification on the embodiment to such phenomenology] determined the floor-seating design “to fit the user” postural behaviour within the modern residing space. Chapanis (1996, p. 559) strengthens this definition by articulating the aspect of psychology, anthropometry, and industrial design that consequently solidified the justification of the term that is applied in this research. One may inquire the differences between the *Ergonomics* and *Human Factors*; the distinguishing of the two similar disciplines is not that far reached as the development of the two are interconnected along with their differences in definition. Fundamentally, ergonomics is strongly grounded in biological sciences, and the similar discipline of human factors focuses on the psychological aspect (Bridger, 2009, pp. 15-16). The integration of the two disciplines is essential within this researcher’s research.

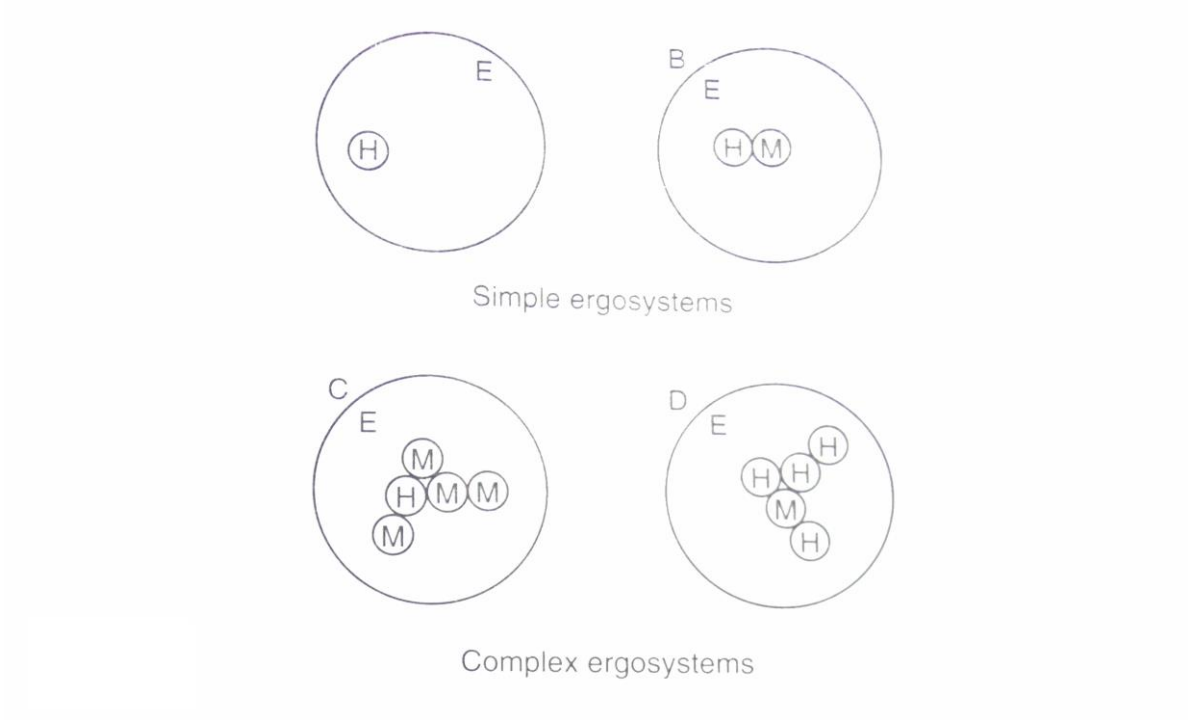


Plate 2.3. The Human-Machine Systems. Theoretically embodies: A structural ergonomic view of the work system showing the components. The focus is on how the components fit together and interact. Note: E, environment; H, human; M, machine [Further explanation on above relevancies in 2.4.2 The Environment, Human and Machine and its coherencies in Chapter 3, page 39] by Bridger, 2009, Boca Raton, FL: CRC Press. Copyright 2009 by T.F Group.

2.4.2 The Environment, Human and Machine

The ergonomics ergosystems fundamentally associates the environment, human, and machine significances (Bridger, 2009, pp. 2-4) [see *Plate 2.3*]. The systems' fundamentally function as a platform to design a better interface in the context of real settings. Bridger (2009) explains, by principle, every time we use a tool or a machine to interact, the needs of stimuli such as a handle, a steering wheel, a computer keyboard and mouse is necessary. Then the maximum feedback will be received. The way this interface is designed determines how easily and safely we can use the machine (Bridger, 2009, pp. 2-4). In relation to this research, it was also found that the body kinaesthete responds to the residing space [environment] and

manifested the signification of ergosystem's framework. Through observation, it was founded that the body connected to the floor and other architectural elements such as objects in environment [sofa, chairs, walls, etc] by means of sitting or perching to achieve comfort, and forming a kinaesthetic experience within the space allocated. The interface design is demonstrated in the floor-seating design for the whole system's interactions.

2.4.3 Anthropometric Data

The anthropometry refers to the measurement of human body dimensions with certain physical characteristics of human variability in size, shape, and strength. Anthropometry is considered a branch of ergonomics (Mattila, 1996). The anthropometric database differs between regions and ethnicity with the objective to specify the local physical dimensions of workspaces, workstations, and equipment as well as when applied to the dimensions of product design. The appropriate use of anthropometry in product design may improve the well-being, health, comfort, and safety of the user (Mustafa, 1992). The Malaysian anthropometric data is applied into prototype designs in order to comply with the development of the floor-seating design.

2.4.4 Perceptual Systems and Body Kinaesthesia

Like Aristotle, J.J Gibson (1966) has listed five basic senses and defines them as *perceptual systems*. The senses within those systems are recognised as the visual system, the auditory system, the smell-taste system, the basic-orienting system, and the haptic system. This researcher however, has identified the use of basic-orienting and haptic systems that

significantly apply to the context of this research; for these two senses seem to contribute and articulate more than the others to our understanding of three-dimensionality (Bloomer & Moore, 1977, pp. 33-36). The relevancies of the two significances are explained at points below.

2.4.4.1 Basic-Orientation

Basic-orientation refers to the body mobility [when sitting] orientating for total body balance, reflected by the influence of the senses of sight, sound, touch, and smell in environment. For example, when someone sits on the floor and finds refuge perched against the wall or at the sofa cushion edge, and then changes the sitting with sequence of postures for postural comfort.

2.4.4.2 The Haptic Sensing

The haptic sensing involves the touch by experiencing the objects with the entire body in the environment, rather than merely touching only by hands – i.e. by sitting on the floor with various postures. Established as the perceptual system, according to Bloomer and Moore (1977, p. 35) by citing Gibson (1966), that the haptic sense incorporates all those sensations [pressure, warmth, cold, pain] thus accelerating the individual kinaesthetic experience, and the feeling of satisfaction in an [interior] architectural space. In order to understand the systems operation, one needs to dwell in it. One will contribute to the performance when the body is engaged in interacting with surrounding objects in the home environment as well as being affected by the situation. It thus includes all those aspects of sensual detection that

involve physical contact both inside and outside the body. This movement of the body or the property of the haptic sensing is called *kinaesthesia*. The kinaesthesia movements in space may leave traces behind, transforming it into a *locus*; a place marked by personal history (Jantzen & Vetner, 2009) and such movements would repeat continually mostly at the same or similar place. The presence of the elements of architecture: such as the wall partition, windows, lightings and furniture dictates the kinaesthetic experience.

2.5 Summary

This chapter composes some of the key documented works related to the studies of human behaviour, which is significantly coherent to seating design research. The reviewed literature in this chapter is mainly ethnographic, weaving the architecture-related context and philosophy that is associated to ergonomics significances, aiming to generate comprehensible points for guidance in the construction of the research design found in Chapter 4 onwards. This study presented a brief account of past and present literature on the human postural behaviour, as well as the review of key elements upon which the subject of research is linked to and set as a foundation of this research trajectory. From this, the coherency of the floor-sitting behaviour to environmental significances was developed as the fundamental idea within this research, and subsequently made the integration of the ergonomics field feasible. Their coherency towards design will be elucidated in Chapter 3. The integration of diverse field of study is seen necessary when wanting to explore the cultural related studies. Hence, to develop seating design research, the bridging to and the amalgamation of the ergonomics studies is needed to uncover new knowledge that requires thorough attention.

Chapter 3.0
THE COHERENCY OF THE SOURCES

3.1 Introduction

This chapter explicates the coherency of the integrated context extruded from the epistemologies in Chapter 2. The explication is a furtherance of the idea that elaborates the propagated context towards the synchronization of the scope of the floor-sitting and perimeter sets within the research objectives. With the articulation of the structured research questions, this chapter details the relationships of the elements that are established within the existing sources. The issues relating to the subject, as well as the connections to the existing body of work are exemplified through the review of literatures and selected major designed works.

3.2 Postural Behaviour: The Form, Senses and Dynamics: The Philosophical and Technical Coherency

> Forms and behaviour have an intricate relationship. The form of an organism or city affects its behaviour in the environment, and a particular behaviour will produce different results in different environments, or if performed by different forms in the same environment. (Weinstock, 2010, p. 26)

Stamp (2011) in his research outlined 6 contributing factors that in general affected the body posture and the architectural experience. Those factors are comprised of the element of scale,

texture/materiality, climate/temperature, people/society, weight/resistance, and the configuration of those five elements in the environment. In relation to this researcher's research, these elements manifest according to Pallasmaa's (2005) , as the catalysts of memory as well as functioning as encounters, and confrontations to the body which articulate the sensory aspects towards the whole body kinaesthe. In his book *The Eyes of The Skin: Architecture and the Senses* he adds:

> We feel pleasure and protection when the body discovers resonance of space. When experiencing a structure, we unconsciously mimic its configuration with our bones and muscles: The pleasurable animated flow of a piece of music is subconsciously transformed into bodily sensations, the composition of an abstract painting is experienced as tensions in the muscular systems, and the structures of a building are unconsciously imitated and comprehended through the skeletal system. Unknowingly, we perform the task of the column or of the vault with our body. (p. 67)

The sensory experience denoted the body-image theory, which distinguishes the notion of body kinaesthe to the sense of dwelling. Bloomer (1977) in his writing extending Gibson's (1966) propagation on the architectural experience, body and memory integrations, stresses that our body and the movement through the psychoanalytic thought, manifests the haptic and orienting experiences that subsequently fluctuates the feeling of dwelling. It synchronizes the body-image concept through the propagation of the body kinaesthe when confronting the elements of architecture within the dwelling space. He subsequently adds:

> All experiences in life, especially experiences of movement and settlement in three-dimensional space, are dependent on the unique form of the ever-present body. It appears that individuals possess an unconscious and changing image of their bodies which is quite separate from what they know objectively and quantifiably about their physicality. (p. 37)

Bachelard (1971) in *The Poetics of Reverie*, vindicates these relationships through the *polyphony of the senses*. He distinguishes the connection of sight and its complementary effects with other perceptual systems harmonizes the body kinaesthe and added, "every touching experience in architecture is multi-sensory". Earlier, the psychologist James J Gibson (1966) in *The Senses Considered as Perceptual System*, asserted this relevancy by propagating the body behaviour's articulation through sensory systems when reacted to the types of environment. He added that in order to understand the sensory systems operation one needs to dwell within the particular space, and thus would inspire the engagement of the kinaesthete's experience. Elaborating this concept, and synchronizing this significance is Jantzen and Vetner (2009) in the paper presented at the Regional Studies Association Annual Conference in Belgium which stated that the dynamics caused by the kinaesthete's experience will consequently leave traces behind, and transform into a *locus*; a place marked by [personal] history and such body dynamics would repeat concomitantly. This can be seen when one refuge perched at the same spot, or similar section at the space where they occupied for comfort.

In relevance to the technical perspectives, Leuder (2004) in her review on the ergonomic seating movement adds that one who sits freely tends to cycle their postures over the day (Bhatnager, Drury, & Schiro, 1985; Branton & Grayson, 1967; Fleischer, Rademacher, & Windberg, 1987). She quotes Graft et al. (1993; 1995) by stating that fixed

postures promote more discomfort and chronic disorders and “movement reduces these risks” (Aaras, Horgen, & Ro, 2000; Kilbom, 1987). When we move or sit freely, “people are usually in constant motion” (Branton, 1969a; 1967; Jurgens, 1980), and “tend to develop unique patterns of seated movements (Fleischer et al., 1987; Jurgens, 1980; Ortiz, Marcus, Gerr, Jones, & Cohen, 1997). Linking this, as Branton (Branton, 1969b) signified, quoted by Bridger (2009) the author of the *Introduction to Ergonomics*, intergrades to the a *body-link* concept aiming to stabilize the open-chain system. For example, while sitting, behaviours such as folding arms, crossing, or flexing the legs can be seen as postural strategies to turn closed chains into approximate open chains that are stabilized by friction for comfort. He adds that a comfort sitting position in a dynamic sense, permits muscular relaxation while stabilizing the open-chain system of body-links (p. 142). Strengthening that significance to this research concept is ergonomists Galen Cranz (2000) views on the floor-sitting effects to the body in *The Chair: Rethinking Culture, Body, and Design*; where according to Mertens (2007) citing her, such exercise allows “better alignment of the spine than Western-style furniture.” He added that when sitting on the floor our body is free to express the body image with movement and variety of positions to cushion for support.

3.3 The Ergonomics Ergosystems' Connections and Integration to the Concept

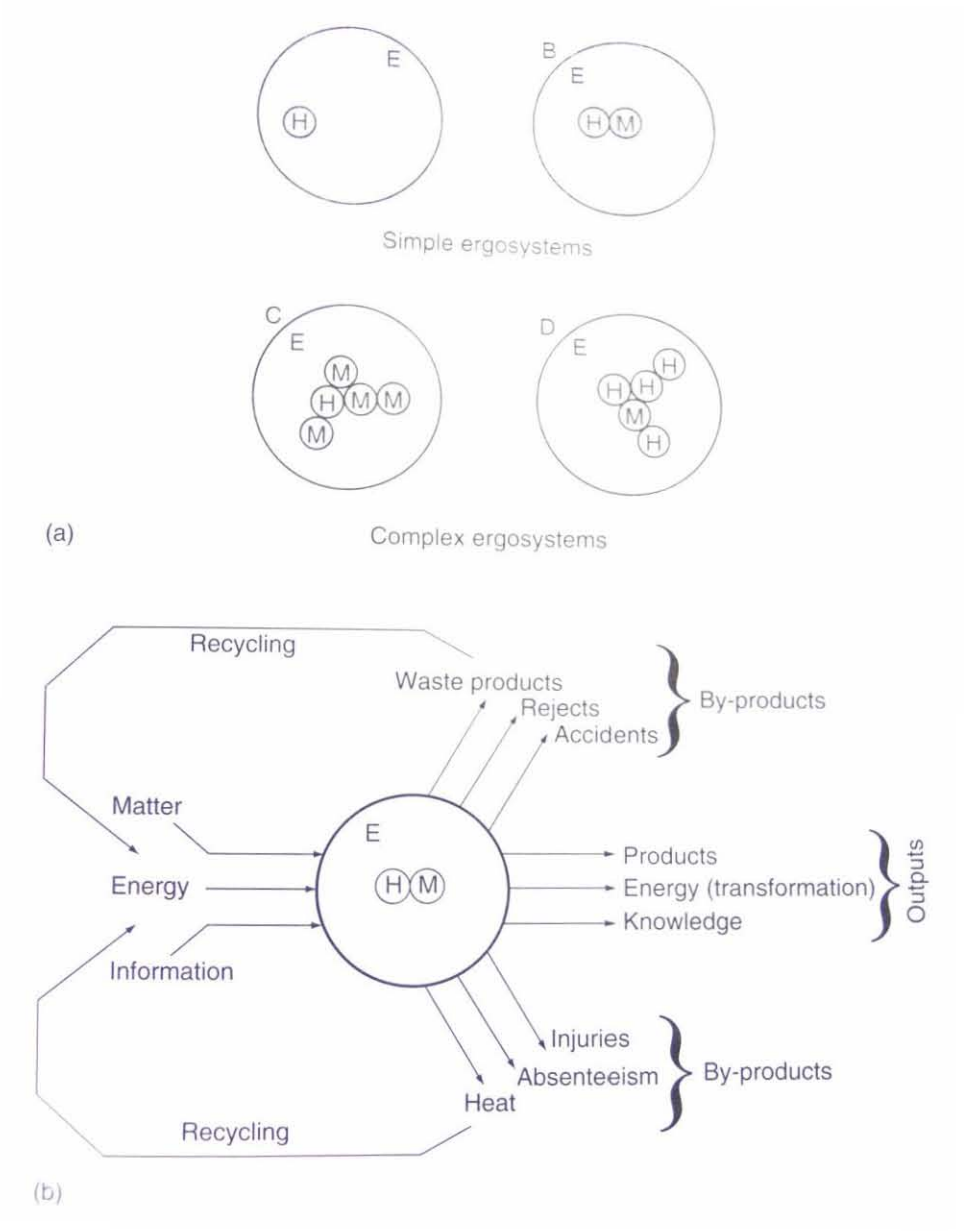


Plate 3.1. The complete illustration of the Human-Machine Systems. Theoretically embodies: [a] A structural ergonomic view of the work system showing the components. The focus is on how the components fit together and interact. [b] A process ergonomic view of the work system. The focus is on system performance parameters such as productivity, capacity, and effectiveness. Note: E, environment; H, human; M, machine. by Bridger, 2009, Boca Raton, FL: CRC Press. Copyright 2009 by T.F Group.

This section seeks to understand the flow of the ergonomics' ergosystems. This significance in one part [based on *Plate 3.1*(a)] has been delivered in section 2.4 *The Foundation of the Floor-Sitting Behaviour to Ergonomics* that concisely explained the definition of the interactions of the human, machine, and environment as the components of the systems that fit into the context of this researcher's research. Stretching from such a simple relationship, part (b) explains the interaction process evolvements by linking those three components within the templates of work systems.

In general, the systems consist of sets of elements that relate one another to the boundary around them [see *Plate 3.1*(b)]. The foundations of the systems consist of the synchronization of 'people' and 'machine' interactions to form a function towards producing some form of output. Auxiliary elements in the form of matter, energy, and information supply input that varies betwixt the levels of human performance research. In relation to this research, the structural ergonomics view of the work systems are being widely applied as templates for the optimization of the system operations [and other disciplinary field such as industrial design, engineering, environmental medicine, and operations research] that are adopted in appropriation to the subject of the floor-sitting for further development within the context of design. The synchronization of the elements of sciences such as the physics, psychology, anatomy, physiology, and engineering are all applied to illuminate the system's animation in the embodiment of the floor-sitting behaviour [see *Plate 3.2* and section 3.3.1-3.3.5].

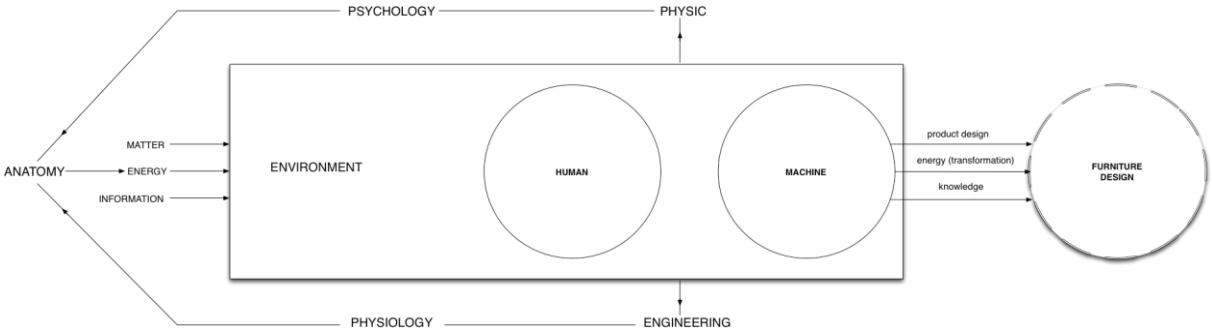


Plate 3.2. This researcher's theoretical framework adopted from the original ergosystems framework and apply appropriated to this researcher's research context. [Self-creation].

3.3.1 Physic

In the works cited earlier in Chapter 2, the spatial significance and the human behaviour's association were brought into discussion where the aspect of the physical environment was highlighted. The coherency of the science of physics articulating the body's kinaesthe through the behavioural expressions is decisively immanent where Bridger (2009) outlined this as part of the key elements in the major framework of ergonomics development towards the design of products or designing work systems. This significance finely intertwines the context of thermoregulatory where both the physical and climatic factors took place reflecting the human living environment. To achieve comfort, constant body movement is necessary to maintain heat balance. By demonstrating this, the thermoregulatory mechanism is produced. For example, people who live in hot and humid environments sweat in order that their bodies cool down when their body evaporates [but profuse sweating can cause dehydration and loss of salt in the body]. Those who live in cold environments shiver involuntarily, and likewise move voluntarily to increase heat production. The relationship of the human body, and the

objects [elements of architecture] configuration within the environment of the dwelling space promotes the projections of postural variety such as sitting, perched against the sofa edges or wall, and is observed as the strategy to gain thermal balance. These relationships are interconnected to the next point and later it is further elaborated upon.

3.3.2 Psychology

The feeling of dwelling is rooted in psychoanalytic thoughts, and it very much influences one's postural behaviour. Listed below are the indicators to the determination of postural behaviour articulated to the human psychology as outlined by Stamp (2011). Nevertheless, they are not the only factors determining the feeling of dwelling leading to postural behaviour. It is however, suffice to state that these are the recognizable elements that we can incorporate the body behaviour with.

3.3.2.1 Texture / Materiality

> Texture and materiality are important to the environment because every element in the environment has a specific materiality that has a unique texture to it, which can interact with the human body in different ways. Touch and sight are the main senses that perceive texture and can affect the person's posture. Through touch our bodies can pick up the unevenness or instabilities on the ground plain through our feet. (Stamp, 2011, p. 14)

The function of the perceptual system is best prescribed in this context and articulates to the rest of the highlighted elements in this section to the animation of the human postural

behaviour. In order to exemplify and justify its relevancy to this research concept and context, two different surfaces that universally affected body posture during sitting were sampled. The first surface was a vinyl-leather covered sofa and the other, a carpeted floor. The sitting of 43 centimetres above the ground on standard sofa is what we would typically call normal; the person sat with an upright posture and the feet touched the floor surface. The body posture of the person sitting and leaning on the sofa's soft and squishy surface is something that we experience on a daily basis. The fabric of the sofa seat determined the body comfort. However, the moment the body glided past the seater contacting the buttocks to the carpeted floor [or empty floor], our body posture changed and the definitions of comfort diversified [when refer to the dynamics sitting justification]. Sitting on the floor enables us to "adjust our posture freely and position cushions for support" (Cranz, 2000) [see *Plate 3.3*]. The textures on the floor being either rough or fluffy, or hard or smooth allowed those who sat to feel the floor, and potentially promoted another dimension of sitting sensation. Through materiality, the textures invite the body to explore the forms and shapes around the environment in many ways based on individual postural experience. For example, the body posterior feels cold and rough on the skin when perching against concrete or textured walls; or feels cold when sitting on marbled or tiled floors that may, or may not bring pleasure to the body [depending on the climatic relevancy; or perching against the edges of the squishy, upholstered sofa seat for back resting as the response when sitting on the floor]. As Papanek (1983) in *Design or Human Scale* stated:

> Bruno Mathsson of Sweden manufactures a superbly designed and crafted chair made of wood laminate and upholstered in a cotton-based fabric, it is handsome and anatomically healthful. Chairs usually made of chrome steel tubing, a material as cold as a corpse and as unpleasant to

touch. The upholstery is usually some vinyl-coated fabric or other plastic-based material. These materials become sticky when they are sat on all day. (p. 25)

3.3.2.2 Climate / Temperature

Climate is something that is experienced through the entire body, the skin can sense different temperatures that exist in the environment. The posture of a person's body can change with a change in temperature in the environment. (Stamp, 2011, p. 15)

The architectural space design relationships to the postural behaviour have been highlighted in Chapter 2, and their relevancies intertwine the climatic significances. Linking such relevancy to the climatic pattern in Malaysia where it is hot and humid, the connections of the human dynamics for human thermal comfort are mellifluously related. The sitting with legs stretched, arm resting on a flexed knee continuously samples the 'eccentric' body-image and observed as the attempt of stabilizing the open-chain system of body links in order to achieve body comfort, and thermal comfort, and thus demonstrates the relevancy of climate/temperature that subtly influences to postural behaviour. [This relevancy will further elucidate in 3.3.3 onwards].

3.3.2.3 The Configuration of Architecture Elements

Configuration refers to the arrangement…elements. Configuration is not just the way objects are laid out in an environment, but can be the shape or forms of the objects that fill the environment as well. Configuration can be the shape of a wall, whether it is convex or concave, it can also be the exact shape of a chair or other piece of furniture. The configuration of objects in the environment

> changes the way people interact with the environment, which inevitably changes the posture of one's body. It is important to understand that configuration directly affects a person's body posture. Through our senses or body can scan and read the environments configuration. (Stamp, 2011, p. 18)

The perceptual system of sight and touch influenced the individual postural experience in respose to the environment. Narrowing into the breadth of the interior dwellings, the way a space is set up can transform the way someone feels and subsequently affects the body posture. An interior with many wall partitions may cause the feeling of being cramped, and could potentially create somewhat quirky expressions. Alternatively, an open interior could create the feeling of openness. Furthermore, people would freely express their posture to

Plate 3.3. Azhar Abd Jamil. (2012, August 18). The example of the utilization of the architecture elements when sitting on the floor. [Photograph]. Retrieved from https://www.facebook.com/azharabdjamil?fref=ts.

coalesce the sense of dwelling within the designated space. The stairs for example, were often utilized as a sitting mechanism albeit it is not intentionally designed for such purposes. It

expands the imagination of people perceiving the objects in the designed space. The floor would be a comfortable open resting platform by dislodging the sofa cushion to articulate the sitting posture without any hindrance from the seater armrest, or limitation of the square size seat for buttock-popliteal support.

3.3.3 Anatomy

According to de Looze (2003) by reporting Lueder (2004), Helander and Zhang (1997), that "there is no widely accepted definition of comfort nor sitting comfort" hence, the symmetrical and the unsymmetrical postures during the floor sittings were observed as an additional stream towards achieving another dimension of sitting comfort. This significance is finely connected to the body-link concept intertwining to the element highlights in 3.3.4.

3.3.4 Physiology

> Branton (1969) used the body-link concept to evaluate the comfort of train seats by observing sitting behaviour. An open-chain system of body links can behave in unpredictable ways when subject to internal or external forces. The prime function of a seat is to support body mass against the forces of gravity. A second function, which was emphasized by Branton, was to stabilize the open-chain system. In the absence of external stabilization, tonic muscle activity is required leading to discomfort if sustained. Behaviours such as folding the arms and crossing the legs can be seen as postural strategies to turn open chain into approximate closed chains stabilized by friction. The comfort of a seat depends, in a dynamic sense, on the extent to which it permits muscular relaxation while stabilizing the open-chain system of body links. (Bridger, 2009, p. 142)

Floor sitting such as cross-legged, one knee up the other down and flexed, one knee up the other stretched out and sitting with legs stretched out are ubiquitous and technically observed as a response of balancing the open-chain system [see *Plate 3.3*]. The elements of anatomy and physiology help to articulate the whole concept of body kinaesthesia in the environment through the projection of dynamics, and it has an intricate relationship that reflects the local climate to achieve thermal comfort. The human thermal comfort depicted is achieved by balancing the two main factors that determine body posture, which is comprised of [1] the metabolic heat produced and [2] the rate of heat lost. In conjunction to the body kinaesthesia and sitting behaviour relationship, constant dynamics of the open-chain system are manifested to maintain a comfort muscle activity in a steady room temperature of approximately 33°C or colder but not exceeding core temperature of 36°-37°C (Astrand & Rodahl, 1977) for thermal comfort. Listed below is the postural typology documented by Hewes (1955) in relation to the human thermoregulation outdoors [see *Plate 3.4*].

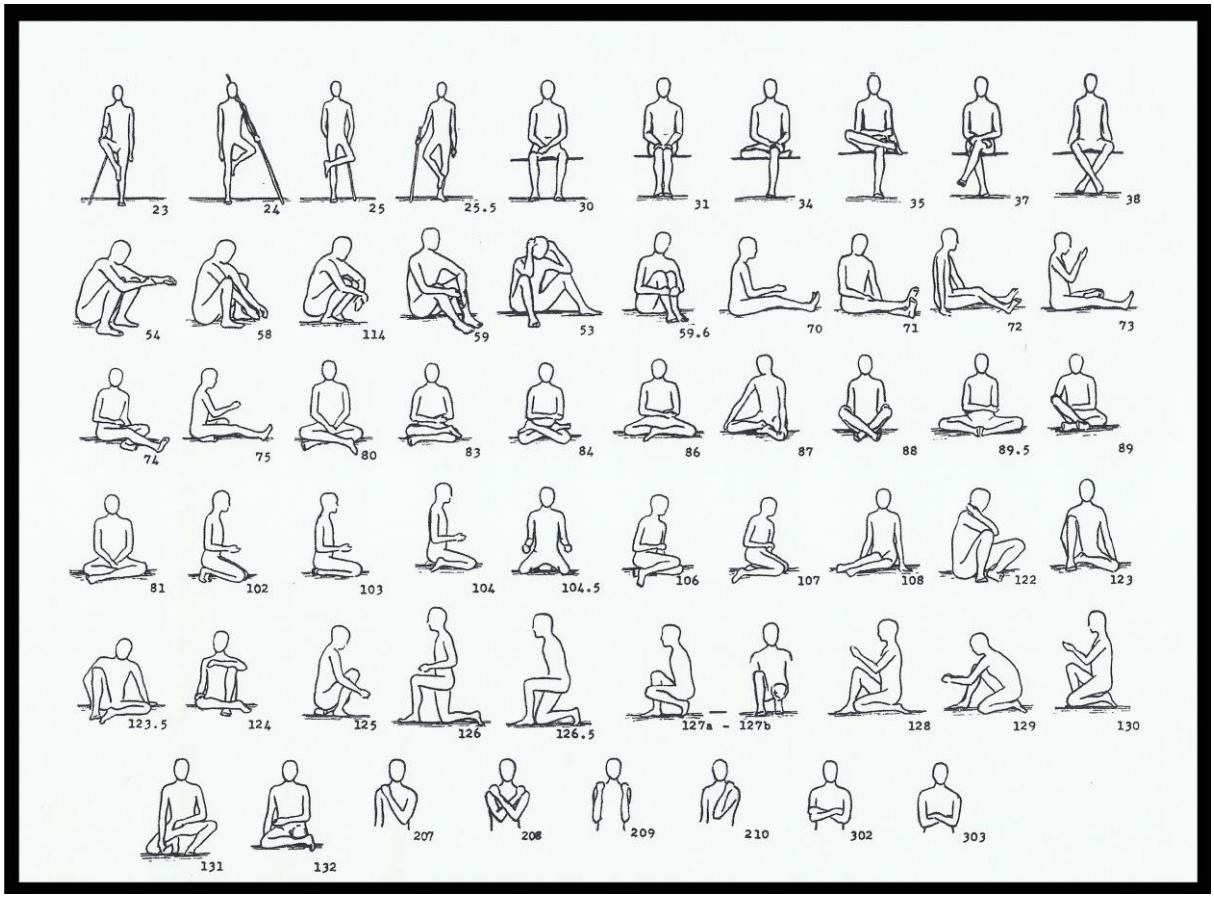


Plate 3.4. The world distribution of postural habits postural typology. Adapted from "World Distribution of Certain Postural Habits" by Hewes, 1955, American Anthropologist, 57(2). Copyright 1955 by Blackwell Publishing on behalf of the American Anthropological Association.

The postural typology depicted leisurely body-images in relation to the stabilization of the open-chain system. Postures in line 2 and 3, labelled from number 70 to 81 are some of the postural examples that often see practice in Malaysia at home; however, the postural data were never documented. This is the gab that this researcher trying to fill and subsequently to understand the embodiment of the floor-sitting behaviour. The signification of the embodiment of the sitting behaviour in response to individuals' environment is explained next, articulated in point 3.3.5 onwards.

3.3.5 Engineering

The body corresponds to different architecture elements and its layout design that varies betwixt environment. The elements such as a chair for example, are specifically designed to accommodate the body depending upon an individual's needs, or their activity during sitting. An office chair is designed with height adjustability and a tilted seat to provide stable body support whilst handling the computer or other deskwork. Ottomans are designed as being multifunctional either as a seater or stool, or acting as a footstool complementing the chairs. In some cases, it may also function as a coffee table or side table – depending upon individual need, with relevance to the connection of the human body adaptation on the elements within the environment, and an individual's ability to determine ways of utilization and inhibiting it. For instance, a tired body will seek out any form of refuge even the floor, whereas most people would see it as a non-proper sitting and resting mechanism. Even when there are benches, chairs, or sofas in the living room, due to the dynamic sitting context perching against the wall or sitting on the floor by cushioning part of the body from the dislodged sofa seats, or using a tumble short stool to prop the stretching legs is observed as comforting. These architectural elements are not specifically designed to be used in this fashion, but linked to the body-link significance as propagated by Branton (1969a), and the body-image relationship applied in the works of Pallasmaa (2005), Bloomer (1977), and Weinstock (2010) our body posture reacts to the environment in many unexpected ways.

3.4 The Need to Move: A Beneficial Exercise

Staffel (1884), Hooton (1945), and Akerblom (1954) are among the ergonomists whom for centuries believed that we should sit upright to prevent sitting discomfort and health

disorders. Nevertheless, Lueder (2004) when she cited NIOSH (1997), reported that this previously believed posture is identified as being hazardous. The sitting constrained the dynamics which, according to Hult (1954) with the same view shared by other researchers in the literary works such as Adams and Hutton's (1983) *The Effect of posture on the Fluid Content of Lumbar Intervertebral Discs* and Hunting et al. (1980; 1981) researches on postures in workplaces, as bad for health. The dynamic of sitting is essential and there is no negligence on its importance. Although according to ergonomist, Leuder (2004), arguments arose between the ergonomists contradicting the health professionals view on a user's need to move by changing positions from anything to anything with regards to the risk of musculoskeletal injury that may be caused by improper posture; to develop from one posture to another regardless of the postural composition [anything to anything] is actually relevant. The reason is that it "stabilizes the body-link concept in the open-chain system" as propagated by Branton (1969a). The open-chain system steers the body kinaesthesia in unforeseeable ways, where the connections of the haptic senses of touch accelerates the movement. Gazing into this relevancy is the model based on the *body-image* theory; where according to Bloomer (1977), citing Gibson (1966) that individual psychoanalytic thought conveys the unconsciousness of image changing to the bodies that separate from what they objectively and quantifiably determine about their physicality when immersed into the environment. On this juncture, the floor-sitting such as sitting cross-legged, sitting with the legs folded to the side, sitting with one knee up the other down and flexed, sitting with one knee up and the other stretched, and sitting with legs stretched out are among the examples of behaviour propagating the body-image theory, and are observed as bodily strategies to balance between the open-chains into closed-chains friction. Indeed, static seating causes discomfort to the postures; as Branton (1969b; 1967) and Jurgens (1980) agrees that "when

the body allowed moving freely, people are usually in constant motion", thus inclined to develop somewhat 'idiosyncratic' patterns of seated movement towards comfort. This significance as Fleischer at al. (1987), Ortiz et al. (1997) and also Jurgens (1980) in their research unanimously propagated that it is a norm for "people tending to develop unique patterns of seated movement". Bendix et al. (1986; 1985) tested this relevancy with the evaluation of seat design that could tilt from 5° backward to 10° forward over a transverse axis. The very raison d'être of the seat design was to engage users into a mechanically condition by rocking the seat back and forward to prevent postural fixity. Users respond by demonstrating a variety of sitting postures from tilting, to frequently moving the seat at adjustable heights. Another example of a similar assessment referred by the ergonomists is Van Deursen et al. (2000) office chair design that applied motor rotations which enabled dynamics twisting motion among users.

The domains of ergonomics are diverse and are widely proliferated within various requirements, and priorities are set at a different practical problem solving platform. This subsequently brings us to explore human performance through the study of the floor-sitting behaviour within the interior residential space context, as opposed to the work environment context [which normally linked to the human-equipment, human-computer relationships]. However, this study does not intend to seek to dwell into the issue of good or bad posture [although this plays a role in the effect that the ergonomics study has on the body's posture] as opposed to the issue that normally arose within the work environment context. This study tends to explore the floor-sitting as the alternative comfort preference in conjunction to the body dynamics relationship. To stretch this relevance further, the compatibility of ergonomics sciences elements such as physics, psychology, anatomy, physiology, and engineering are referred. By examining these elements, it is hoped the rationale behind the floor-sitting

behaviours would provide a comprehensible floor-sitting data that can be utilized towards the formulation in the development of future floor-sitting furniture design. The adaptation of video observation approaches as demonstrated by ergonomists Branton and Grayson (1967) video and photo recording, and Guha's (1979) cinematographic observation is significant for further elaboration into this research endeavour. In the research paper titled *An Evaluation of Train Seats by Observation of Sitting Behaviour* and Guha's (1979) *Body Movements and Muscle Activity in Sitting Cross-Legged*, the sitting movements relating to significant relationship between most activities and the position of the head, trunk, and arms were meticulously observed to obtain the different instances of the sitting and squatting data. In response to the method of evaluating how people adapt different postures during floor-sitting, therefore, Ashton's et al. (1972) approach in setting up a room [as car simulator adjacent to the control room] for observation to measure the reaction times of human subject behaviour was referred. This researcher's research however, will engage to the home environment setting.

Other related approaches are by Shechtman and Irani (2005) using a three-dimensional space-time video-template correlation approach for recognizing dynamic actions, Kilpatrick's (1970) model for the design of manual work stations and Snyder's et al. (1972) *Link System of The Human Torso*. Nevertheless, such computerized kinematic approaches require high computation cost, which surpassed this researcher's capability in preparing such research instruments.

3.5 The Design Relationships

Vanlaethem et.al (1989) the author of the *Gaetano Pesce: Architecture Design Art*, quoted Pesce's manifestation on the creative expression within the concept of *Design as Major Art* where "design must be open and the designer has to experiment with all the fields of creative activity" (p. 9). He explained creativity as further elaborated by Pesce as, "the freedom to be and to express whether it was oriented towards industrial production or limited to the simple creation of three-dimensional forms" (p. 9). This section provides the account to that significance, linking to some of the key furniture design works that are significantly related to this researcher's research on the floor-sitting behaviour and exploring the design concept.

3.5.1 Gaetano Pesce: Architect / Designer, Italy

Plate 3.5. UP 5-6, by Gaetano Pesce, 1969, London: Thames and Hudson Ltd. Copyright 1989 by Thames and Hudson Ltd. Reprinted with permission. Below right: The object's utilization.

Pesce's 1969 *UP Series* furniture design demonstrates *design as major art* relationship, where the concept signifies the idea, and creativity should be explored extensively. Vanlaethem and Sorkin (1989) writes that Pesce wanted to produce furniture that is more than merely just functional objects; above all he wanted them to signify a new value by their mere physical presence and even in the act of purchase by users. With connotations of growth, the UP armchairs are moulded out of expanded polyurethane foam, and then compressed under a vacuum to a tenth of their volume, the chairs are reduced to the shape of a pancake

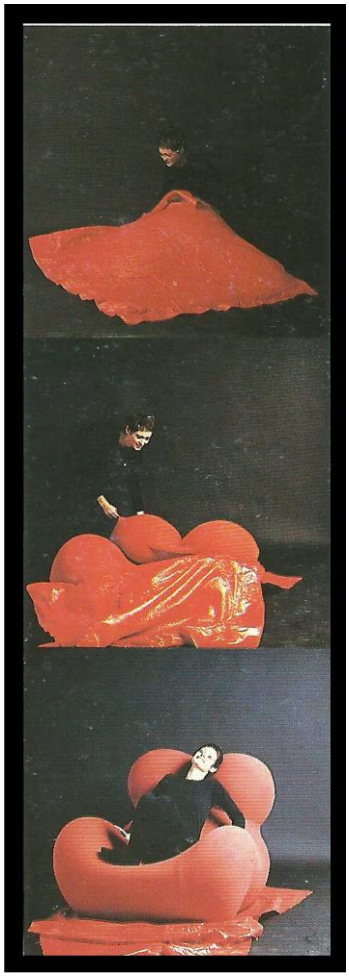


Plate 3.6

[see *Plate 3.5*, *Plate 3.6* and *Plate 3.7*], enclosed in PVC envelopes, and packed in flat, compact boxes. All that is required before use is to open the envelope; the chairs soon regain their normal dimensions and properties of elasticity and comfort. Moreover, the UP series is made up of seven different chairs, satisfying the requirements of different users and uses: normal-size chairs for adults, reduced sizes for children, sofas for two people and so on. The idea of modularity with the folded, size reduction, and expandable concepts for various users and uses were the criteria for developing this researcher's research product.

Plate 3.7. UP 1 Chair Collapsed Version, by Gaetano Pesce, 1969, Retrieved from http://www.moma.org/collection/object.php?object_id=4572. Copyright [2003] by seesaa.net.

3.5.2 Kirsten Hoppert and Steffen Kroll: Designer, Halle, Germany

Plate 3.8. LAVA, by Kirsten Hoppert and Steffen Kroll, 2007, Retrieved from http://www.trendir.com/ultra-modern/lava-reclining-lounge-furniture-from-cor-gets-another-award.html. Copyright [2012] by trendir.com.

Studio Vertijet's interior designer Kirsten Hoppert and product designer Steffan Kroll explored the sculptural form into multi-functional seating design. Departing from the traditional concept of Western-style sitting furniture, the *LAVA* [see *Plate 3.8*] a reclining lounge experiments both standard 45 centimetres above the ground seater and the floor as the medium of free postural configurations. The design of this upholstered seating and mats concept is visually expressive and relates to this researcher's multi-functional seating work.

3.5.3 H.Kjellberg and M.Lindqvist: Designer, Stockholm, Sweden

Plate 3.9. Carpet Diem, by H.Kjellberg and M.Lindqvist, 2003, Retrieved from http://annualdesignreview.id-mag.com. Copyright [2011] by I.D. Magazine Annual Design Review.

H.Kjellberg and M.Lindqvist's design is recognized for the exploration of interactivity and functionality. *Carpet Diem* [see *Plate 3.9*] is another sculptural-form sitting furniture that offers an alternative for those who prefer sitting on the floor. Similar to the *LAVA* design, the Swede was observed using two fundamental elements to visually connect the users through forms and texture. The use of carpet as the subject matter is synonymously parallel to this researcher's research prescription for trigging user's visual familiarity with carpet being used as a cushion for floor-sitting.

3.5.4 Jitrin Jintaprecha: Designer, Bangkok, Thailand

Jitrin Jintaprecha's *Tung Seatable* [see *Plate 3.10*] features a combination set of a side table, ottoman and low table. The furniture design displays the aesthetic role of bringing together traditional Thai floor-sitting culture into the modern living space that corresponds to this researcher's objective of proposing diverse resting furniture designs based on Malaysian practices.

Plate 3.10. Tung Seatable, by Jitrin Jintaprecha, 2003, Retrieved from http://www.jitrin.com/index.php?/2003/tung-seatable/. Copyright [2009] by Jitrin Jintaprecha.

3.6 Summary

Without a doubt, the floor-sitting behaviours are finely connected to cultural significations. However, the possibility of technical amalgamation into the subject concept and context of this research is immanent. The ergosystems is a structured template that for decades has been applied by the ergonomists, researchers, and industrial designers to solve appropriate problems relating to the work systems and product design. Hence, by understanding this to the integration of the ergonomics' science elements and its connections to the body kinaesthesia, it permits the foundation to the development of the floor-sitting furniture design. In contrast to the ubiquitous of furniture products that applied the same ground-sitting based

concept, the amalgamation of cultural and technical significances is the basis of the development of this research.

The ergonomics science elements such as physics, psychology, anatomy, physiology, and engineering are potential determinants to the whole understanding of the interaction of the body kinaesthesia when immersed into a closed environment.

Chapter 4.0

THE RESEARCH METHODOLOGY

4.1 Introduction

In the previous chapters, the discussions of postural behaviour within the context of culture research have been reviewed towards integrating the technical study of ergonomics for furniture design. Its value and validity was considered and informed by looking at number of previously related studies that should provide a good foundation for further discussions, as well as steering significantly towards the construction of this research design. This chapter moves onto describing the explanation of the research strategies involving the implementation of the methodological approach, the overview of the research design, and the process of research involved based on the significances and enquiries that arose from the synchronization of the research objectives and the research questions outlined in Chapter 1.

4.2 The Methodology and Method: What are they to this Research?

In order to gain a clear grasp of the research process, this section first provides the description of the definition of the term methodology, and the method that is often confounded to its meaning in delivering the detail of research activity. In relation to the research process that employs ranges of methods, procedures, and models of research methodology in order to achieve the research objectives, in this study, the research process encompasses these main steps; (a) formulating the research problem; (b) developing research objectives; (c) reviewing literature; (d) constructing research design; (e) collecting the data; (f) analysing the data, and (g) interpreting the data.

4.2.1 Addressing the Research Problem: Mixed Method

This study amalgamates cross-discipline studies which according to Creswell (2011) are suited for the application of mixed methods based on the criteria of this research that employs multiple philosophical perspectives as guidance, and incorporates various elements of methods and research processes. In researching the subject that deals with subjective human behaviours, feelings, and perspectives the application of qualitative study is inherent, but its limitation is displayed when wanting to generalize the results numerically. On the other hand, it is difficult for researchers to understand the relationship of individual behaviour and characteristics quantitatively. Hence, the limitations between these methods can, and will balance out one another through the strength of other methods. By which the amalgamation of qualitative and quantitative data provides a comprehensible grasp of the research problem than either approach could by itself. Based on the key components of conducting the mixed methods as highlighted by Creswell (2011) and appropriated to this research process, this study encompasses:

a. Collecting and analysing persuasively and rigorously both qualitative and quantitative data based on research questions;
b. Mixing [or integrating or linking] the two forms of data concurrently by combining them, by having one build on the other sequentially, or embedding one within the other;
c. Giving priority to one, or to both forms of data in terms of what this research emphasizes, and what this study emphasised on qualitative strands;
d. Using these procedures in a single study or in multiple phases of a program of study;

e. Combining the procedures into specific research designs that direct the plan for conducting the study.

(p. 5)

By adopting the ergonomics ergosystems' framework [see Plate 3.2] as the foundation to the mixed method research, the implementation of the qualitative and quantitative strands [QUAL + QUAN] unfolds the cause and effect factors of human behaviour in obtaining findings of the floor-sitting behaviour data. The main perquisite of the design to this research application is as Morgan (1998), Tashakkori and Teddlie (1998), and Creswell et. al. (2003) added and emphasised, the two strands can be done in separate phases and collects only one data at a time, which applicable to this research. The coherency of the mixed methods designs is explained next.

4.2.1.1 Identify an Approach to Design: Exploratory Design

There are several design options available in conjunction to the implementation of mixed methods that reflects interaction, priority, timing, and mixing during data collection (Creswell & Plano Clark, 2011, p. 68). In particular to the designing of this research approach, this researcher has selected the exploratory design that best matches the research problem and reasons for mixing in order to make the whole research process manageable. The design, as Creswell (2011) defined is implemented in sequence starting with qualitative data collection and analysis in the first phase, then followed by quantitative data collection and analysis in the second phase that builds from the first phase. The design is also recognised as 'the instrument development design' (Creswell, Fetters, & Ivankova, 2004). The detail

characteristics of the design are simplified in *Table 4.1* and further explained its significances in 4.2.2 onwards.

Model Characteristic	**Exploratory Design**
Definition	Methods implemented sequentially, starting with qualitative data collection and analysis in Phase 1 followed by quantitative data collection and analysis in Phase 2 which builds on Phase 1
Design Purpose	Need to test or measure qualitative exploratory findings
Priority of the strands	Qualitative emphasis
Timing of the strands	Sequential: qualitative first
Primary point of interface for mixing	Data collection
Primary mixing strategies	Connecting the two strands: 1. Qualitative data collection and analysis synchronising quantitative data collection 2. Use qualitative results to make decisions about quantitative research questions, sampling and data collection in Phase 2

	involving back qualitative analysis, then quantitative subsequently
Variants involve	1. Theory development 2. Instrument development

Table 4.1. Model characteristic of the applied mixed method strand appropriated to the application of this researcher's research design [Adopted and adapted to this research context from Creswell & Plano Clark (2011)].

4.2.1.2 The Purpose of the Exploratory Design to this Research

As the definition of research design clearly justified the emphasizes of the qualitative approach as the initial step of the research process, the primary reasoning of its implementation is to generalize qualitative findings based on small scale subjects [or individuals] in this researcher's research context from the first phase to a larger sample gathered during the second phase. The exploration is needed in order for this researcher to explore a [floor-sitting behaviour] phenomenon which suited with the propagation propagated by Creswell et. al (2003) in *Teaching Mixed Method Research: Practices, Dilemmas and Challenges* that with the design, a phenomenon can be explored in depth and the occurrence of its dimensions measured. Furthermore, the approach is appropriated for this researcher to test the aspect of theory, or the classification of theory that is applied within the framework of the ergonomics ergosystems, as this significance coherently is immanent to Morgan (1998) from his writing in *Practical Strategies For Combining Qualitative And Quantitative Methods: Applications To Health Research*.

4.2.2 The Qualitative Strand

The purpose of this strand is to understand the floor-sitting behaviour phenomena, and the participants' reflection to the theories underlined within the structured research design. The focus of this method is to observe the frequency of the anatomical movement of the floor-sitting within the perimeter of a home environment and to validate the theoretical aspects connecting to the floor-sitting behaviour based on the ergonomics ergosystems theoretical framework. The obtained qualitative data and findings will complement the quantitative processes subsequently, as explained earlier in the previous points.

4.2.2.1 The Criteria of the Method Applied to the Research

a. Document research that includes photographic observation [preliminary visual analysis].
b. Video observation encompasses the pilot study, pilot analysis and actual analysis.
c. Open-ended interviews with experts in respective areas.

4.2.3 The Quantitative Strand

The quantitative process complements mellifluously to the qualitative strands from the first phase, and it developed subsequently. It synchronises the numerical point of view, and employs the qualitative data analysis in order to achieve findings to the research problems. It measures human responses in biphasic questionnaire surveys and, time and event sampling, and conveys the findings in statistical tables, graphs and typology.

4.2.3.1 The Criteria of the Method Applied to the Research

a. Questionnaire surveys: The procedure that involves two phases of identifying and validates floor-sitting data in the early conceptual phase. The first phase is to identify the validity of the theories elucidated in the reviewed literature and subsequently to signify its signification in the pilot study. The data gathered in the pilot study then is constructed for the second phase of the questionnaire survey for the proof of concept in the pilot analysis and actual behaviour analysis.

b. Time and event sampling: An observation technique use to observe the aspect of human behaviour. The procedure involves video recording of human floor-sitting behaviour in an extended period of time where a presetting length of time is set for 10 minutes in this context of study, in order to enable subject to acclimatize to the recording and subsequently sustain with what the subject is doing for another 60 minutes. The objective of this method is to validate the data of floor-sitting timing obtained from the questionnaire survey.

The detail of this methods is explained next in point 4.6.2 The Biphasic Surveys and 4.7 Step 3: The Analysis of Data onwards.

4.3 Research Questions: Steering the Research Processes

In the beginning of this research, four main research questions arose based on the goals set within the research objectives. The research questions' [RQ.1 to RQ.4] coherencies to the method-detection-justifications are illustrated and elucidated in MDJ.1 to MDJ.4, and it established the point of departure to the trajectory of the key research procedures. The research procedures complemented to each justification is expounded correspondingly:

(RQ.1) What are the features accentuated from the study of anthropology that engaged to the floor-sitting behaviour and in coherency to the context of furniture design?

(MDJ.1)

Although Hewes (1955) and other previous anthropology scholars emphasised that the relationship of human behaviour and the postural variations are cultural, and not anatomically determined, Tatsukishi Irizawa (1920-21), Nishi and Hozumi (2012), Syed Ahmad Iskandar (2001) and Tajuddin et. al (2005) however, are among those who established such significance to the coherency of technicality within the sitting behaviour by highlighting the geographical factors and the coherency of space design, specifically to the house construction. In addition, the body movement that the anthropologists established as habits technically acknowledges the fragmentation of the anatomical, physiological, and psychological signification that demonstrated the foundation to the exploration and illumination within the context of ergonomics and design.

Research procedures:

a. Preliminary visual analysis to understand the floor-sitting behaviour phenomenology.
b. Survey analysis of the human sitting behaviour that synchronizing the existing literary context.
c. Floor-sitting behaviour analysis via video observation.
d. Reporting approach: Reported the floor-sitting behaviour data using percentage and descriptive interpretation.

(RQ.2) How does the technical framework articulate the embodiment of the floor-sitting behaviour and what steers this context?

(MDJ.2)

According to Bridger (2009), the human behaviour or bodily movements are governed by the technical context of ergonomics by means of the acceleration of the work system called the ergosystems. It connects to this researcher's application of the ergonomics science elements that consist of the *Physics*, *Psychology*, *Anatomy*, *Physiology*, and *Engineering* which forms the foundation and templates to the articulation of the technical analysis of the floor-sitting behaviour taken from the cultural signification. At the conceptual level, there are three interconnected variables engaging this research that is composed of the *floor-sitting, ergonomics' science elements*, and *ergosystems*.

Research procedures:

a. Survey analysis of the human sitting behaviour that synchronizing the existing literary context.

b. Floor-sitting behaviour analysis via video observation.

(RQ.3) What is the relevance of designing the floor-sitting furniture?

(MDJ.3)

The theoretical and philosophical connections to the embodiment of the floor-sitting needs to be clearly evidenced; hence, the construction of an appropriate research instrument is essential. With the technical significances imposed within the ergosystems' interface and the influence of the ergonomics science elements that are embedded in the manifestation of the philosophical references synchronizing this research context, the design intervention is observed immanent to validate the floor-sitting behaviour/posture and subsequently signifies the ergonomic design relevancy.

Research procedures:

Elucidating the technical aspects of the human floor-sitting behaviour in synchronization to this research subject, and to decipher into the design of the floor-sitting furniture prototype.

(RQ.4) Is there difference between the Malaysian floor-sitting behaviour to the postural data compiled by the western scholars, and how significant is the design of the floor-sitting furniture affecting the floor-sitting behaviour compared to the same sittings seated without designed furniture?

(MDJ.4)

Kinaesthetically, Malaysian floor-sitting customs are similar to what was documented typologically and literarily manifested by the previous anthropologists on ground sittings by the natives in Australasia, Asia, and some parts of the Americas. Contextually, the embodiment of such sitting and its behaviour on the ground was not technically elucidated, and there is no evidence linking the technicality aspects and philosophical justifications from both past and present researchers from the respected fields. In addition, the Malaysian floor-sitting behaviour data has yet to be appropriately documented. This loop is needed to be filled with the amalgamation of cross-disciplinary studies in enriching the knowledge of the sitting behaviour that is fundamentally associated to the cultural context. The coherency demonstrated by the presence of the ergonomics study to human behaviour is immanent towards justifying this relevancy. The furniture design significances should provide a broader perspective on the dynamics of floor-sitting, and adds to the alternative of the sitting comfort definition when the body is interacted to the designed object. This study should contribute to the new knowledge forming a divergence of understanding on the embodiment of the floor-sitting behaviours, as well as the concept for furniture design that is governed by integrated links within the ergosystems.

Research procedures:

a. Integrative approach: Integrating the findings of the qualitative and quantitative analyses that emerged from the focussed issues.
b. Floor-sitting behaviour analysis via video observation complementing with the designed furniture prototype as the auxiliary research instrument.

4.4 The Research Design

The research design outlines how data is to be collected, what mechanism of instruments to be employed, and how the instrument[s] will be utilised in measuring the researched subject for data collection. The model characteristic of the exploratory design in Table 4.1 is referred. The overviews of these phases are illustrated in the research design framework [see *Plate 4.1*]. With the application of the ergonomics ergosystems template, the framework divides the research procedures and illustrates the strategy in accomplishing the main research objective. The following phases outline the strategy of conducting this research and the step-by-step tasks are explained next:

a. The conceptual phase.
b. Empiric and analytic phase.

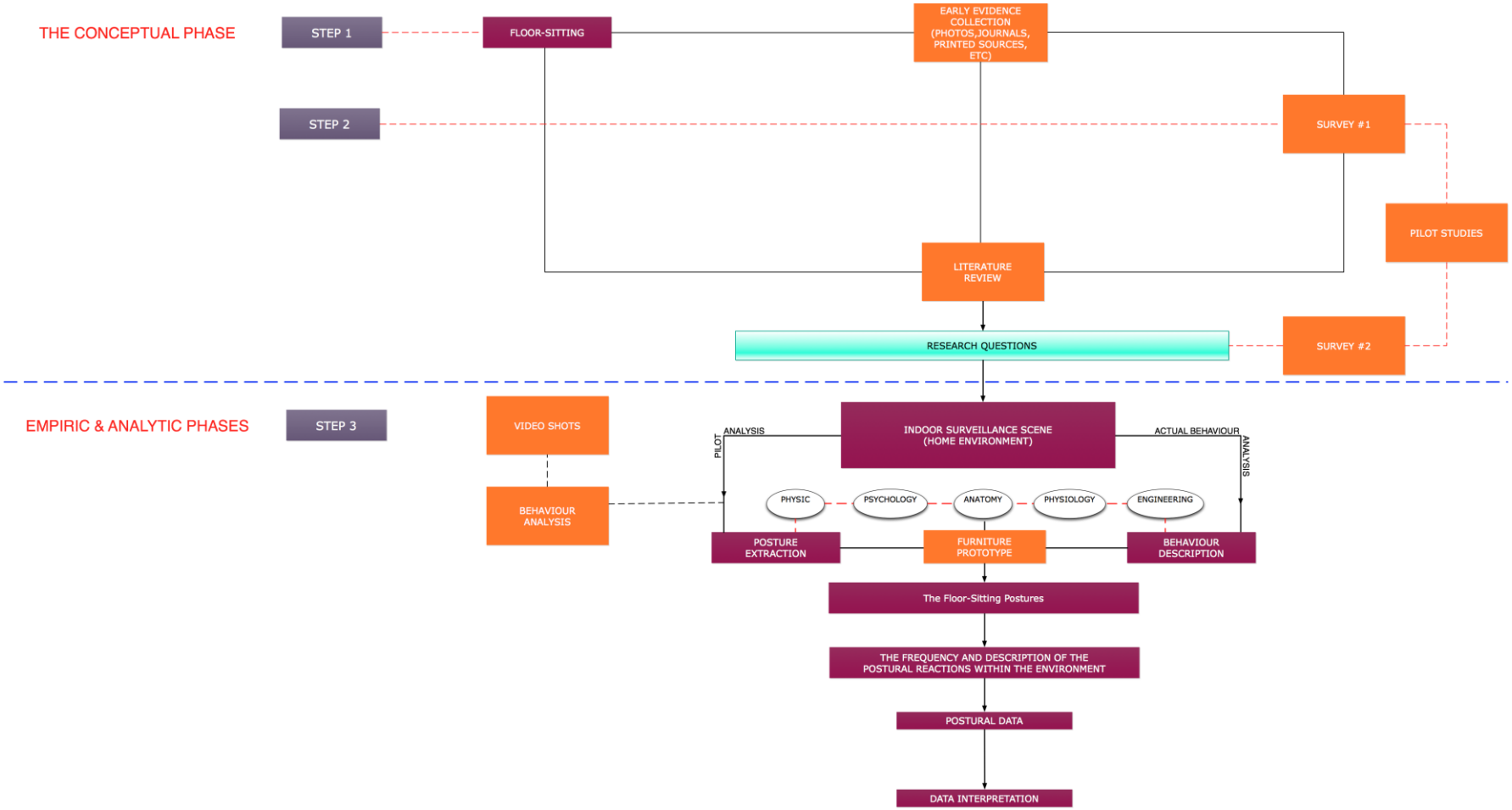


Plate 4.1. The research design framework. [Self-creation].

4.5 Step 1: Exploring Information: Early Evidence Collection

In the beginning of this research, the method of collecting preliminary data incorporates these techniques:

a. Research of documents.

b. Open-ended interviews with experts in respective areas.

c. Reviewing the literature.

4.5.1 [a] Research of Documents

The preliminary information gained from:

a. Primary sources such as: publications of journals, conference proceedings, and photographs.

b. Secondary sources such as: design and culture study textbooks, magazines, and web sites/internet sources.

4.5.2 [b] Open-Ended Interviews on Experts in Respective Areas

Kvale (1996), in his writing justified that this technique aims to illustrate the significance of central themes within the occurrence of the subjects. In order to dig up a clear foundation of the development of the research themes, experts views on this research's research problem are require within the field of culture, design, and human behaviours during this researcher's preliminary data excavation. Contributed experts are:

a. Prof. Dato' Dr. Othman Md Yatim
Akademi Pengajian Melayu, Universiti Malaya, Malaysia.

b. Prof. Madya Datu Hj. Sanib Hj. Said
Faculty of Social Sciences Universiti Malaysia Sarawak, Malaysia.

c. Prof. Madya Dr. Mohd Sabrizaa Abd. Rashid
Centre For Knowledge And Understanding of Tropical Architecture and Interior [KUTAI] Faculty of Architecture, Planning and Surveying Universiti Teknologi MARA Perak, Malaysia.

d. Prof. Dr. Syed Ahmad Iskandar Syed Ariffin
Center For The Study of Built Environment in The Malay World [KALAM] Universiti Teknologi Malaysia, Malaysia.

The selection of experts was based on their establishment locally and internationally in both the academic and professional fields in art and culture study, three-dimensional design, space design, and human ergonomics.

4.5.3 [c] Reviewing The Literature

This was the task starting at the beginning of the research process and continued throughout the project. According to Walliman (2001) in support to Wiersma (1986), the author of *Research Methods in Education* and Paul D. Leedy (1989), the author of *Practical Research: Planning and Design Manifestation*, the same way as this researcher had to plan the research strategy; by reviewing relevant literature it enables this researcher to obtain and strengthen background information for the context of the research subject, and subsequently was made able to limit and identify appropriate answers to research problems. The task also provides

important information for subsequent phases of the research investigation. The sources of information at which is also mentioned in 4.5.1, is comprised of the primary and secondary sources such as books containing background information, periodicals, technical reports, reports of research studies, and academic theses. The overall literary sources reviewed in order to accelerate this researcher's research primarily included the fields of architecture, ergonomics studies, anthropology studies, and furniture design.

4.6 Step 2: Collecting Data

In application of the QUAL + QUAN sequential design, and to get a clear grasp into people's notion on their floor-sitting habits, the study began with incorporating preliminary visual analysis by assessing photographic visuals from various sources linking significant research questions to enquire and steer further research activities. Then, participants were invited to complete a biphasic-structured questionnaire survey, in which participants conveyed their thoughts towards their experience sitting on the floor. These processes then complemented to the series of pilot studies, pilot analysis, and final actual behaviour analysis. It was anticipated that these measures would accelerate the statistical and theoretical rationale into clear evidence of the synchronization of the ergonomics science elements to the floor-sitting behaviour.

4.6.1 Preliminary Observation: Visual Analysis

Within the documentation research jurisdiction, visual analysis enabled this researcher to recognize and understand the still visuals concerning the researched phenomena. This

preliminary descriptive data collection process addresses the visual assessment regarding the floor-sitting behaviour's sitting phenomenon, its pattern, and articulation to the preliminary research questions [PLRQ] at every significant point assessed. The result or conclusion obtained at this phase was the basis to further stretch into the next level of investigation and analysis through video observation.

4.6.2 The Biphasic Surveys

The research began with the execution of a series of structured mixtures of open-ended and closed-ended questionnaires using mail surveys with aims to identify the appropriateness of the foundation of the theoretical and philosophical rational that arose from the research problems, reviewed literatures, and research questions for further validation and execution. Initially, the questionnaires were distributed to a few housing areas with aims to get responses from respondents living in flats, and medium cost housing. It was apparent at this stage that this method appealed ineffective for data gathering procedure. The reasons for this were:

a. Many of the mailed surveys were never returned.
b. This researcher had very little control over the respondents to complete and return the survey.
c. Delays in this researcher's investigation timeline which affected the research costs.

Therefore, the online email survey was identified as being both practical and reliable when substituting the inefficiency of the traditional mail survey method. A total number of 200 random participants among local IT users within the perimeter of the Malaysia internet server terminal completed the questionnaires. The surveys were dispersed in two different stages

appropriated to the objective of the research to get a clear grasp of the subject, and the coherency to the theoretical connection. [see *Plate 4.2*].

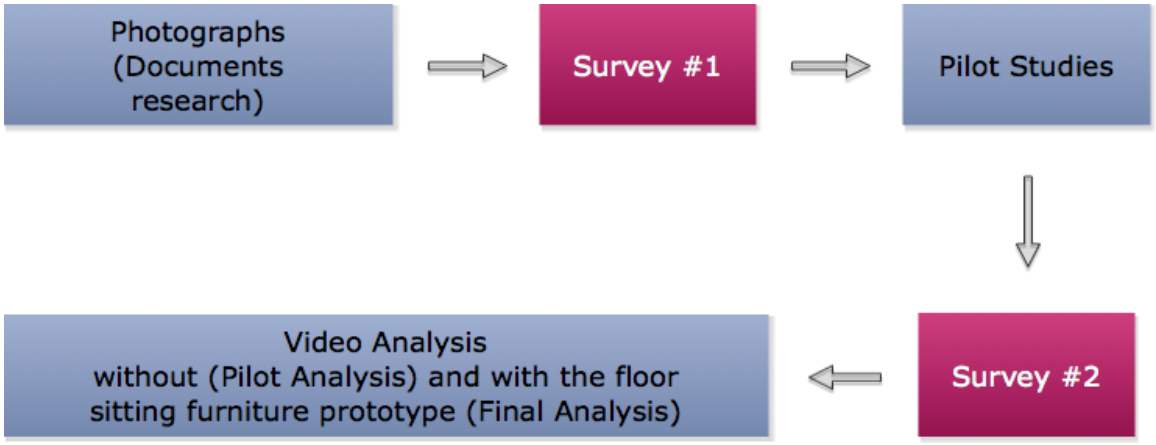


Plate 4.2. The flow of the biphasic survey applied to the research. [Self-creation].

Despite the advantage of executing an online survey, there was also a technical hitch, where the online data stored within the online survey database was corrupted and affected its entire users worldwide. This type of problem however, does happen occasionally and is beyond any users' control. This researcher managed to retain the complete summary of the survey results at the final stage of the biphasic survey narrowly before the online database became corrupted.

4.6.3 Video Observation: The Floor-Sitting Behaviour and Theoretical Validity

The incorporation of the video observation validated the behaviour preconception built by the answered questionnaires to support the adequacy and the appropriateness of the theoretical and philosophical context of this research. In light of this, the video surveillance technique

was adopted, integrating with a series of floor-sitting behaviour pilot studies, pilot analysis, and final video analysis involving overall 15 participants that comprises of 3 participants in pilot study, 6 participants in pilot analysis and 6 participants in actual behaviour analysis in the home environment with different living room layouts. Note that the participants' participation as subject was based on their consent given during the previous email survey sessions. The initial challenge for this researcher when conducting video observations was to record all 28 potential participants whom initially agreed as they stated in the initial survey form that their floor-sitting behaviours could be observed. However, the one of the challenges faced was that some of the potential participants' were in scattered locations in regards to where this researcher's research was stationed. On that remark, this researcher organized potential study locations based on this researcher's accessibility to contact the participants appropriated to the research tasks and timeline. The 15 participants were filtered and chosen among those living in the major cities and town in Penang, Ipoh, and Kuala Lumpur due to the easy access of participants' locations. Given that the floor-sitting model is unanimously recognised as following the exploratory design applied in this research, the small sampling size of 15 participants is rather sufficed based on Filgueras and Rebelo (2007) analysis on the human, product, and environment interactions. They stated that when there is a complication as to what this researcher experienced in handling random participants, and time management it is as recommended to only record 10% of the participants that execute the same task type. Other studies that applied a similar intervention were Creswell and Plano Clark (2011), Hekmer and Csikszentmihalyi (2002), Lewis-Beck et al. (2004), Onwuegbuzie and Johnson (2006), Reis and Gable (2000), and Siren Films (2010). On the contrary, it was suspected but understandable that the feeling of discomfort may have caused the remaining 72 respondents to reject their participation in the video session.

4.6.4 Pilot Study

The objectives of the pilot studies were to validate the interpreted data obtained at the preliminary phase of the research, respond to the photo analysis, and establish the first biphasic survey on the participants' architecture experience pertaining to the floor-sitting behaviour. It is the method as van Teijlingen and Hundley (2001) at the University of Aberdeen described by citing Polit et. al (2001) the author of *Essentials Of Nursing Research* as trial-run[s] or mini versions of a full-scale study. Three participants were video recorded and photographed in order to study the subject's phenomena based on the synchronization of theories manifested from the reviewed literary content that comprises of the interior-architecture significances, the human physiological and psychological context to space, environment, and practical ergonomics. Other significant rationale of conducting the pilot studies as outlined by van Teijlingen and Hundley (2001) appropriated to this researcher's research include:

a. Developing and testing adequacy of research instruments.

b. Assessing the feasibility of a (full-scale) study.

c. Designing a research protocol.

d. Assessing whether the research protocol is realistic and workable.

e. Establishing whether the sampling frame and technique are effective.

f. Identifying logistical problems that might occur using proposed methods.

g. Developing a research question and research plan.

(p. 2)

Personal notes that were made during the studies, and the criteria of observation in this study encompasses of:

a. Observing the pattern of the floor-sitting posture.

b. Observing the frequency of the floor-sitting in response to the sitter's environment.

c. Observing the gender and age practice of the type of sitting.

Observing the relationships of the space design significance to the sitting behaviour was based on the ergonomics science elements. The coherency of elements comprising of the physic, psychology, physiology, anatomy, and engineering signification were observed.

4.6.5 Coding Design

Coding system is an interpretive technique that organizes copious data [survey, notes, and observation] to provide a reasonable means to analyse the responses within quantitative measures. It provides a clear and simple reference system so that the data obtained can be illustrated and visually understood. In this study, the coding is presented mainly in the form of postural typology, abbreviated alphabets, and symbols.

POSTURES										
CODE	LS 1	LS 2	LS 3	SKX 1	SKX 2	SKX 3	CLS 1	CLS 2	CLS 3	CLS 4
SYMBOL	×	×	×	○	○	○	△	△	△	△

POSTURES										
CODE	CLS 5	CLS 6	CLS 7	LFS 1	LFS 2	LFS 3	S1KU 1	S1KU 2	S1KU 3	S1KU 4
SYMBOL	△	△	△	▽	▽	▽	□	□	□	□

Table 4.2. Postural typology adopted from Hewes' World Distribution of Postural Habits and recomposed appropriated to this researcher indoor sitting context: Coding design relationships. [Adapted and adjusted to this research context from Hewes, (1955)].

Table 4.2 exemplifies the ground sitting postural data. The code and symbol are given for each of the postures for easy reference; 'LS' stands for 'sitting with legs stretch out' and symbolled with '×'. Each initial letters applied in the coding is an abbreviation form of word. The number '1' to '3' [and so forth] are the reference numbers of the type of sitting that was frequently observed being exercised among Malaysians at which also applied to other coding's in the table. The letter 'X' is set to delineate the sitting that sometimes with the ankles and knees crossed.

a. 'SKX' is short for 'sitting with knee flex and one leg stretch' with symbol '○' set to it.

b. 'CLS' is 'cross-legged sitting' represents by the symbol '△' that homologous with the shape of sitting.

c. ‘LFS’ stands for ‘sitting with the legs folded to the side’. Symbol ‘▽’ symbolizes the posture.

d. ‘S1KU’ stands for ‘sitting with one knee up, other down and flexed’. The number ‘1’ indicates the abbreviation of ‘one’. If for example, the name of the sitting incorporates ‘number of moved body parts’ therefore numbering will be inserted. Symbol ‘□’ symbolizes the posture.

Other coding applied in this chapter onwards includes:

e. ‘P’ stands for ‘PARTICIPANT’.

f. ‘+’ stands for ‘OTHER SITTING POSTURE’ and the number complemented to it indicates the type of numbers that the other sitting postures demonstrated.

4.7 Step 3: The Analysis of Data

The process of measuring the reliability and validity of the collected data is executed through the synchronization of the qualitative and the quantitative strands [QUAL + QUAN] where both strands are synchronized within the qualitative emphasis, and the results of the separate strands were converged. The data analysis procedures were executed in phases involving:

a. The performing of the *test-retest* reliability test based on the series of biphasic online surveys involving 200 random respondents to validate and collect the mixture of open-ended and closed-ended data.

b. The execution of the video recording based on the interpretation of the descriptive statistics, and theories from the survey by performing the pilot studies in *sampling validity* using surveillance method to validate the characteristics of the elements that

affected the floor-sitting behaviour in responding to the home environment. Further surveillance method applied within the pilot analysis and the actual behaviour analysis.

c. The construction of the floor-sitting furniture prototype as the auxiliary research instrument synchronizing point [b] significance for the analysis continuance in the actual behaviour analysis.

d. The integration of the qualitative and the quantitative analyses' findings from the departure of the focused issue.

As a research that focuses mainly on observation, the implementation of video recording immanent. The fragment of the behaviour analysis framework is shown in *Plate 4.3* with the detail sequence and synchronisations of the analysis shown in *Plate 4.4*. The analysis consists of the posture extraction and behaviour description data. The nexus of time and event sampling is significant within this research process where it functioned as the backbone to accomplish the data collection and analysis processes. By referring to Bentzen (2005) this research adopted such sampling techniques appropriated to this research necessity:

a. Observing the participant's total behaviour in order to find out what the participant's would typically do when sitting on the floor in his or her own private space.

b. Focusing on a certain aspects of floor-sitting behaviour to reveal the frequency of that sitting behaviour.

c. Focusing on activities involving participant's in their living space with reference to the connection of the ergonomics science elements significances. Example: observing

people finding a perching spot for body resting when sitting on the floor; the action relates to theoretical context underlying within the said ergonomics elements.

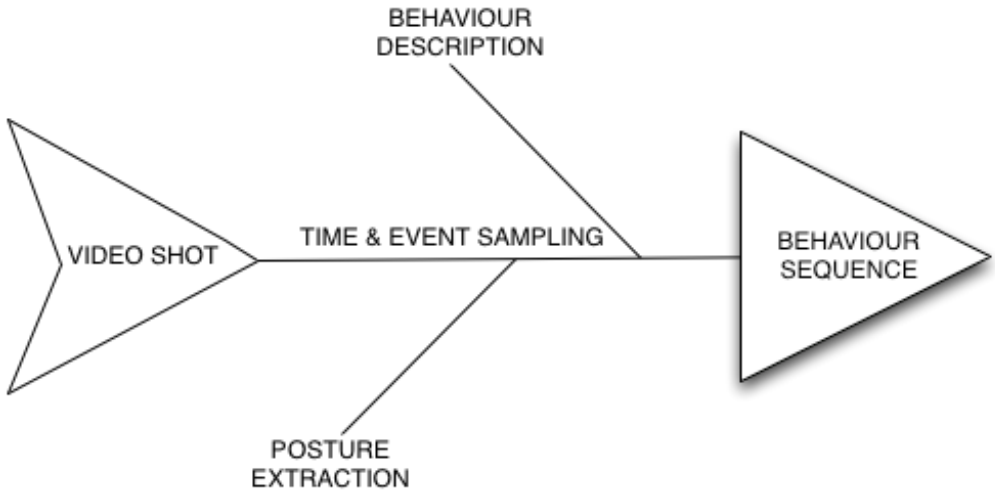


Plate 4.3. Fragment of the behaviour analysis framework. [Self-creation].

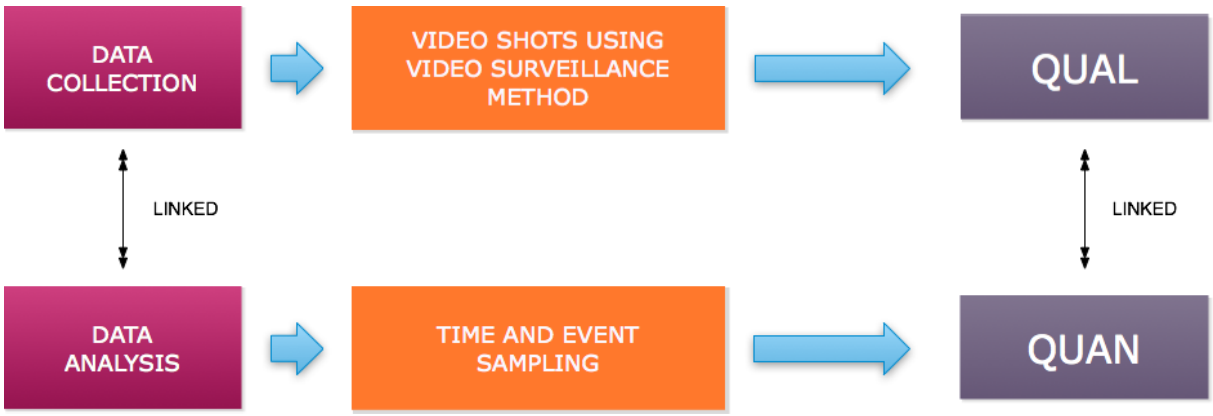


Plate 4.4. The sequence and synchronisation of methods within the behaviour analysis framework. [Self-creation].

The following items were obtained or constructed for the video surveillance approach:

a. *Full HD video camcorder*: fitting the proposed method of 'video surveillance', it was used to document all motion activity and visual information within the home environment for the video analysis.

b. *Floor sitting furniture prototype* as instrument in floor-sitting data collection: a prototype designed based on the Malaysian anthropometric standards as the instrument for the participant use during the actual behaviour analysis [see *Plate 4.5*].

c. *Living room*: *Plate 4.17* shows how the apparatus was installed in the living room. The room was properly set to ensure the participants comfortable to express their sitting behaviour during the video recording.

Plate 4.5. The floor-sitting furniture prototype designed by this researcher. [Self-creation].

4.7.1 The Prototype Design: The Engineering Significance

Plate 4.6. The modularity feature of the prototype. [Self-creation].

A prototype based on the analysed element's signification was constructed from the soft materials in order to provide the ergonomic need of the body when sitting on the floor. The design process embodies the connections of the ergonomics and *somatic* principles. 'Somatic' is the field of enquiry and practice that according to Linden (1994) engages the participation of the human being as a whole and focuses in a practical way on the interactions of posture within the articulation of movement, emotion, self-concept, and cultural values. The three somatic principles were extracted as Cranz (2000) initially outlined, and thus adopted to this analysis, and the three somatic principles connected to the construction of the furniture design prototype are:

a. Philosophical ideas about the human body.

b. Ideas about anatomy.

c. Ideas about psycho-physical processes.

Compared to the concept of ergonomics that normally focuses on one part of the body; for example, by designing good lumbar support for cushioning specifically for the curves of the lumbar lordosis. The two fields of discipline [ergonomics and somatic] subtly articulate the

participation of the mind to reorganize, and realign the entire body at which this point steers this researcher to design a ‘complete package’ product. Furthering this relevancy, the exploration of ‘space of imagination’ significance where the utilization of the unused space ones ‘sees’ within sitting peripherally, and refuge while being perched on the floor was developed. The essential criterion of designing this prototype was based on the anatomical concern of the freedom a person has to organize and maintain appropriate dynamics, and thus consequently balancing the open-chain system.

The *Lapis* prototype conveys the meaning of ‘layers’ which is designed with adjustability, and can be dismantled or arranged into four segments, or stacks of cushion seats. These features are specifically designed for the sitter’s adjustment, and to their desired sitting or lounging positions. The design features, and the sitting positions linking to Cranz’s (2000) writing would take off the load experienced by the spine, neck, and head with the softness and firm characteristics of the cushions. The prototype was designed in such a way that it fits into the nature of the human dynamics where most people will make use of what is available to them in search for comfort within their surroundings when sitting on the floor. The prototype with stacked cushions demonstrates a platform for a headrest, shoulder rests, and other parts of the cushions that support the kyphosis to the lower lordosis. This subsequently demonstrates the Alexander Techniques manifestation of good biomechanical articulation which begins with head and neck primacy, and subsequently is followed by the kinaesthesia of the pelvic balance or hip, knee, and ankle joints.

The idea of design is influenced by the ‘space of imagination’ significance within an unused area where the individual’s floor-sitting behaviour is steered by the synchronization of their locus within the dwelling space. Linking this relationship, the floor mat forms the subject matter, and is visualized within the designed form due to its cultural implications, and

customization to Malaysians. Moreover, with the characteristics of the subject matter that can be spread out, kept rolled, or can be folded at user's degree of utilization and "rarely kept spread all the time" (Syed Ahmad Iskandar, 2001), the concept of modularity was considerately applied into the design [see *Plate 4.6* and *Plate 4.7*]. In terms of materiality, soft materials that were comprised of the combination of cushion foam and fabrics, from the use of imitation leather to tweed felt were employed to suit the engagement of the tactility stimulation of the designed form, and its textures to the whole body when assimilating to the sitting environment. The floor base that is associated to the cushions, measures at a stretchable 95th percentile of the overall Malaysian anthropometry. The loosening cushions when it is stacked, forms a single seater at the Malaysian standard of 40.8 cm sofa heights.

Plate 4.7. The design of the floor-sitting furniture prototype. [Self-creation].

Overall, six target features were adopted and applied in the prototype design as these features are suggested and endorsed by Springer's (2009) in designing sitting furniture:

a. Support a person's body.

b. Support activity.

c. Promote movement.

d. Enable performance.

e. Be easy to use.

f. Does not harm.

4.7.1.1 The Prototype Design: The *Lapis* Development

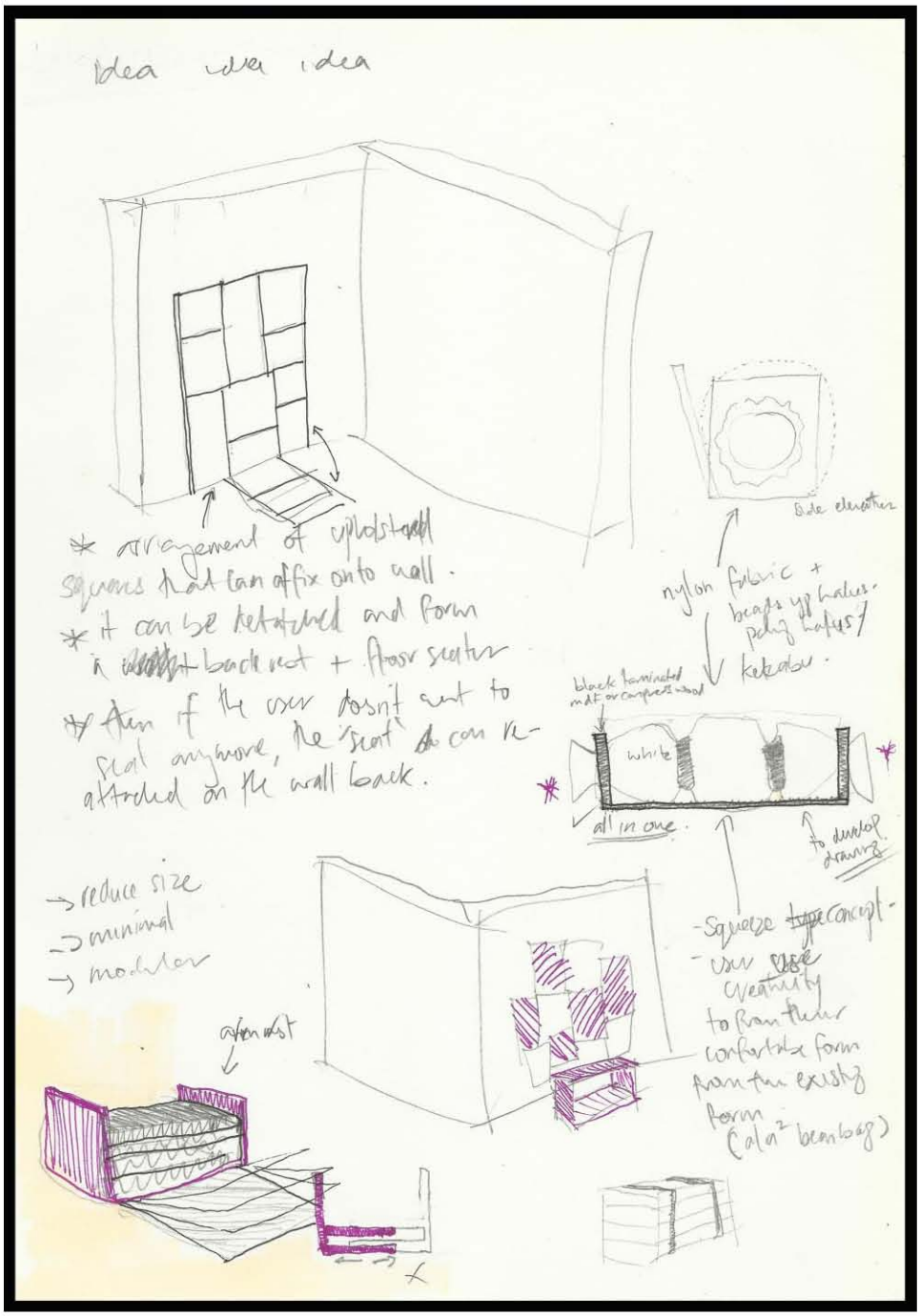


Plate 4.8. The idea development sketches of the floor-sitting prototype 1. [Self-creation].

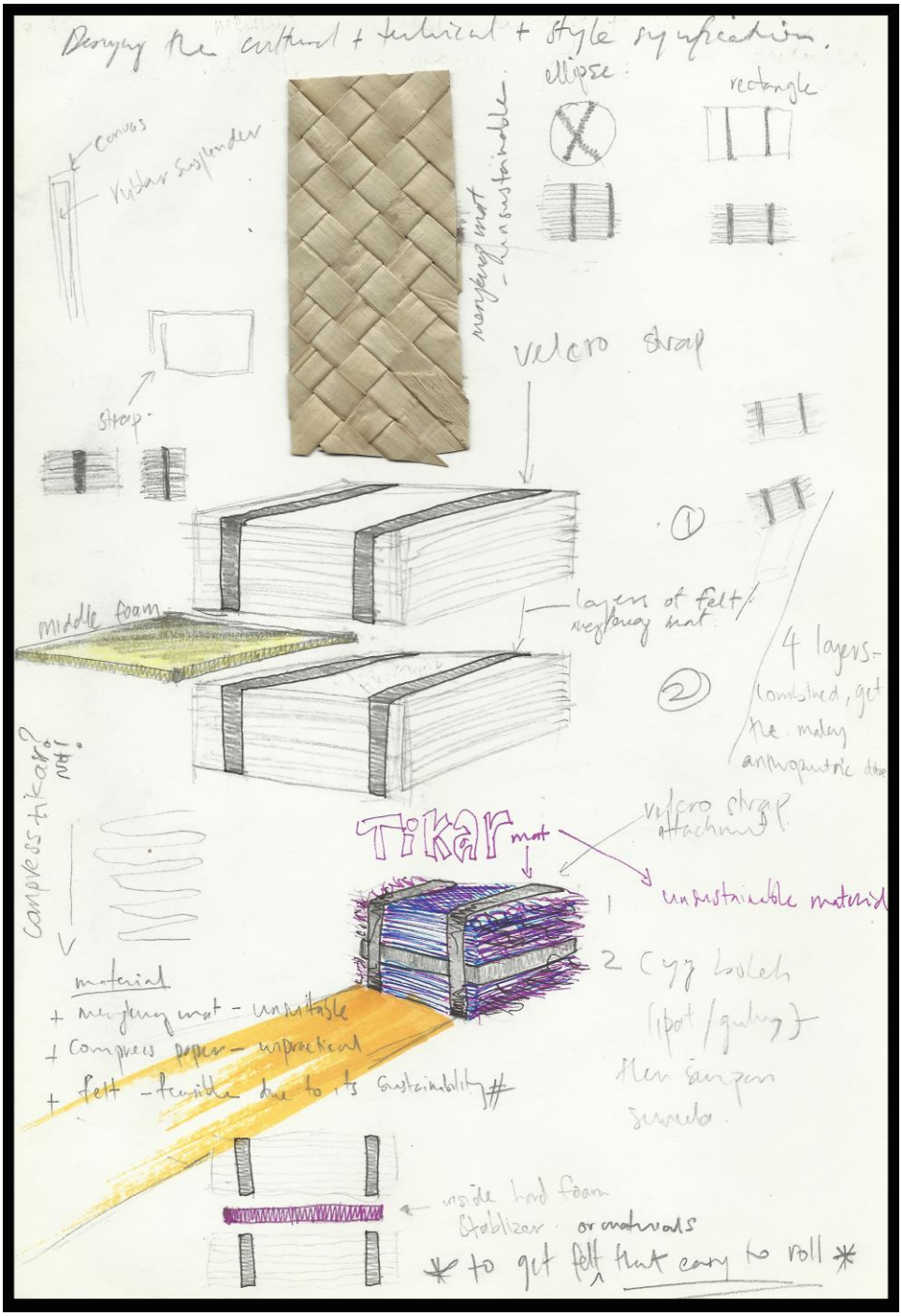


Plate 4.9. The idea development sketches of the floor-sitting prototype 2. [Self-creation].

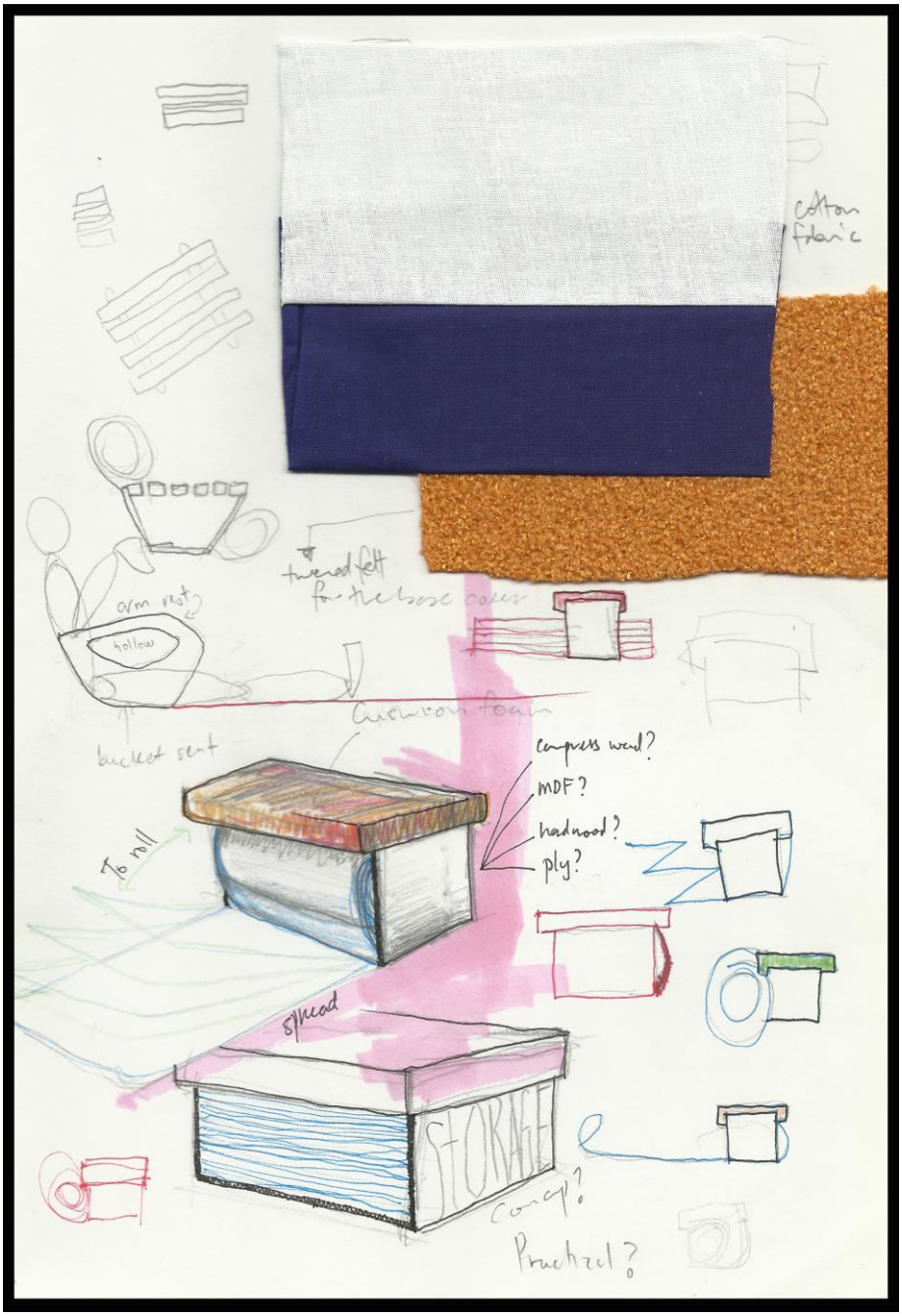


Plate 4.10. The idea development sketches of the floor-sitting prototype 3. [Self-creation].

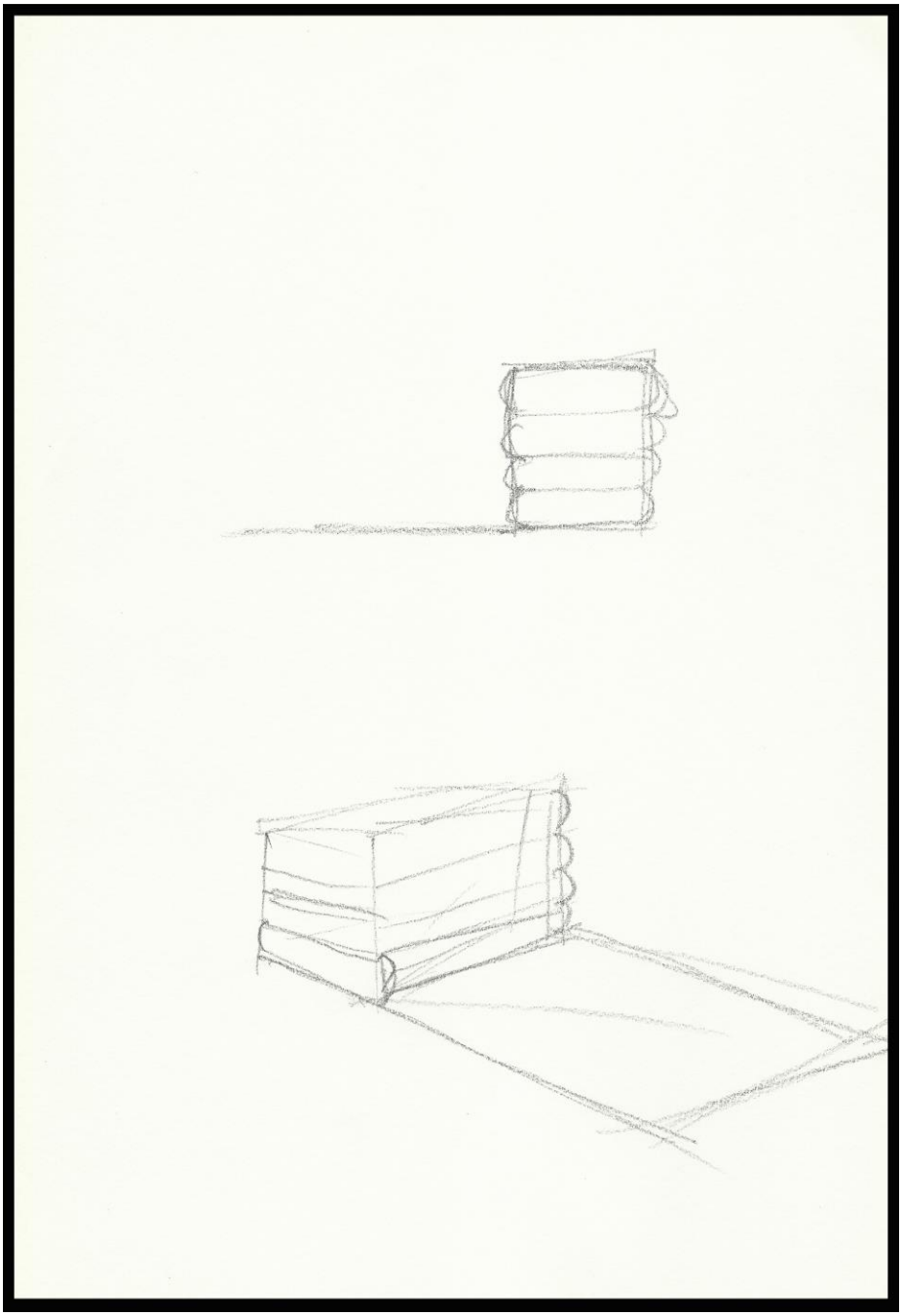


Plate 4.11. The idea development sketches of the floor-sitting prototype 4. [Self-creation].

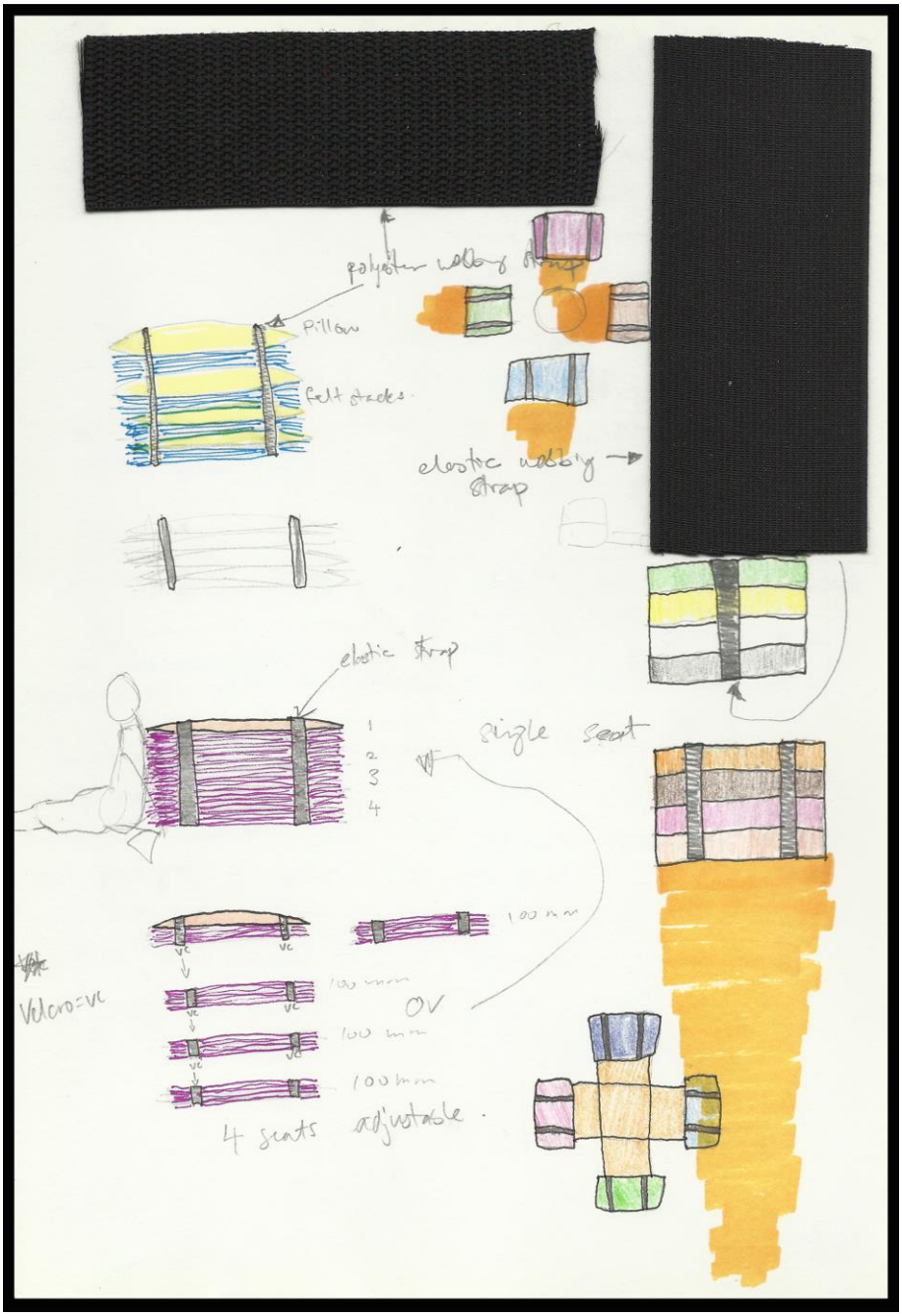


Plate 4.12. The idea development sketches of the floor-sitting prototype 5. [Self-creation].

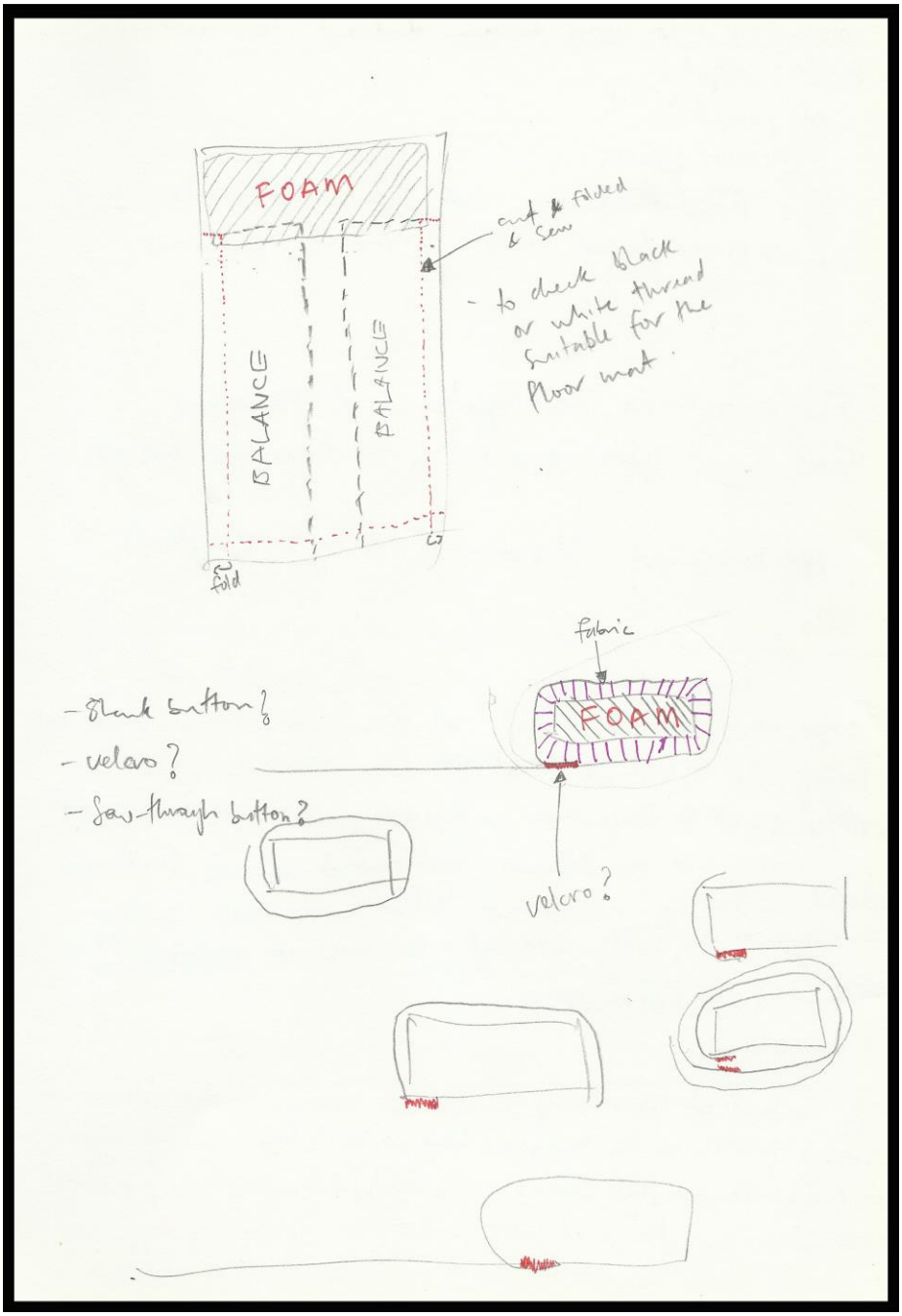


Plate 4.13. The idea development sketches of the floor-sitting prototype 6. [Self-creation].

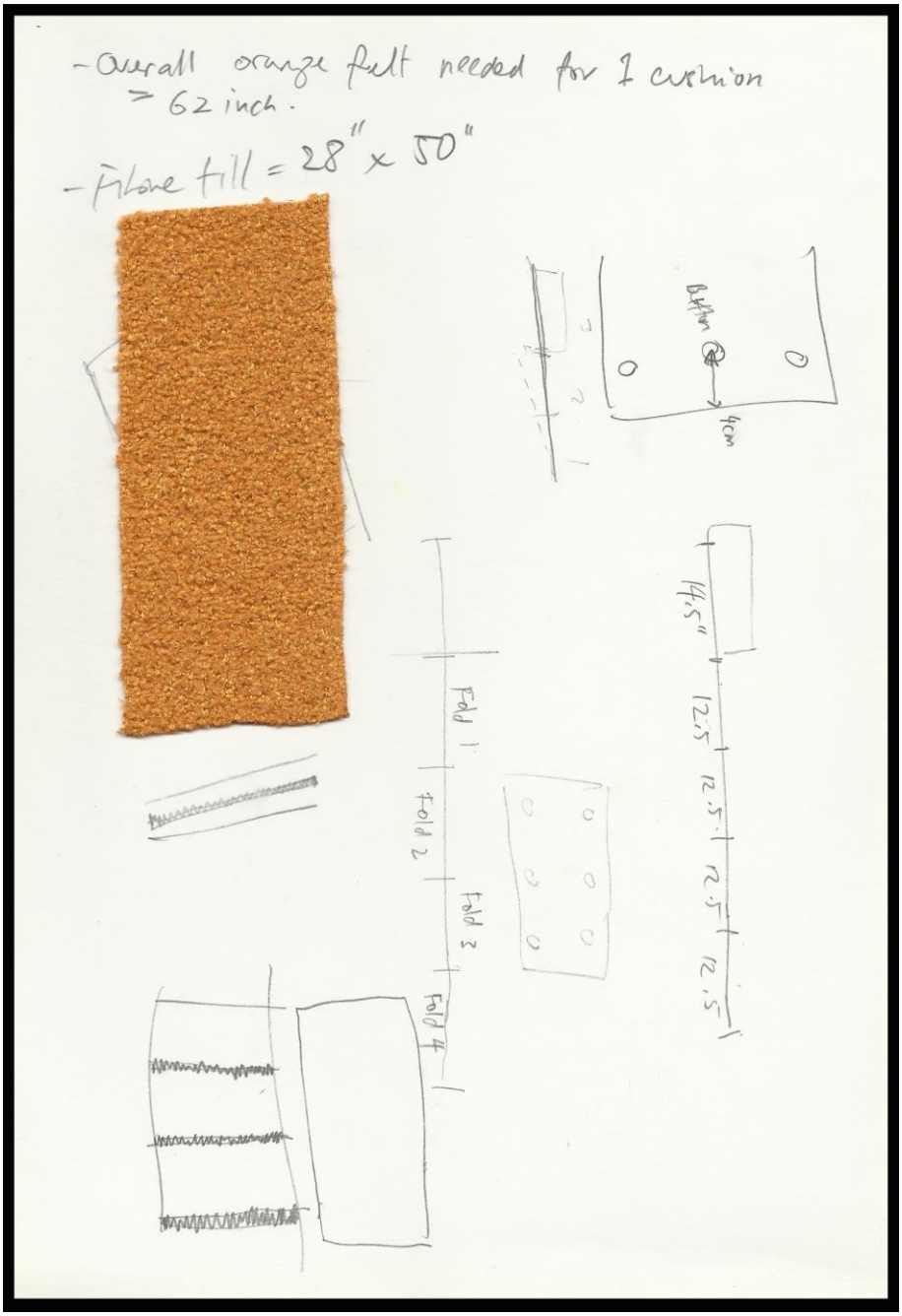


Plate 4.14. The idea development sketches of the floor-sitting prototype 7. [Self-creation].

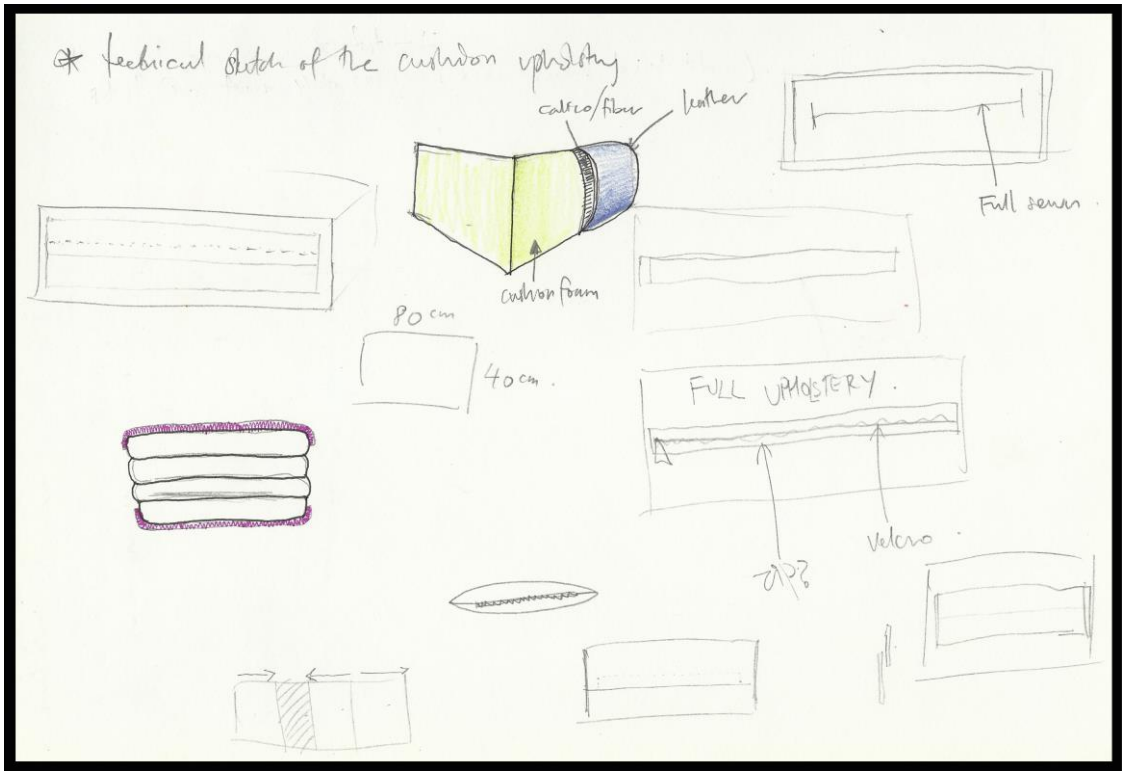


Plate 4.15. The idea development sketches of the floor-sitting prototype 8. [Self-creation].

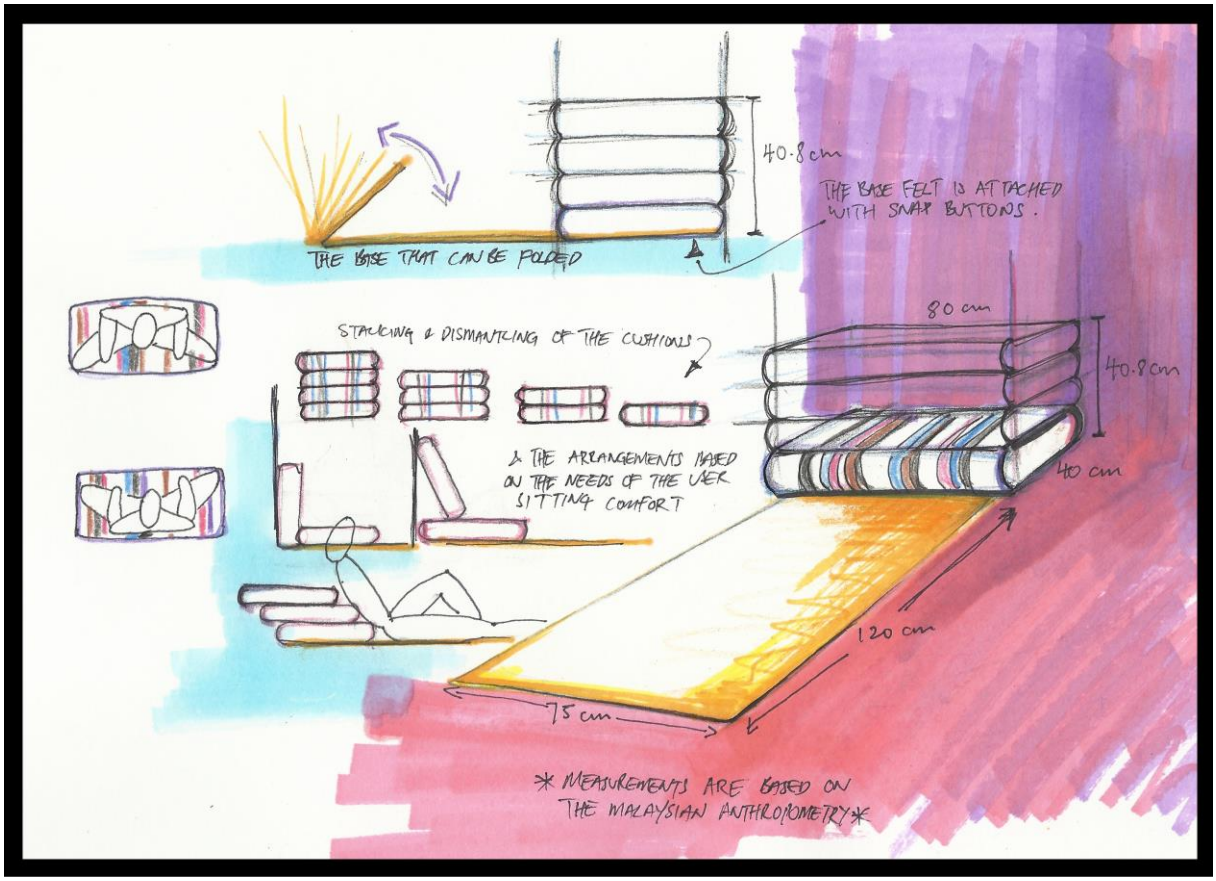


Plate 4.16. The idea development sketches of the floor-sitting prototype 9. [Self-creation].

4.7.2 Overview of The Observational Procedure

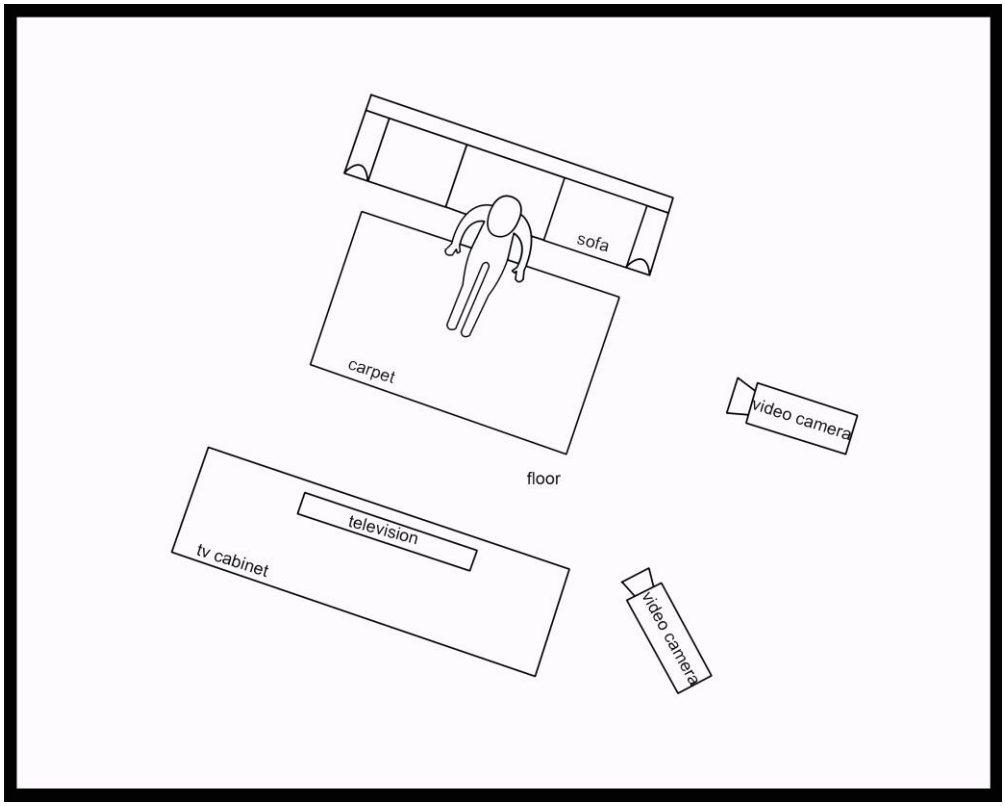


Plate 4.17. The general layout of the apparatus installed in the living room. [Self-creation].

The video recordings were all undertaken within the interior dwelling and was conducted by this researcher involving the host-participant[s]. The apparatus for the video recording was installed in the living room and operated by the researcher. The participant[s] then sat in the living room and their activity was recorded and assessed using the behavioural assessment sheet [see *Plate 4.7*]. In some situations, the need to have an arbitrator is essential to facilitate conversation, as well as helped to ease participants' awkwardness when their movements were video recorded. Such relevancy was applied to this research. The recording took one hour with ten minutes subsidiary time added for the participant[s] to get adjusted to the surveillance video surrounding.

Observer: Najib Sani Participant: Khairudin Izzamudin (Din) #1

Participant's Age: 20 Sex: Male

Observation Context: HOME ENVIRONMENT

Date of Observation: Nov 2012 Time Begun:10.00 am Time Ended:11.10 am

Brief Description of Physical Environment:

Today's temperature is 30 degree Celsius (based on Apple MacBook Pro temperature indicator). The participant fairly settles down with the situation and trying to cope within the warm ambience for physical comfort. Standing fan was switched on. The general demeanour in the room is dynamic.

OBJECTIVE BEHAVIOURAL DESCRIPTION (OBD) AND INTERPRETATIONS: EVENT AND TIME SAMPLING

OBD 1: (Time Begun 10.00 AM Time Ended 10.20 AM)

Din sat on the sofa while watching television. For the first 15 minutes Din sit on the sofa then sliding down to sit on the floor. Din sat with the legs stretch.

Interpretation 1:

The first 5 minutes Din's gestures seem shy and lethargic. It was suspected it might due to the feeling of inconvenience with the presence of the camera recording his movements.

OBD 2: (Time Begun 10.20 AM Time Ended 11.40 AM)

Din ignored the camera and carry on his activity in the living room while sitting on the floor. Sitting postures such as cross-legged sitting, sitting with the legs folded to the side, sitting with one knee up other down and flexed, sitting one knee up and other stretched and sitting with legs stretched were subsequently demonstrated.

Interpretation 2:

Din withdraws the feeling of inconvenience having been recorded and continue sitting freely on the floor.

OBD 3: (Time Begun 10.40 AM Time Ended 11.10 AM)

There are times when Din get up and sit back on the sofa. Nevertheless, it was not for long as he slide back sitting and at times lied-down on the floor with the support of the dislodged sofa seats (then back sitting on the floor). The floor activities continue surpassing the setting time (more than 1 hour 10 minutes).

Interpretation 3:

The connections of the five elements of the ergonomics sciences and their indicators per discussed in chapter 2 and 3 were demonstrated throughout this session.

Plate 4.18. The assessment sheet sample during the postural analysis. [Self-creation].

4.7.3 Research ethics

Research disciplines within the social science and humanities involves the conduct of human participant research. The disciplines that include the areas of anthropology, political science, history, psychology, and sociology are examples of the areas in social science. While in humanities, the areas are comprised of literature, philosophy, visual and performing arts, and cultural studies. According to MacDonald and Walton (1994), Associate Professors at the Ryerson University in Toronto, each of these highlighted areas and the kind of research undertaken in these areas are distinctive, incorporating a diverse significant approach in studying the human behaviour, the human condition, and the notion of the social life of individuals and groups. In the issue of research ethics, as the two research scholars added, the combination of the two disciplines often stimulates ethical issues pertaining to the risk of harm. The authors of *Ethics And Educational Research*, Hammersley and Traianou (2007) outline the ethical principles that this researcher needed to be aware of when including human participants as the subject of research. The commonly recognised principles include:

a. Harm: This researcher needs to know if the research strategy is likely to cause harm or not. Any methods applying to the process of data collection needs to be clearly justified to the participants. If the methods are leading to harm, it should not be included. 'Harm' in this context of definition not just imply to the consequence of the people being studied, but also affecting others in the future in the same setting of investigation.

b. Autonomy: The research process implemented in this research study should display respect for people [participants] in the sense of allowing them to make decisions for themselves pertaining to whether or not to participate in the research.

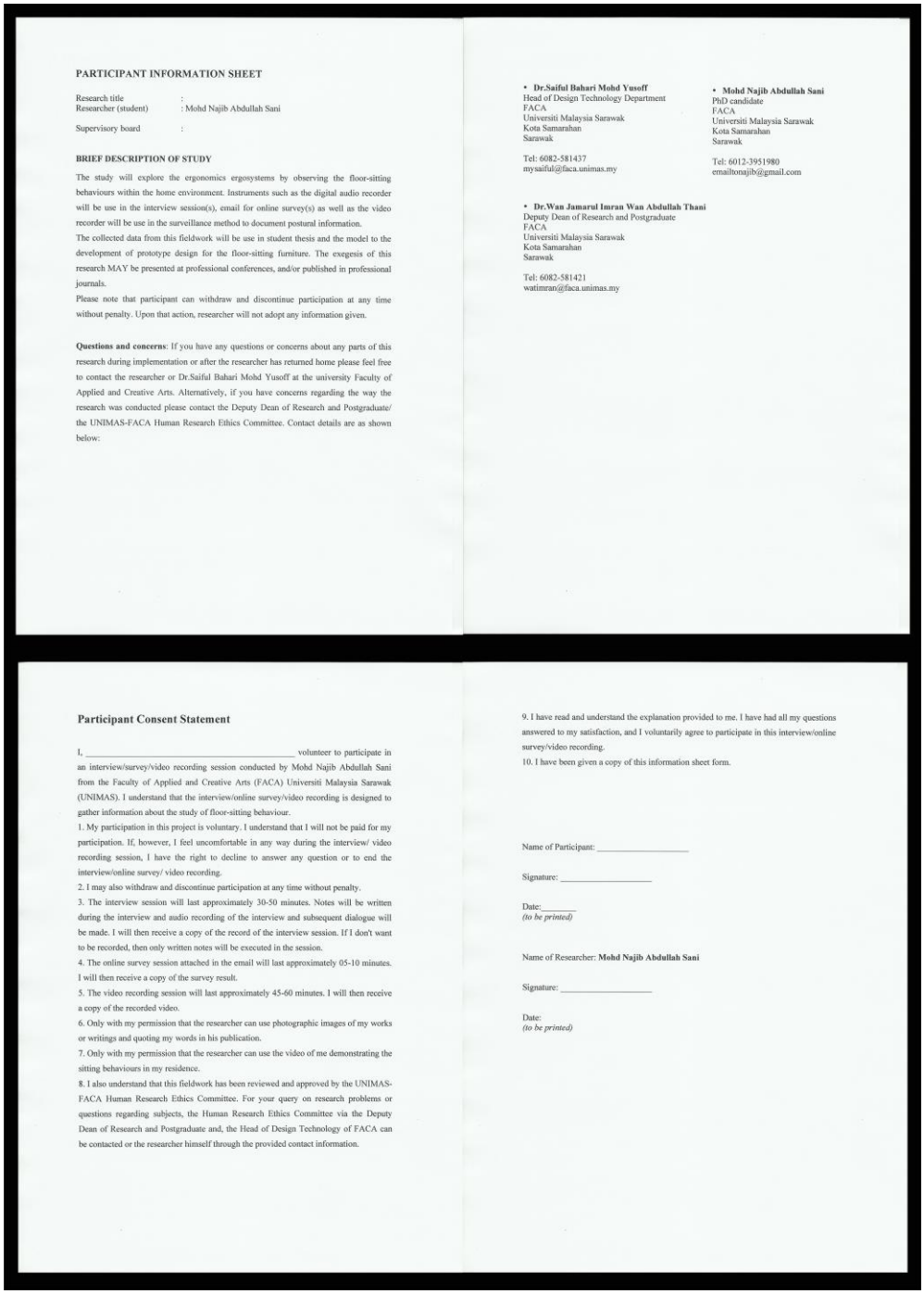
c. Privacy: This researcher needed to know, and have an understanding on matters that are appropriate to make public, and those in which should not be made public. For example, in relation to this research, this researcher with the participants' consent should be aware of the boundaries set for video or audio recording of the participants' individually, or relating to their dwelling space and belongings.

d. Reciprocity: In being allowed to have access to data that may involve people cooperating in various ways; for example, people giving up time in order to be interviewed or video recorded. In addition, the research process could also interfere with people's lives in unforeseeable ways. In lieu of this pattern of people management, it is essential at the beginning to establish mutual agreement upon the endeavour that might benefit both parties. Even though the participants' participation may be voluntarily, an appreciation is vital.

e. Equity: This researcher needed to treat various individuals involved in the research process equally fair, and ensure that no one is unjustly favoured or discriminated against.

With application and reference to this research process of data collection, is the authorization of the participants for their participation involving interview sessions, online surveys, and the use of the dwelling spaces for the video observation and recording by the host-participants. Due to the rights and privacy issue of the home space recording, the participants only allow the video observation to be conducted and recorded within the living room. As a study that demands recording of peoples' behaviour using video and audio recordings, the need for ethics clearance is inevitable, and must be signed before the above procedure is executed. Hence, the inscriptions of participants' informed consent statements then applied [see *Plate*

4.19]. The inform consent statement as stressed by the University of Colorado research scholar, Howe and Moses (1999), is the central of research ethics, not to any particular kind of research method, dejecting the suggestion by the qualitative method research and research ethics authors, Lincoln (1990), Murphy and Johannsen (1990), that the procedure is primarily designed only for biomechanical and experimental research. The issue of respecting and protecting people's autonomy is an essential concern when taking a close look at social structures, as well as establishing intimate relationships with participants.



PARTICIPANT INFORMATION SHEET

Research title :
Researcher (student) : Mohd Najib Abdullah Sani

Supervisory board :

BRIEF DESCRIPTION OF STUDY

The study will explore the ergonomics ergosystems by observing the floor-sitting behaviours within the home environment. Instruments such as the digital audio recorder will be use in the interview session(s), email for online survey(s) as well as the video recorder will be use in the surveillance method to document postural information.

The collected data from this fieldwork will be use in student thesis and the model to the development of prototype design for the floor-sitting furniture. The exegesis of this research MAY be presented at professional conferences, and/or published in professional journals.

Please note that participant can withdraw and discontinue participation at any time without penalty. Upon that action, researcher will not adopt any information given.

Questions and concerns: If you have any questions or concerns about any parts of this research during implementation or after the researcher has returned home please feel free to contact the researcher or Dr.Saiful Bahari Mohd Yusoff at the university Faculty of Applied and Creative Arts. Alternatively, if you have concerns regarding the way the research was conducted please contact the Deputy Dean of Research and Postgraduate/ the UNIMAS-FACA Human Research Ethics Committee. Contact details are as shown below:

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Participant Consent Statement

I, _____ volunteer to participate in an interview/survey/video recording session conducted by Mohd Najib Abdullah Sani from the Faculty of Applied and Creative Arts (FACA) Universiti Malaysia Sarawak (UNIMAS). I understand that the interview/online survey/video recording is designed to gather information about the study of floor-sitting behaviour.

1. My participation in this project is voluntary. I understand that I will not be paid for my participation. If, however, I feel uncomfortable in any way during the interview/ video recording session, I have the right to decline to answer any question or to end the interview/online survey/ video recording.
2. I may also withdraw and discontinue participation at any time without penalty.
3. The interview session will last approximately 30-50 minutes. Notes will be written during the interview and audio recording of the interview and subsequent dialogue will be made. I will then receive a copy of the record of the interview session. If I don't want to be recorded, then only written notes will be executed in the session.
4. The online survey session attached in the email will last approximately 05-10 minutes. I will then receive a copy of the survey result.
5. The video recording session will last approximately 45-60 minutes. I will then receive a copy of the recorded video.
6. Only with my permission that the researcher can use photographic images of my works or writings and quoting my words in his publication.
7. Only with my permission that the researcher can use the video of me demonstrating the sitting behaviours in my residence.
8. I also understand that this fieldwork has been reviewed and approved by the UNIMAS-FACA Human Research Ethics Committee. For your query on research problems or questions regarding subjects, the Human Research Ethics Committee via the Deputy Dean of Research and Postgraduate and, the Head of Design Technology of FACA can be contacted or the researcher himself through the provided contact information.
9. I have read and understand the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this interview/online survey/video recording.
10. I have been given a copy of this information sheet form.

Name of Participant: _____

Signature: _____

Date:_____
(to be printed)

Name of Researcher: **Mohd Najib Abdullah Sani**

Signature: _____

Date:
(to be printed)

Plate 4.19. The sample of the inform consent statement used for ethics clearance. [Self-creation].

4.8 Summary

The ergonomics ergosystems framework presents many advantages in the development of a work system to the design stage of industrial product design. The redesign of the systems' interface appropriated to this research context illustrates the interface suppleness for researcher's to explore and develop innovative tasks in order to create new products or to optimize the existing system or product. The method applied in this research, channels the variations of this interface in shaping the system tasks for the analysis of the human sitting behaviour towards the findings of the floor-sitting behaviour data. The video surveillance technique signifies the research approach that mainly involves observation, which allows detail validation when observing the factors of influence synchronizing the sitting dynamics. The analysis and findings based on this methodology are demonstrated in Chapter 5 and 6 onwards.

Chapter 5.0
DATA ANALYSIS

5.1 Introduction

This chapter is structured in two sections based on the implementation of the Exploratory Sequential Design to analyse data collected within the qualitative and quantitative strands [QUAL + QUAN] appropriated to this research design. The synchronization of the qualitative and quantitative analysis, and the results of the postural behaviour data were obtained from the video observations, survey analysis, and time and event sampling that was incorporated within the pilot study and pilot analysis. These processes have subsequently drawn [1] the reliability of the manifested ergonomics theories and philosophies formulated for the application of this research, [2] the obtained results steers for the design of the floor-sitting furniture prototype that simultaneously formed as the auxiliary research instrument in the execution of the actual behaviour analysis. Results set out participants' descriptive and numerical postural behaviour data in response to the floor-sitting within the home environment. The gathered data was presented clearly in the form of tables, line charts and pie charts deciphered from the descriptive analysis and statistics from both qualitative and quantitative strands. The overall aim of this chapter was to validate the applied research theories and philosophies towards the findings of the floor-sitting behaviour posture data that will be elaborated upon in the next chapter.

5.2 The Qualitative Data Analysis

This strand incorporates the implementation of descriptive visual analysis, and series of earlier survey analyses that is subsequently interconnected to the video observation in searching for the result of the floor-sitting behaviour frequency data. This incorporates the process of deciphering the coherency of the ergosystems framework using the ergonomics science elements as moderating variables [see *Plate 5.1*]. Besides examining the floor-sitting behaviour, the process moulds a baseline towards designing the furniture prototype that subsequently formed an instrument in the actual behaviour analysis.

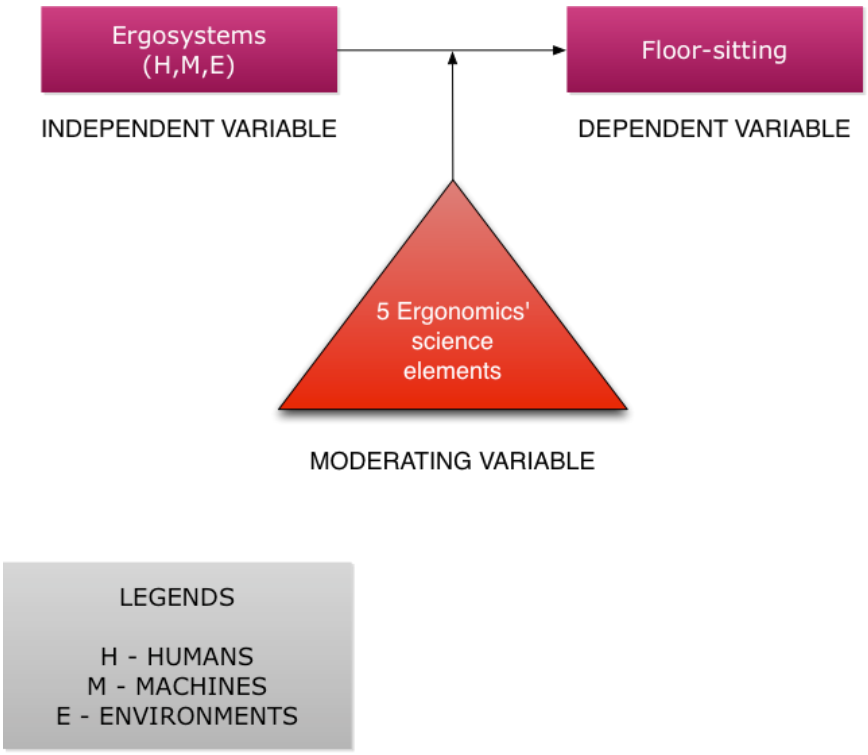


Plate 5.1. Schematic diagram of the relationship between the dependent, independent and moderating variables. [Self-creation].

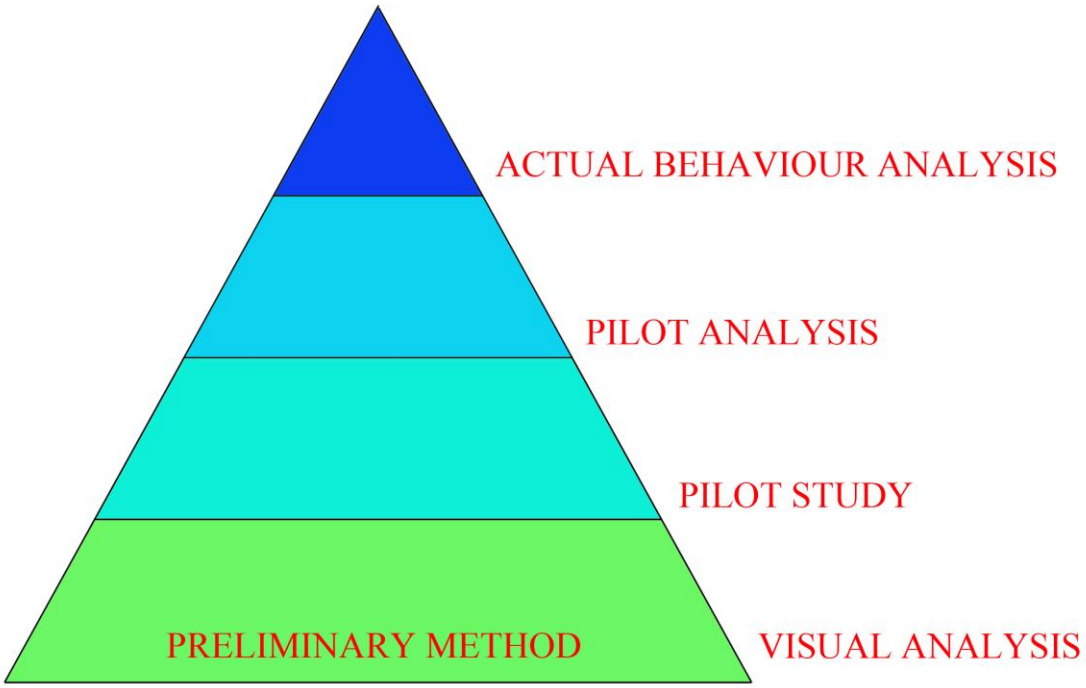


Plate 5.2. Diagram of the breadth of the qualitative phases involve in the data analysis. [Self-creation].

5.2.1 Visual Analysis

This section analysed 16 selected still images that this researcher observed relevant to delineate based on hundreds of collected photographs. The visual analysis reviewed that:

a. The floor-sitting practices were exhibited by all genders regardless the gender distinction that is established within cultural perspectives.

Plate 5.3. Still visuals of the floor-sitting exercised at various locations [Part 1]. [Self creation].

It was observed based on the A, B, and C images that the floor-sitting with the legs folded to the side [LFS], and the cross-legged sitting [CLS] were practiced by both men and women without any cultural hinders differentiating between ethnicities. The floor-sitting was also practiced by men and women of all ages. In this researcher's opinion, the floor-sitting behaviour could possibly be affected by certain medical conditions and age, thus restricting an individual's ability to sit on the floor. Nevertheless, if the medical justification is excluded in this assessment, in general, based on the collected photographed images, older men and women do sit on the floor because of the fact that it is a customary practice.

[PLRQ.1] What contributed to such sitting behaviour?

Plate 5.4. Still visuals of the floor-sitting exercised at various locations [Part 2]. [Self-creation].

b. Similar Pattern of the Floor-Sitting Behaviour

There is a fine line between cultural significances and technical factors influencing the floor-sitting. In a cultural perspective, it is observed that physically people living in Asia pose similar floor-sitting postures, but it is possible to signify that Asians practice them in different cultural contexts. Technically, the sitting such as: cross-legged sitting [CLS], sitting with a knee flexed and one leg stretched out [SKX], sitting with the legs folded to the side [LFS], sitting with one knee up, the other down and flexed [S1KU], and sitting with the legs stretched out [LS] are observed as being frequently exercised in any spatial condition.

[PLRQ.2] How does the technical context measure and define the embodiment of the floor-sitting behaviour, and to what scope of the floor-sitting should this researcher focus on?

c. People Utilizing the Floor-Space for Sitting Comfort

Ample ground space promotes free postural expression when sitting on the floor. The floor, with the ornamentation of the floor mat or carpets, even rolled futon mattresses perceptually engaged people to sit or to lie down on the floor.

[PLRQ.3] With the sense of perceptible by touch engaging this signification, can this characteristic be applied in exploring design context?

d. People Utilised the Objects in their surroundings as Comfort Mechanisms

It was observed that most people were keen to utilize various objects surrounding them as their comfort mechanism. Besides sitting while perching against the wall, house post, door-frame, sofa cushion, chair seat edges, or low cabinet edges for backrest, people tended to sit within the floor-sitting postures while on the sofa, the low stool, and even on a stack of bricks. What was of interest to this researcher was to find that people used their creativity extensively to improvise by utilising and assembling objects they encountered not being limited to the use of a backrest, but they also improvised objects making arm rests, shoulder rests, and even neck rests in order to achieve maximum comfort while on the floor. This consequently demonstrated various floor-sitting postures.

[PLRQ.4] How do we measure or establish the factor to the embodiment of such sitting behaviour?

e. The Individual Surrounding Space Influences the Floor-Sitting Behaviour

The individual space configuration, disposition and atmospheric conditions were observed to contribute to people's sitting behaviour, psychologically, and physically. The ample the space promoted further postural exploration and expressions. However, if the space was dense fewer postural dynamics were demonstrated.

[PLRQ.5] How does this coherency become established?

5.2.1.1 Problems in Visual Analysis

During this phase of analysis this researcher found that:

a. Still image analysis protocol not able to contribute to the embodiment of the floor-sitting behaviour. Further enquiry needs to be made, and possibly applying different research method through video observation in order to validate the research questions that arose based on this preliminary stage.

b. Further qualitative intervention through video observation with the amalgamations of quantitative methods and analysis in the time and event sampling [QUAL + QUAN] were observed to be coherent in order to understand the phenomenon better, especially when this research is objectified within the context of furniture design; the understandings of the sitting patterns and the postures are essential.

5.2.2 Video Observation

In the video surveillance method the observation concept and instrument use is rather subjective, where people's behaviours are traced and monitored depending on different research data needed by researchers. In general, the video analysis procurement to the computer vision is not a new concept, and the most common feature that it is typically recognized for is the extraction method within the human behaviour research. This research applies the time and event sampling framework as the motion descriptor, and complemented with the feature extraction concept appropriated to this researcher's research need towards gaining the floor-sitting behaviour data. Hsiao and Keyserling's (1991) *Evaluating Posture Behaviour During Seated Tasks*, and Yang's (2006) analysis in the *Development of a Portable System for Physical Activity Assessment in a Home Environment* was observed immanent and

adopted into this researcher's space observation method, and drew a coherent juncture that is intertwined in threefold; [1] Space as the determinant to certain postural behaviour, [2] tasks that influence sitting postures which this researcher focused on for any floor-sitting activity and the participants freedom to express their sitting expressions, and [3] justifying the indicator to the preferred [floor] sitting postures. The detail data of the video analysis is explained in 5.2.4 onwards.

5.2.3 The Sample

The overall study involved 15 participants, which included a mixture of male and female participants from different racial backgrounds whose ages varied between 20 – 50 years old. The study aimed to develop and validate the floor-sitting behaviour data based on the frequency of the sitting patterns displayed by the participants, which in turn could help aid the development of furniture design; by amalgamating the furniture's modularity concept and the researched floor-sitting positions with the harmonization of ergonomics signification. The method of evaluating how people adapt to the unused space of the home environment while performing various floor-sitting positions was proposed here, and the selection of participants was based on the overall standards of Malaysian anthropometry (Malaysian-Standard, 2003).

5.2.4 Pilot Study

The study was conducted in a traditional Malay house [TMH]. The space was chosen due to the coherency of the space design context as manifested in the Malay architecture literatures that is closely associated to the ergonomic signification, which part of its coherency is

associated to the floor-sitting practice. The objective of the study was to observe the pattern of the floor-sitting, and the connection to the ergonomics theories propagated in the reviewed literatures on the environmental and climatic influences to human postural behaviour. The study was conducted for 5 days, with an overall observation time of 10 hours [2 hours each day during day and night time].

The relationship of the architecture elements and the sitting behaviour on the floor were studied based on the research objectives and questions, and was guided by the ongoing reviewed literatures. By implementing the Exploratory Design (QUAL+QUAN), the observational investigation involved three participants. The research was conducted on a porch [*rumah anjung*], the space reserved for receiving guests [which made the postural data collection via video recording possible due to certain issue of privacy]. The main house and other sections were considered as private areas therefore the entry and recording were prohibited.

The observation criteria and collected data were based on the elements incorporated within the ergonomics ergosystems, encompassing five ergonomics science elements linking synchronously within the scholars' epistemological manifestation. The ergonomics science elements are:

a. Physic.

b. Psychology.

c. Anatomy.

d. Physiology.

e. Engineering.

5.2.4.1 The Physic Signification

a. Geographically, the Malay Peninsular is located in the south-eastern end of the Asian continental landmass. Due to the fact that the hot and humid climatic environment of this region essentially governs the need for climatic designs to be applied to the local dwellings. In other words, the house design and climatic significance develops a fine relationship and, consequently influences cultural postural behaviour.

b. From this researcher's observation, the architecture design elements such as the low placement of windows, and the fact that the main door ergonomically permits excellent ventilation to the house, consequently contributes to the floor-sitting behaviour. In relation to the floor-sitting, the ample space of the *rumah anjung* [the area where guests are greeted, entertained, and where family members can relax] typically has neither benches or chairs which in turn invites people to sit and freely express their sitting postures on the floor.

c. The floor helps the air coming in underneath the lifted floor from the plank's gap. To comfort the sitting of back resting, people perched against the wall, and the carved windows balustrade.

d. This researcher discovered that the measurement of the point at which the panel and window balustrades is where people tended to frequently perch against. This discovery is anthropometrically measured to the Malaysian anthropometric data for furniture backrest design [5^{th} percentile 484mm]. People perched against the wall and window balustrades to comfort their backs between the *thoracic vertebrae* down to the *lumbar vertebrae*. As researched by Tajuddin (2005), almost similar to the Japanese tradition, the Malay way of sitting and doing almost everything on the floor has strongly influenced their house design.

5.2.4.2 The Psychology Signification

Human psychoanalytic thoughts are finely articulated to postural behaviour. To unfold this significance, this researcher has adapted the basis made earlier by Stamp (2011), and expanded the appropriate elements into this researcher's research context. The elements that were used here are recognizable, and closely engaged to the human perceptual response. The elements are texture, climate/temperature, and the configuration of interior-architecture elements.

5.2.4.2.1 Texture and Materiality

a. The texture of the wooden wall panel that is rough and hard, and the carved window balustrades was inviting for people to perch against, allowing them to invent a backrest. It was evident that people perched in such way frequently to comfort the back of their bodies, and subsequently demonstrated changes in the sitting postures. It is the nature of human beings to react to the environment in an extensive manner through their senses.

b. The texture of the floor mat or *tikar* [the pandanus floor mat] contributed to the changes of sitting posture as well. This was evident when the floor mat was used at night, or while it was raining when the temperature is cooler, consequently influencing the sitting posture on the floor.

c. It was observed that the connection to scientific rationale might be relevant, and the floor mat surface helps to warm or comfort individuals from the cold plank floor surface that absorbs moisture in the air.

5.2.4.2.2 Climate and Temperature

In relation to the participants sitting dynamics, the theory of the body-link open-chain system's (Branton, 1969) signification was observed being applied throughout the session, responding to the climatic coherency. The sitting dynamics increased during the daytime as to facilitate the circulation of air around the body due to the effect of hot weather. Due to the fact that the house was made using timber, it therefore promoted cooler air to enter the house, and subsequently reduced the body dynamics.

5.2.4.2.3 Configuration of Architecture Element

a. The body through senses respond to the configuration of the architecture elements through the expression of the body posture, and the postural experience varies individually. Nevertheless, based on the findings of the observation, the participants frequently perched at the same wall panel and window balustrades for backrest when sitting on the floor. Other sitting postures follow subsequently.

b. Of what was mentioned by Syed (2001) about the construction of the TMH linking the human figure measurements, and aesthetics is indeed relevant to this researcher's enquiry pertaining to the ergonomics sitting research. Results concluded that when people perched against the wall in order to comfort their backs between the *thoracic vertebrae* down to the *lumbar vertebrae*, will unmistakably perch at the same panel point heights regardless of their physical stature. The architecture elements and the human body have a finite relationship both technically and culturally.

5.2.4.3 The Anatomy Signification

a. Through the observation of the sitting behaviour, it was found that indeed the wall and the window balustrades were frequently used as a refuge for individuals to perch against. It was evident that the participants frequently changed their sitting postures to symmetrically comfort the back of their body while sitting. Moreover, due to the hardness of plank surfaces, the adjustment of the buttocks and leg flexing articulated the comfort of sitting.

b. The sitting behaviour on the floor such as cross-legged sitting [CLS], sitting with one knee up, other down and flexed [S1KU], sitting with the knee flexed and one leg stretched [SKX], sitting with legs stretched out [LS], and sitting with the legs folded to the side [LFS] were frequently demonstrated. However, these are not the sitting postures that defined ‘fixed’ sitting when present in an interior space, and it was not at this stage of research to validate such sitting behaviour as being frequently practiced; because individual postural experiences may vary, as well as their perceptual experiences intertwined with personal and cultural memories concluding that “the body link can behave in unpredictable ways.” (Branton, 1969). Nevertheless, these are the five most common sitting postures determined through the analysis of data, information gathered from primary and secondary sources, and through the use of a survey. While the five sitting postures were frequently expressed, others were infrequent.

5.2.4.4 The Physiology Signification

a. The kinaesthetic impact of floor-sitting has an intricate relationship with the local climate and human thermal neutrality, and through the observations made it was made evident through the subsequent and constant dynamic postures of open and closed-chain systems which promoted human thermal neutrality.

5.2.4.5 The Engineering Signification

a. Originally, the TMH interior did not have sitting furniture like that of the western culture. This significance as Lim (1984) supported in *Under One Roof: The Traditional Malay House*, most activities take place on the floor. Nevertheless, through the wide use of the pandanus floor mat in local culture, established as the sitting furniture.

b. There are different types of floor mats for different purposes. According to Syed (2001), as he refered to Siti Zainon (1986) the types of floor mats are typically comprised of: the guest mat, prayer mat, sleeping mat, bride mat, and ornament mat which indicates the role of human activities, and ergonomics in regards to the shaping of various mats. The signification concerning the role of sitting objects' design and its ergonomic to individuals' sitting are immanent as design subject matter to the development of floor-seating design in relation to this researcher's research.

c. From this researcher's observation, supported by Gibson (1966), Pallasmaa (2007) and Weinstock's (2010) epistemologies, the kinaesthesia of sitting depends on the body linkage and the application of the senses to the respective environments. Hence, the relationship of the five most common sitting postures within the TMH interior-

architecture elements was made in order to give readers a better understanding of the potential influences of how a designed space can contribute to the sitting behaviour, and ergonomically influence sitting postures in unexpected ways.

Plate 5.5. The video excerpts of the postural behaviour studies in the pilot study. [Self-creation].

5.2.4.6 Inference on Pilot Study:

The findings determined through the pilot studies set the threshold for the research trajectory. This subsequently led to research being conducted on a larger scale, based on the rectification

of the research strategies used during the series of pilot studies. It was considered and decided:

a. To conduct this design oriented research within the perimeters of a modern home environment. According to Wan Hashimah (2005) the development of Malaysian houses and residential space designs has changed over the time, as opposed to the Malay vernacular house that has affected the Malaysian lifestyle in general. Furthermore, not all Malaysians' live in the vernacular house thus making the connection of developing designed furniture feasible within the scope of the user dwelling, and also within the modern residential space. This significance however, is not repudiating to the function of the Malay vernacular house. However, it has set a good foundation for ergonomics study, and in relation to this research, the significances that lay within it have expanded into a larger spectrum.

b. Based on the observation and report produced, the application of the ergonomics science elements along with other theories that were mellifluously integrated and developed into being the foundation of the ergonomics ergosystem framework which was immanent to the research context, and potentially to be used for further analysis.

c. The use of participants to the research was expanded, and the use of video as part of the research instrument was rational.

5.2.5 Pilot Analysis

Pilot analyses were performed on six participants based on the theoretical significations manifested within the reviewed literatures, results obtained from the series of biphasic surveys, and a series of pilot studies. The observations were conducted within the perimeters

of various modern home environment settings. The criterion of analysis continued with the observation of patterns seen within the floor-sitting behaviour, which was reflected to the sitting environment in response to the ergonomics science elements significances without the use of the floor-seating prototype. The analysis encompasses the perimeter of:

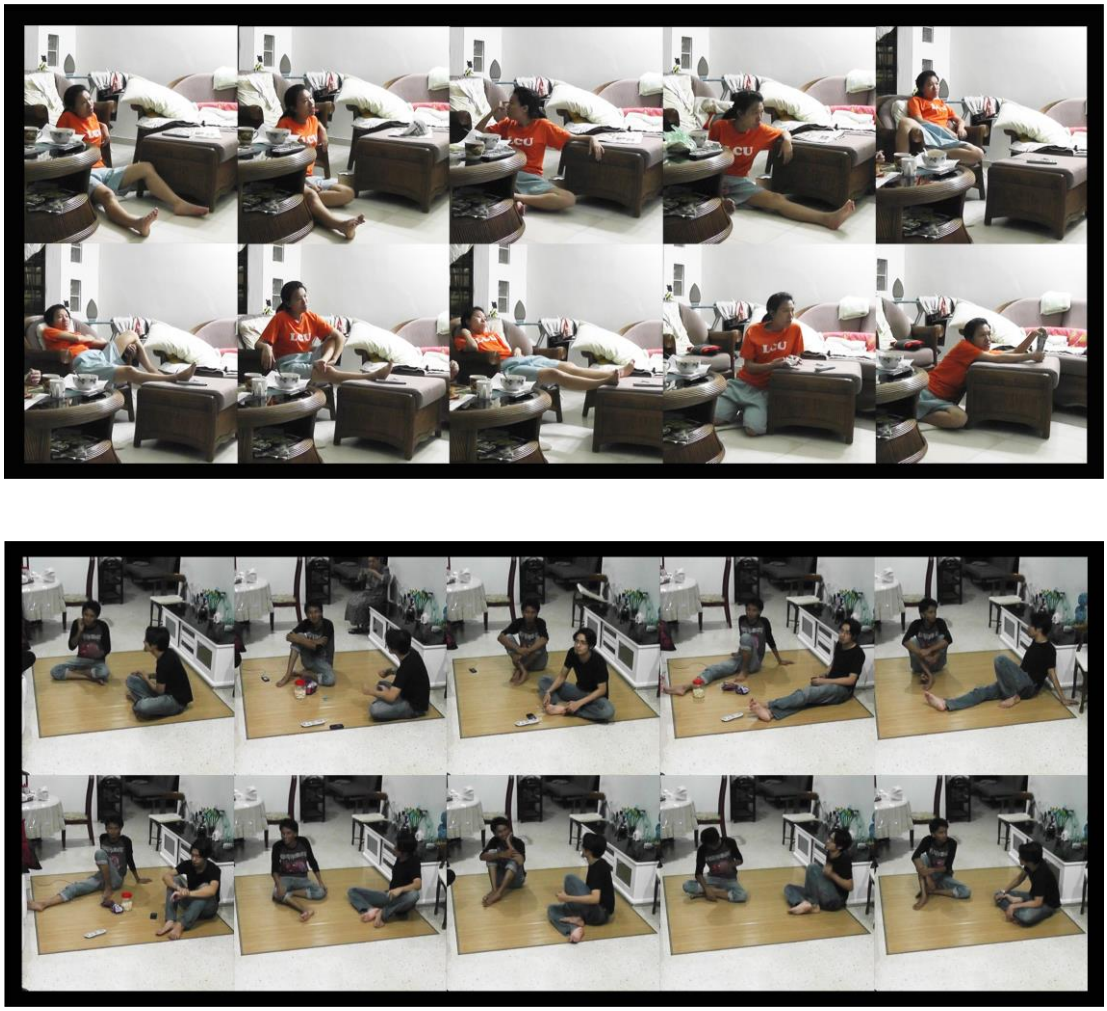


Plate 5.6. The video excerpts of the postural analysis in the pilot analysis [Part 1]. [Self-creation].

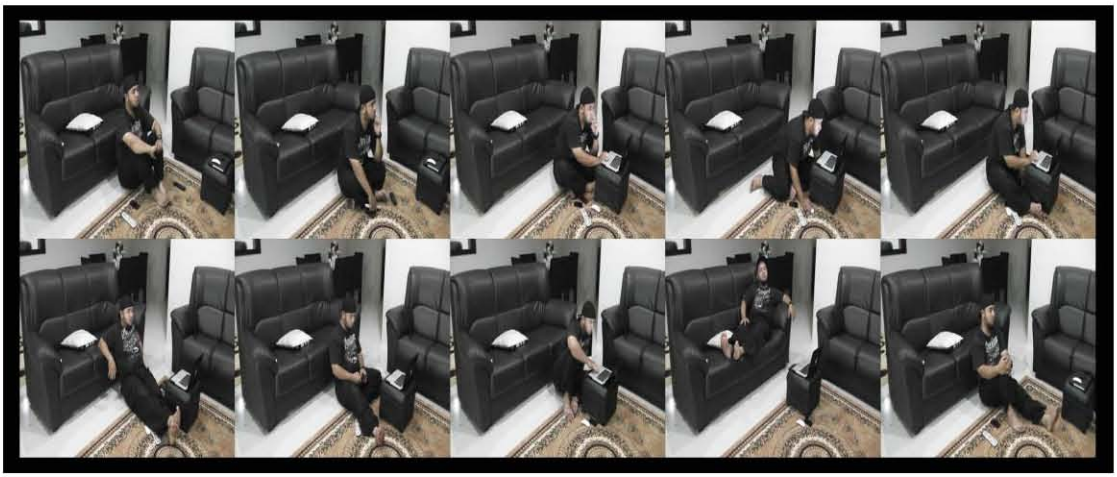


Plate 5.7. The video excerpts of the postural analysis in the pilot analysis [Part 2]. Note that from the top to the bottom of the video excerpts, the participants are labelled as P1, P2, P3, P4, P5 and P6. [Self-creation].

a. The space design significance; participants' response to the occupied space, and the configurations and utilization of the architecture elements:

The participants in different room settings displayed similar sitting characteristics. Compared to the pilot studies, where the participants sitting behaviour was studied within an empty living room with installed sofas and chairs. The configurations and utilization of the architecture elements gave alternatives in determining their preferred comfort position in the room, and it was found that they frequently chose to sit on the floor. The participants utilized the objects encountered within their sitting perimeter such as: small pillows, the soft and hard edges of sofas, foot-stools, and low cabinets with the height to support the cervical, thoracic, and lumbar while freely posturising on the floor in any ambience or physical conditions of the room. The unused space promoted extensive postural expressions that were made evident through the sitting.

b. The participants timing of sitting:

The need to move; the longer the participants sat on the floor, the more dynamics were demonstrated with a variety of body-images being displayed. Sitting postures such as CLS, S1KU, SKX, LS, and LFS were frequently demonstrated. The transitions between participants sitting on the sofa and gliding down onto the floor, and then back onto the sofa followed again by gliding back down onto the floor were observed as variation of the sitting behaviour. The CLS, SKX, and LS were also demonstrated when individuals were resting on the sofa before gliding back down to sit on the floor. This subsequently validates the body-link open-chain system signification in support to the extensive definition of comfort in sitting relevancy. Although these behaviours can raise an argument with the inconsistency of the floor-sitting comfort, which conversely links back to the signification of the need to move as reviewed in Chapter

3; *3.4. The Need To Move: A Beneficial Exercise* on the importance of movement as opposed to constrained sitting postures that are typically found in fixed chair sitting. It is important to move from anything to anything (Lueder, 2004), as the definition of comfort is extensively subjective.

c. Results of Pilot Analysis:

1. All subjects habituated to floor-sitting had similar patterns (see *Table 5.1*).

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	x	▽

Table. 5.1. The distribution of the floor-sitting postures. [images adopted and adjusted to this research context from Hewes (1955)]. [Self-creation].

2. Other sitting postures were discovered and symbolizes as +1 and +2, which never demonstrated and never had found in Hewes (1955) postural research, or manifested in other past anthropology scholars' researches within the scope of home environment. The sitting with legs stretched out, and alternating the right or left knee up is coded with 'LS1U'. The ranges of this sitting posture were coded as LS1U 1 and LS1U 2, and can be seen its differences through the positioning of the arm [see *Table 5.2*].
3. Another sitting postures were also discovered and demonstrated individually; postures resembling the squat but in which the legs were only partly flexed along with the sitting in which the leg is stretched out and the other partly flexed is coded with

'SqX'. Its ranges are coded as SqX 1, SqX 2, and SqX3, and unanimously came into the convergence of practice within the home environment. This signification is opposed to earlier ground-sitting data documented by Hewes (1955) elucidating as outdoor practice. *Table 5.2* illustrates the typological pattern summary of this stage postural results:

POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Table. 5.2. The patterns of the floor-sitting postures frequently exercised based on the pilot analysis. [Images adopted and adjusted to this research context from Hewes (1955)]. ([Self-creation].

4. The CLS [△] and LFS [▽] were observed as common floor-sitting postures and are not necessarily recognised within the context of gender [as this significance often associated within the cultural niche that associates gender].
5. Although individual postural experience varies, the similarities in terms of the architecture elements' utilization by the participants for body segments comfort during floor-sitting are unanimous, and noticeable.
6. The coherency of this signification is articulated in the distribution of the floor-sitting frequency patterns in point 5.3.2: Time and Event Sampling.

5.2.5.1 The Reflection of The Pilot Analysis

Based on the subsequent connections of the qualitative observation from the pilot studies to this phase of analysis, the synchronization of theories manifested through the ergonomics science elements within the framework of ergonomics ergosystem were demonstrated and coherently immanent in order to establish the understanding towards the embodiment of the floor-sitting behaviour. The adoption and application of theories from multidisciplinary fields synchronized the basis of the ergonomics science elements in application to this analysis has successfully demonstrated:

a. The justification of the embodiment of the floor-sitting behaviour definition surpassing the cultural justification into technical perspectives.
b. The relevant factor to the variation of the sitting dynamics in response to the connections of the body-objects relationships as opposed to the pilot studies.
c. The threshold to the trajectory of seating design development.

5.2.5.2 Inference on Pilot Analysis:

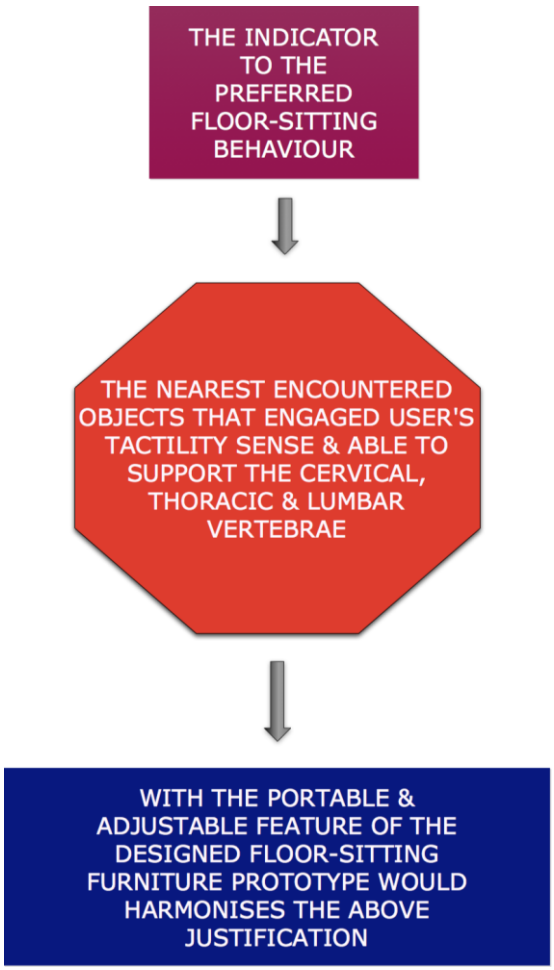


Plate 5.8. The diagram of the detected indicator to the preferred floor-sitting behaviour and the coherency to the proposed designed floor-seating prototype for further floor-sitting behaviour analysis. [Self-creation].

The participants' floor-sitting behaviour was influenced by the configurations and utilization of the architecture elements in the environment, and they integrated mellifluously with the timing of sitting to demonstrate the open-chain system signification. That being said, the participant's floor-sitting postures such as the CLS, S1KU, SKX, LS, and LFS diversified through the body-objects relationships where participants demonstrated the intent to invent perching mechanism. These relationships were consequently formed as the indicator to the preferred floor-sitting behaviour [see *Plate 5.8*]. However, without the 'appropriate' design of the floor-sitting furniture, the participants were observed continuously inventing perching mechanisms when sitting on the floor. Although, in the ergonomic perspective it is acceptable through the response of the perceptual system to keep the body moving by projecting various dynamics, but on the technical justification the objects were not at its nature to be designed for such purpose for the users' usability. By applying the

Malaysian anthropometric data the developed prototype design of the floor-sitting furniture to be used in the following ways, with actual behaviour analysis, its aims:

a. To establish the relevancy of the above mentioned floor-sitting behaviour indicator.

b. To establish the postures of the floor-sitting behaviour at home.

c. To establish the floor-sitting design furniture proposed for Malaysian users.

d. To apply the assessment methodology that comprises of the *Reach*, *Clearance*, and *Strength* factors as the observational criteria in the analysis in order to establish the stated point's above significations. The guidelines were adopted and inspired by Stephen Pheasant's (2005) cardinal rules of anthropometrics, and extended to qualitative field research.

5.2.6 Actual Behaviour Analysis

The actual behaviour analyses were performed on six participants based on the results obtained from the pilot analysis. With the presence of the designed floor-sitting furniture prototype complementing to the participants' floor-sitting; the sitting behaviours were analysed in order to establish the relevancy of the floor-sitting indicator, which subsequently demonstrated the floor-sitting behaviour's postures frequently practiced by Malaysians at home.

5.2.6.1 The Analysis of the Floor-Sitting Behaviour Exercised by Malaysians at Home

a. Analysis: Participant 1 [P1]

Plate 5.9. The video excerpts of the actual floor-sitting behaviour analysis on P1 watching television. [Self-creation].

1. Reach: Refers to the relationship of the participant's extension of the body parts during floor-sitting within the shape of the designed prototype:

   Postures resembling the S1KU, LS, and SKX, but in which the body is reclining/slanting to the object was demonstrated as a response to the exploration of the designed prototype. A mixture of sitting with one knee up and the other stretched,

[LS1U [+1, +2]] and the sitting resembling the squat, but in which the legs are only partly flexed [SqX [+3, +4 and +5]] were also discovered as being demonstrated in adding to the variety of sitting postures.

The dynamics of the CLS, LS, SKX, and S1KU were frequently demonstrated and seen as alternating with LS1U and SqX. The sitting in the same fashion with the body reclined or slanted was also frequently repeated. The sitting on high seats was also demonstrated by stacking the cushion seats at P1's comfort.

2. Clearance: Refers to the adequate room provided by the designed prototype for the body to move without any hinders constraining the usability of the prototype:

   The portable and disassembled characteristic of the prototype designed for user's extensive need for posture comfort, established the incorporation of the earlier floor-sitting behaviour indicator's justification in 5.2.5.2 pilot analysis where participants freely expressed the floor sitting postures.

3. Strength: Refers to the nature of the designed prototype's durability as it functioned as a 'heaviness transfer' object:

   The prototype was fully utilized to P1's sitting predilection. The cushion foam that was soft which was blended with the textured felt cover engaged participant's sense of tactile in relation to the object and was used in the participant's adjustment to the desired sitting or lounging positions putting on body pressure onto the object.

b. Analysis: Participant 2 [P2]

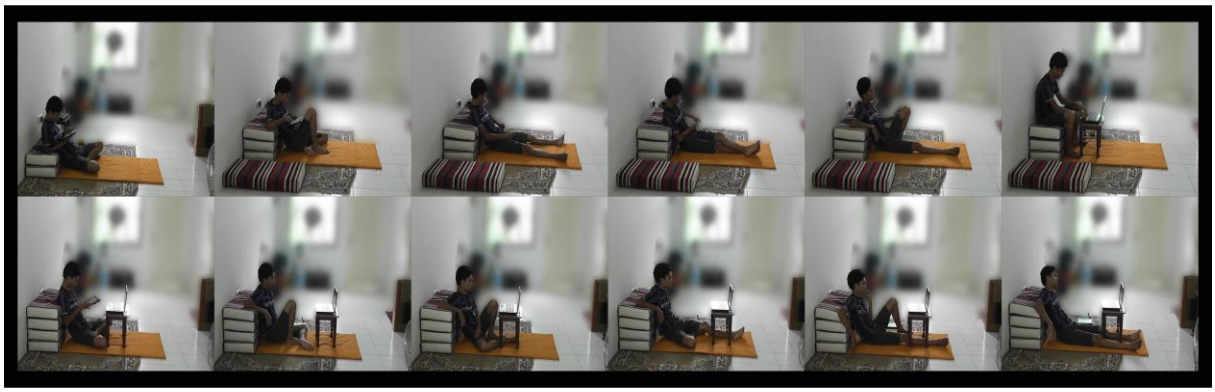


Plate 5.10. The video excerpts of the actual floor-sitting behaviour analysis on P2 watching television and doing computer work. [Self-creation].

1. Reach: Refers to the relationship of the participant's extension of the body parts during floor-sitting within the shape of the designed prototype:

   S1KU was demonstrated alternating the CLS. The LS and SKX were also frequently demonstrated alternating with LS1U. The P2's dynamics was the reaction towards balancing the open-chain systems to achieve thermal comfort. As demonstrated by P1, the connection of ergosystems signification was clearly displayed within P2's situation [the demonstration of the H,M,E relationships significance] through the sitting dynamics. The presence of the prototype engages an intimate utilization of the designed object towards comfort with the increase of sitting expressions on the floor. The expressions are unconscious, and were observed in relevance towards what propagated in Gibson's (1966) theory of body-image.

2. Clearance: Refers to the adequate room provided by the designed prototype for the body to move without any hindrance constraining the usability of the prototype:

   The portable and disassemble characteristics of the prototype designed for the user's extensive need for posture comfort, establishes the incorporation of the earlier floor-

sitting behaviour indicator's justification in 5.2.5.2 pilot analysis where participant's freely expressed the floor sitting postures.

3. Strength: Refers to the nature of the designed prototype durability as it functioned as a 'heaviness transfer' object:

   The prototype was fully utilized to P2's sitting predilection. The cushion foam that was soft which blended with the textured felt cover engaged participant's sense of tactile in relation to the object, and was used in the participant's adjustment to the desired sitting or lounging positions putting on body pressure onto the object.

c. Analysis: Participant 3 [P3]

Plate 5.11. The video excerpts of the actual floor-sitting behaviour analysis on P3 watching television and reading. [Self-creation].

1. Reach: Refers to the participant's extension of the body parts such as the arms and legs within the shape of the designed prototype:

   P3 demonstrated relatively less variety in postural development by only demonstrating sequential movements of the LS and S1KU sitting postures throughout the study. Nevertheless, P3 did not indicate any reaction of discomfort due to this pattern of sitting. The movements, although they appeared to be of less variety displayed an

orderly utilisation of the anthropometrically measured shape prototype where the relevancy of the basic biomechanical movements was demonstrated. The overall sitting position was in a symmetrical condition which involves the resting of the cervical, thoracic, and lumbar vertebrae to the legs with full utilisation of the stacked cushion for backrest and attached spreadable felt layer for the legs to stretch.

2. Clearance: Refers to the adequate room provided by the designed prototype for the body to move without any hinders constraining the usability of the prototype:

   The portable and disassemble characteristics of the prototype, designed for the user's extensive need for posture comfort, established the incorporation of the earlier floor-sitting behaviour indicator's justification in 5.2.5.2 pilot analysis where participant's freely expressed the floor sitting postures.

3. Strength: Refers to the nature of the designed prototype durability as it functioned as a 'heaviness transfer' object:

   The prototype were fully utilize to P3's sitting predilection. The cushion foam that was soft which blended with the textured felt cover engaged participant's sense of tactile in relation to the object, and was used in participant's adjustment to the desired sitting or lounging positions putting on body pressure onto the object.

d. Analysis: Participant 4 [P4]

Plate 5.12. The video excerpts of the actual floor-sitting behaviour analysis on P4 watching television. [Self-creation].

1. Reach: Refers to the participant's extension of the body parts such as the arms and legs within the shape of the designed prototype:

   P4 demonstrated frequent LS, CLS, and LFS postures alternating with the S1KU, SKX, and LS1U postures. However, the dynamics of S1KU, SKX, and CLS were consistent. The cushions were fully utilised in many different orders to achieve P4's need for comfort sitting thus demonstrating the 'reach' factor signification at different user's sitting need.

2. Clearance: Refers to the adequate room provided by the designed prototype for the body to move without any hindrance constraining the usability of the prototype:

   The portable and disassemble characteristics of the prototype, designed for user's extensive need for posture comfort, established the incorporation of the earlier floor-sitting behaviour indicator's justification in 5.2.5.2 pilot analysis where participant's freely expressed the floor sitting postures.

3. Strength: Refers to the nature of the designed prototype's durability as it functioned as a 'heaviness transfer' object:

   The prototype was fully utilized to P4's sitting predilection. The cushion foam that was soft which blended with the textured felt cover engaged participant's sense of

tactile in relation to the object and was used in participant's adjustment to the desired sitting or lounging positions putting on body pressure onto the object.

e. Analysis: Participant 5 [P5]

Plate 5.13. The video excerpts of the actual floor-sitting behaviour analysis on P5 watching television and doing computer work. [Self-creation].

1. Reach: Refers to the participant's extension of the body parts such as the arms and legs within the shape of the designed prototype:

   Similar to P3 floor-sitting pattern, P5 demonstrated frequent CLS and SKX sitting postures although in some instances LS was demonstrated, the CLS and SKX continued to be the consistent sitting postures, and was alternated for extensive durations. The prototype design supports P5's postures while he was in reclining/slanting position. Although P5 is physically big the application of the Malaysian anthropometric measurements in the prototype design P5 'reach' factor to the prototype was never exceeded, and the prototype was fully utilised within P5's need.

2. Clearance: Refers to the adequate room provided by the designed prototype for the body to move without any hinders constraining the usability of the prototype:

The portable and disassemble characteristic of the prototype, designed for user's extensive need for posture comfort, establishes the incorporation of the earlier floor-sitting behaviour indicator's justification in 5.2.5.2 pilot analysis where participant freely expressed the floor sitting postures.

3. Strength: Refers to the nature of the designed prototype durability as it functioned as a 'heaviness transfer' object:

   The prototype were fully utilize to P5's sitting predilection. The cushion foam that are soft blends with the textured felt cover engaged participant's sense of tactile to the object and was used in participant's adjustment to the desired sitting or lounging positions putting on body pressure onto the object.

f. Analysis: Participant 6 [P6]

Plate 5.14. The video excerpts of the actual floor-sitting behaviour analysis on P6 watching television. [Self-creation].

1. Reach: Refers to the participant's extension of the body parts such as the arms and legs within the shape of the designed prototype:

   The designed prototype invited participant[s] [P6] to utilise the instrument to fit into the ambience of the dwelling space. Constant dynamics of the SKX, CLS, LS, S1KU, and LS1U was demonstrated in response to the prototype. Other participants had

experienced the designed prototype increasing the sitting dynamics, thus demonstrating the signification of balancing the open-chained systems in order to achieve thermal balance within the room ambience. The CLS was observed as the most frequent sitting posture, and was demonstrated in fashions engaging to the characteristic of the cushions that can be dismantled and arranged according to the user floor-sitting comfort need [the 'reach' factor signification]. A mixture of LS1U, SqX, S1KU, SKX, and LS were also demonstrated with a combination of reclined/slanted positions alternated for an extensive duration.

2. Clearance: Refers to the adequate room provided by the designed prototype for the body to move without any hindrance constraining the usability of the prototype:

   The portable and disassemble characteristics of the prototype, designed for the user's extensive need for posture comfort, establishes the incorporation of the earlier floor-sitting behaviour indicator's justification in 5.2.5.2 pilot analysis, where participants freely expressed the floor sitting postures.

3. Strength: Refers to the nature of the designed prototype durability as it functioned as a 'heaviness transfer' object:

   The prototype was fully utilized to P6's sitting predilection. The cushion foam that were soft which blended with the textured felt cover engaged participant's sense of tactile in relation to the object and was used in the participant's adjustment to the desired sitting or lounging positions putting on body pressure onto the object.

The actual behaviour analysis articulation to the floor-sitting frequency patterns is expounded in point 5.3.2: Time and Event Sampling; sub point 5.3.2.2 and the inference of the actual behaviour analysis is attached in Appendix E.

5.3 The Quantitative Data Analysis

The preliminary information gained on the postural behaviour was equated to the research conducted by previous anthropologists, chiefly in Hewes's (1955) postural typological data in the *World Distribution of Postural Habits* research. His postural data was adopted and recomposed to fit, and be elaborated upon into this researcher's research concept on the floor-sitting behaviour. Initially, Hewes (1955) postural typological data was clustered into the categories of region and ethnicity, where the postural concepts adopted by this researcher was initially found scattered according to such distributions. For example, sitting with legs stretched out or sitting with the legs folded to the side [see *Table 4.2*, code LS 1-3 and LFS 1-3] was found as customary in the Melanesian region, and is often associated to feminine habits, and not particularly a mannish proprietorship. Another example is sitting with one knee up other down and flexed [S1KU 1-4], where the practice was established amongst the Australian aborigines.

The performed human floor-sitting behaviour survey throughout the online biphasic survey where the numerical results were automatically generic, established the aggregation of postural information considering the recognition of the sitting with the knee flexed and one leg stretched out [SKX], sitting with one knee up, the other down and flexed [S1KU], cross-legged sitting [CLS], sitting with the legs folded to the side [LFS], and sitting with legs stretched out [LS] are within the Malaysian customary context. The preconceive data gathered from the reliability tests formed a precursor reflecting the content enquiry within the research questions. The received data was expounded into this researcher's research concept and context. This further complemented the time and event sampling in the pilot analysis, and actual behaviour analysis of participants' sitting on the floor within the home environment

[see 5.3.2.1 and 5.3.2.2 distribution of the floor-sitting frequency patterns]. The relevancies of the quantitative analysis to this research are expounded in 5.3.1 onwards.

5.3.1 Survey Analysis

The data of the floor-sitting frequency based upon the collective consideration of 100 survey respondents was encoded into the form of typological sequences, tables, and graphs. Table 5.3 illustrates the frequency of the floor-sitting behaviour based on second survey. The percentages highlighted in red indicate the sitting sequence frequency. There are 5 columns labelled with different colours representing the first to fifth postural preferences. The floor-sitting preferences data is summarize in Table 5.4.

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	x	▽

POSTURAL FREQUENCY SEQUENCE	1st Sitting Preference	2nd Sitting Preference	3rd Sitting Preference	4th Sitting Preference	5th Sitting Preference
CLS	48%	14%	12%	16%	10%
S1KU	18%	32%	23%	16%	11%
SKX	12%	17%	36%	16%	19%
LS	12%	20%	15%	36%	17%
LFS	9%	13%	11%	18%	49%

Table 5.3. The percentages of the floor-sitting frequency. [Top images are connected to the table below; and adopted from Hewes (1955) and adjusted to this researcher indoor sitting context].

As shown in Table 5.3, CLS is the most preferable floor-sitting posture with 48% feedback, followed by S1KU with 32%. The third highest floor-sitting preference is SKX (36%) followed by LS (36%). Finally the least preference of floor-sitting is LFS (49%). Detail summary of the postural preference summary in Table 5.4.

5.3.1.1 Postural Preference Summary:

POSTURE	POSTURE PROPENSITY	PRECEDENCE
CLS	48%	CLS1
S1KU	32%	S1KU2
SKX	36%	SKX3
LS	36%	LS4
LFS	49%	LFS5

Table 5.4. The percentages of the floor-sitting propensity based on the collective responds of 100 survey participants. [Survey conducted by this researcher]. [Self-creation].

POSTURES					
CODE	CLS1	S1KU2	SKX3	LS4	LFS5
SYMBOL	△	□	○	x	▽

Table 5.5. The typology of the floor-sitting postures' frequency and propensity in sequence of orders. [images adopted from Hewes (1955) and adjusted to this researcher indoor sitting context].

5.3.1.2 The Average Age Percentages of the Respondents Exercising the Floor-Sitting.

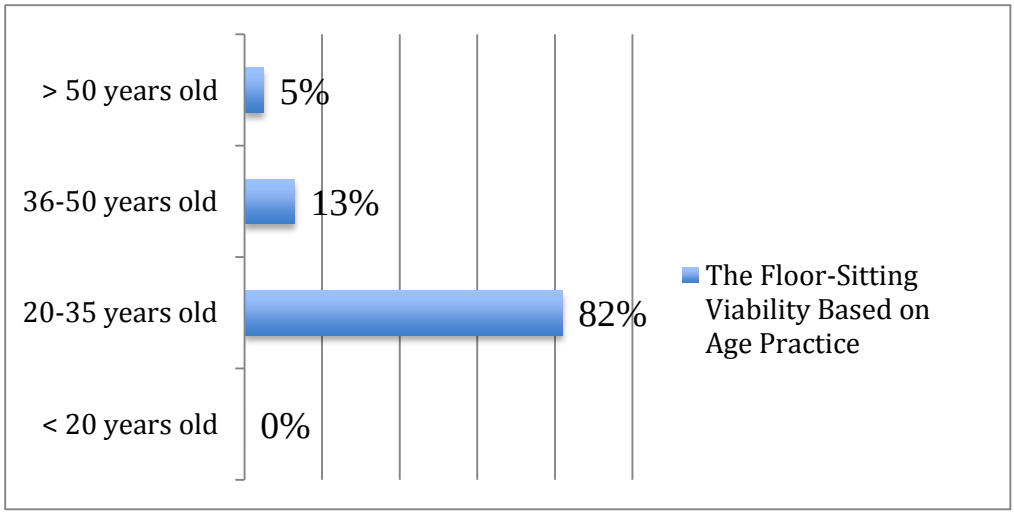


Fig. 5.1. Analysis of the floor-sitting viability based on age practice. [The data is based on the survey conducted by this researcher]. [Self-creation].

5.3.1.3 The Overall Floor-Sitting Enduring Time Based on the Collective Estimation.

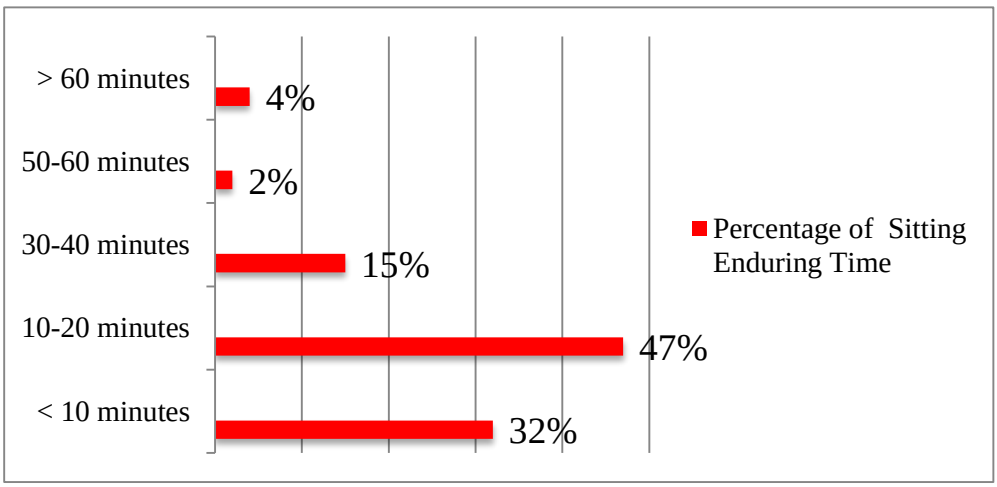


Fig 5.2. Analysis of the percentage of the sitting enduring time. [The data is based on the survey conducted by this researcher]. [Self-creation].

5.3.1.4 Summary

The sitting frequency, and sequence obtained in the order of CLS 1, S1KU 2, SKX 3, LS 4, and LFS 5 justified the dynamics of the ground-sitting. Generally, they signified the unconscious bodily reactions of average individuals reacting [having architecture experience] to their home environment when sitting on the floor. The obtained postural data was predetermined for the departure of this research analysis that overall, demonstrated the weight of the *body-image* context; the model of perception as propagated by Gibson (1966). These postures however, were not *de rigueur* nor the only sequences composed by individuals, as individual kinaesthesia and postural experience varied. The sitting and enduring time formed an indication of the average sitting time that one would let the lower body be contacted to the floor and mostly, preferably, was exercised by people with an average age of 20-35 years old. In this juncture, the approach established the suitability of employment of participant[s]/target user[s] during the time and event sampling [the pilot analysis and the actual behaviour analysis] of the floor-sitting behaviour.

5.3.2 Time and Event Sampling

5.3.2.1 Pilot analysis

This section demonstrates the floor-sitting pattern demonstrated by participants as justified in point 5.2.5: Pilot Analysis to point 5.2.5.2: Inference on Pilot Analysis. The construction of the line charts below and thereafter in the actual behaviour analysis was based on maximum time individual would sit on the floor as surveyed in Malaysia.

Participant: P 1

Analysis:

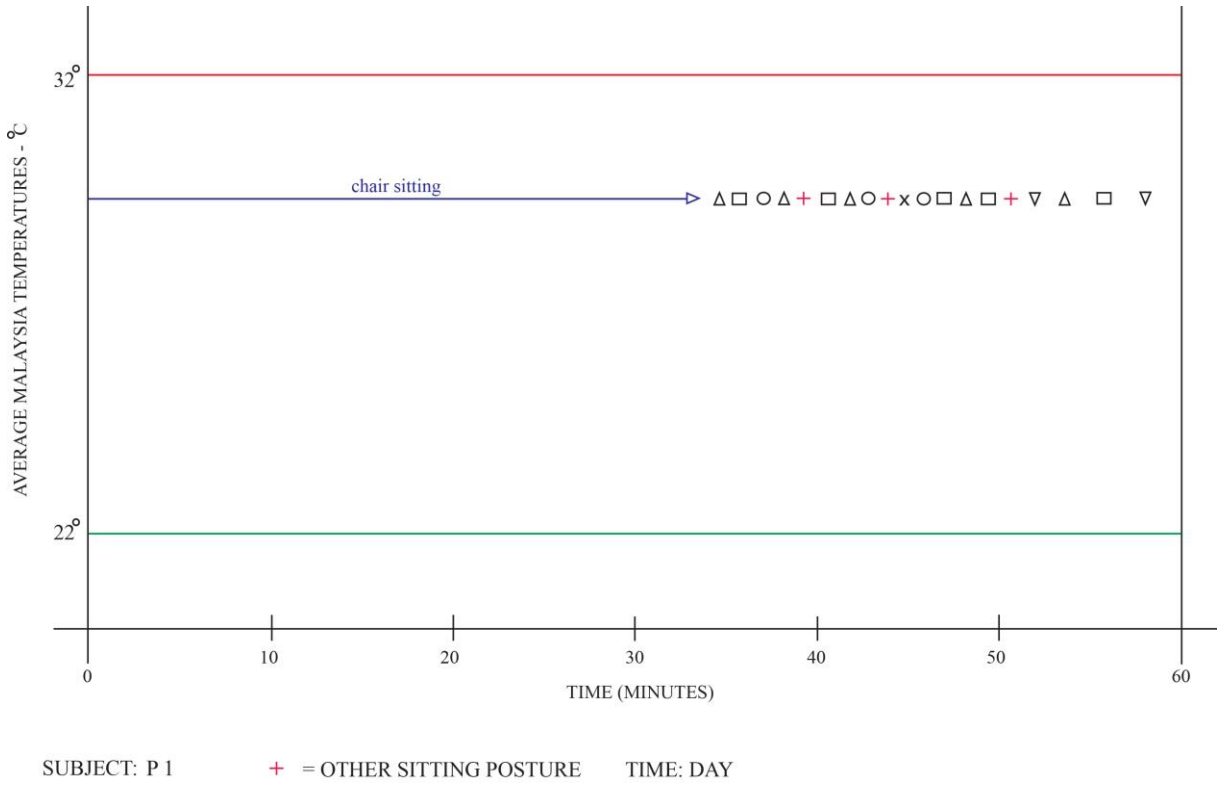


Fig. 5.3. The distribution of the floor-sitting frequency based on the practice of six Malaysians: Participant 1 [P 1]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in the 5.3.2.1.1. [Self-creation].

Fig. 5.3 illustrates Participant 1 [P1] floor-sitting patterns in a home environment. P1 sat on the chair for the first 32 minutes. The sitting style changed afterward and P1 began sitting on the floor. CLS [△] was first established, followed by S1KU [□] and constantly performed. Other floor-sitting style such as LS [×], SKX [○] and LFS [▽] were also demonstrated. LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] were discovered as new sitting style as P1 often associate such sitting postures by perching against the edge of the ottoman chair. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 2

Analysis:

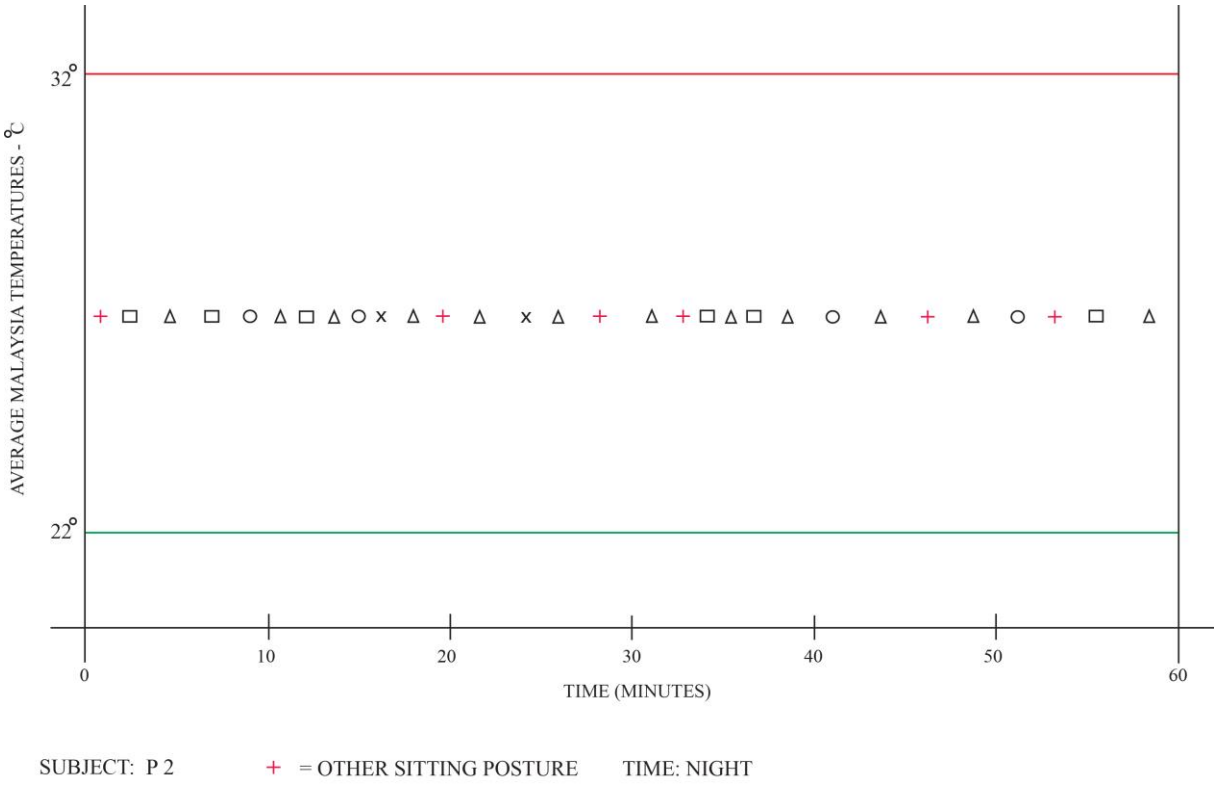


Fig. 5.4. The distribution of the floor-sitting frequency based on the practice of six Malaysians: Participant 2 [P 2]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in the 5.3.2.1.1. [Self-creation].

Fig. 5.4 illustrates Participant 2 [P2] floor-sitting patterns in a home environment. P2 began sitting on the floor with constant interchange sitting posture of S1KU [□], CLS [△]. New discovered style such as LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] were constantly demonstrated. CLS [△] established the preferable sitting style. SKX [○] and LS [×] were least performed. LFS [▽]sitting style were not performed at all. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 3

Analysis:

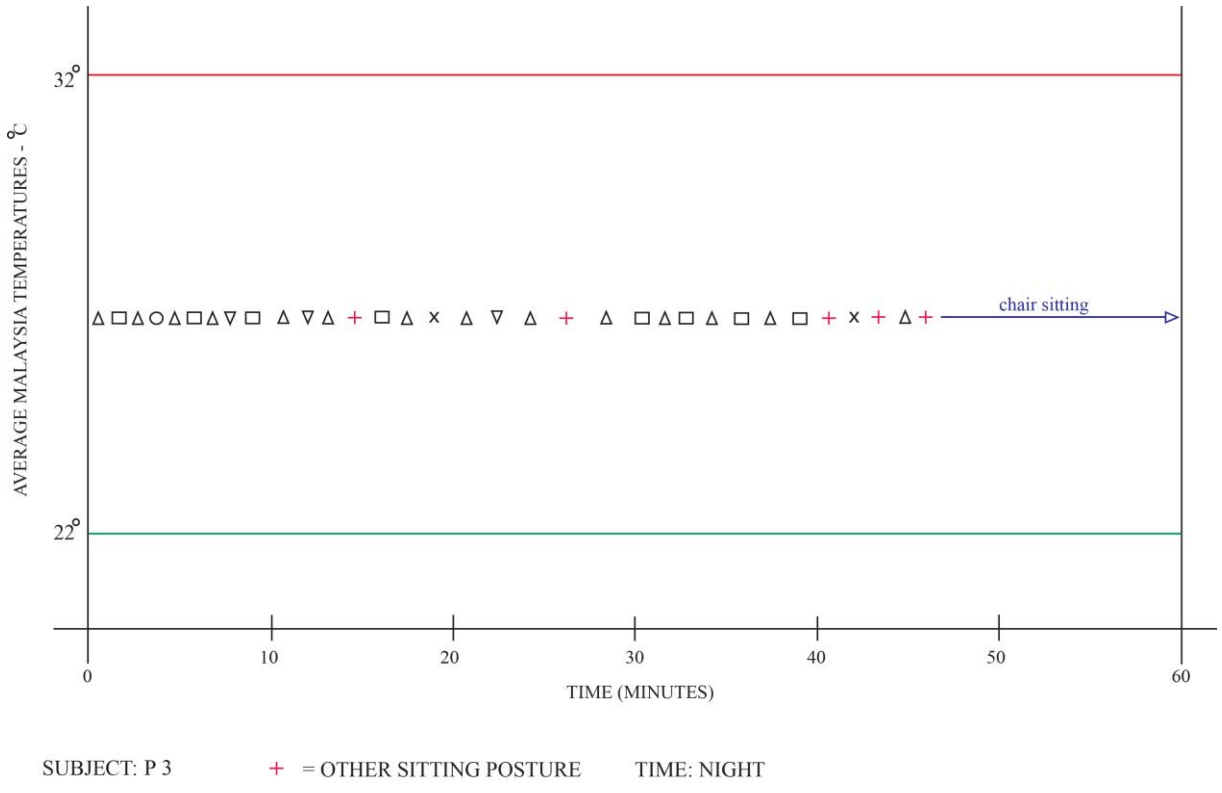


Fig. 5.5. The distribution of the floor-sitting frequency based on the practice of six Malaysians: Participant 3 [P 3]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in the 5.3.2.1.1. [Self-creation].

Fig. 5.5 illustrates Participant 3 [P3] floor-sitting patterns in a home environment. P3 demonstrated a consistent floor-sitting dynamics for approximately 48 minutes with various sitting style and utilizing the low cabinet to perch against for backrest. As P1 and P2, P3 also established CLS [△] as frequent sitting interchanging S1KU [□] sitting style for 40 minutes. Other sitting style such as LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] were complemented. LFS [▽], LS [×], and SKX [○] were least performed. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 4

Analysis:

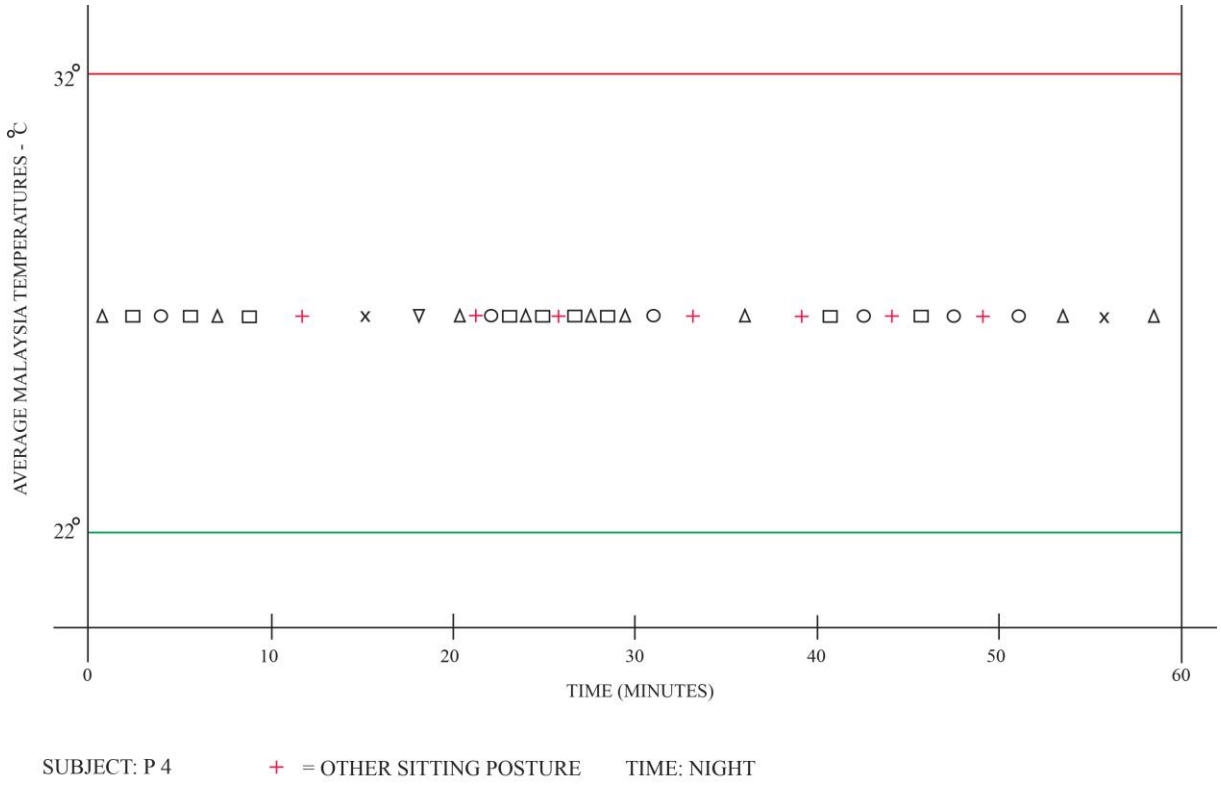


Fig. 5.6. The distribution of the floor-sitting frequency based on the practice of six Malaysians: Participant 4 [P 4]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in the 5.3.2.1.1. [Self-creation].

Fig. 5.6 illustrates Participant 4 [P4] floor-sitting patterns in a home environment. Overall, P4 demonstrated a balance mixture of floor-sitting style through out 60 minutes. By complementing with sitting against the edge of the sofa for backrest, CLS [△] was first established, followed by S1KU [□] that constantly performed as P1, P2 and P3 did. The interchanging of SKX [○] and LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] diversified the floor-sitting style and observed as P4's attempt to maximize sitting comfort. LS [×] and LFS [▽] were least performed. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	x	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 5

Analysis:

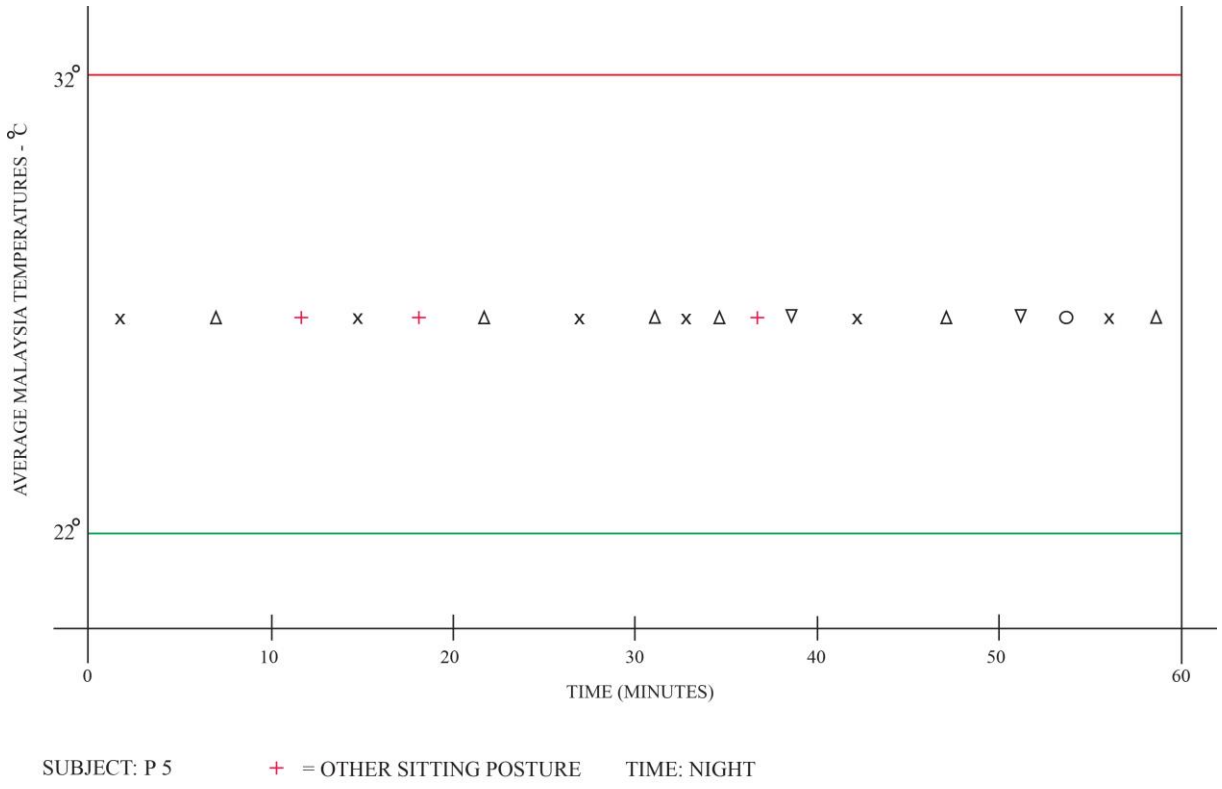


Fig. 5.7. The distribution of the floor-sitting frequency based on the practice of six Malaysians: Participant 5 [P 5]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in the 5.3.2.1.1. [Self-creation].

Fig. 5.7 illustrates Participant 5 [P5] floor-sitting patterns in a home environment. The CLS [△] sitting style was frequently demonstrated as similar to P1, P2, P3 and P4. LS [×] were the second frequent floor-sitting style, in contrast to previous observed participants. In addition to the dissimilarity, S1KU [□] was not performed by P5 through out the 60 minutes. There were few minutes' gaps between the changing of the sittings style as P5 took the time perching against the edge of the sofa. Such action was observed the need to maximize the sitting comfort. LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+], LFS [▽] and SKX [○] were the least performed floor-sitting style. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 6

Analysis:

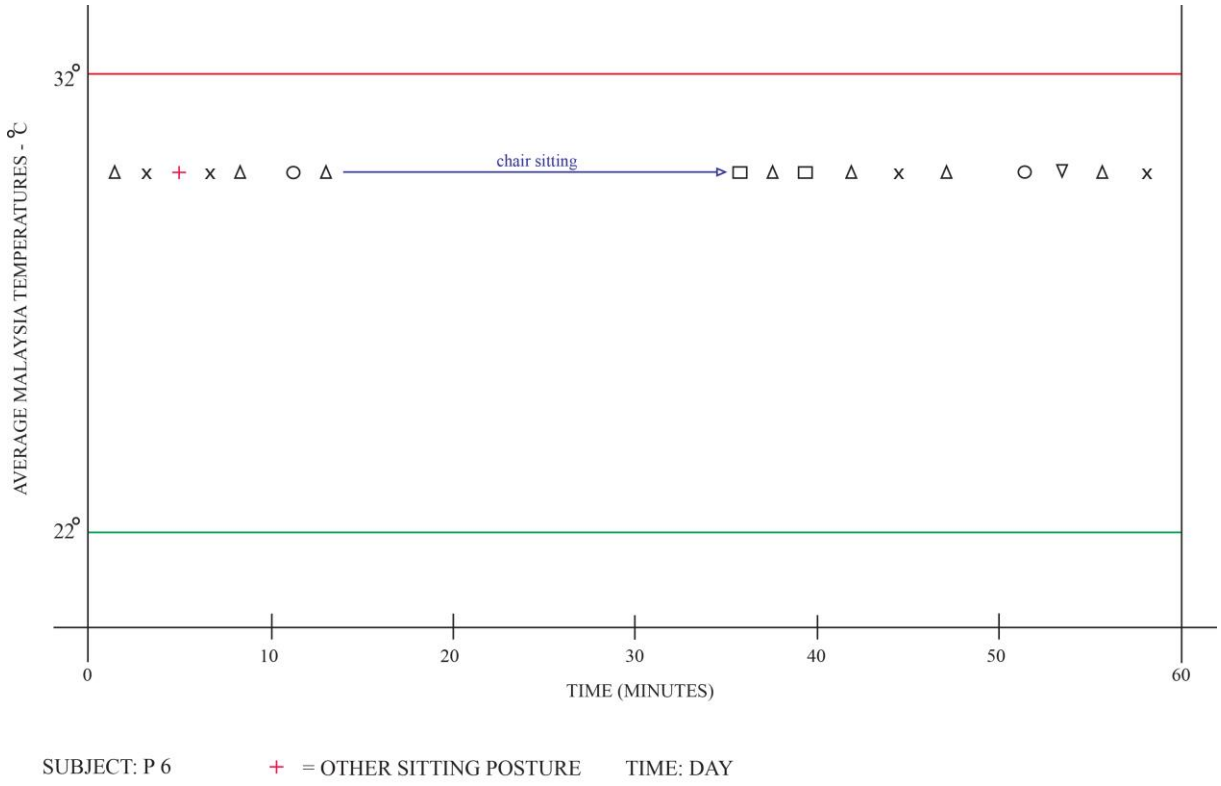
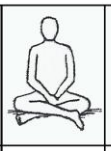


Fig. 5.8. The distribution of the floor-sitting frequency based on the practice of six Malaysians: Participant 6 [P 6]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in the 5.3.2.1.1. [Self-creation].

Fig. 5.8 illustrates Participant 6 [P6] floor-sitting patterns in a home environment. P6 was sitting by perching against the edge of the sofa. LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] were performed only in the first 10 minutes. CLS [△] was established as frequent floor-sitting style as similar to P1, P2, P3, P4 and P5. The floor-sittings however were discontinuing for a short time (15 minutes long sitting on the floor) by P5 sitting on the sofa for 20 minutes. LS [×] were the second preferred floor-sitting style similar to the pattern of sitting performed by P5. S1KU [□], SKX [○] and LFS [▽] were the least performed sitting style. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

5.3.2.1.1 Pilot Analysis Results: The Distribution of the Floor-Sitting Frequency Summary:

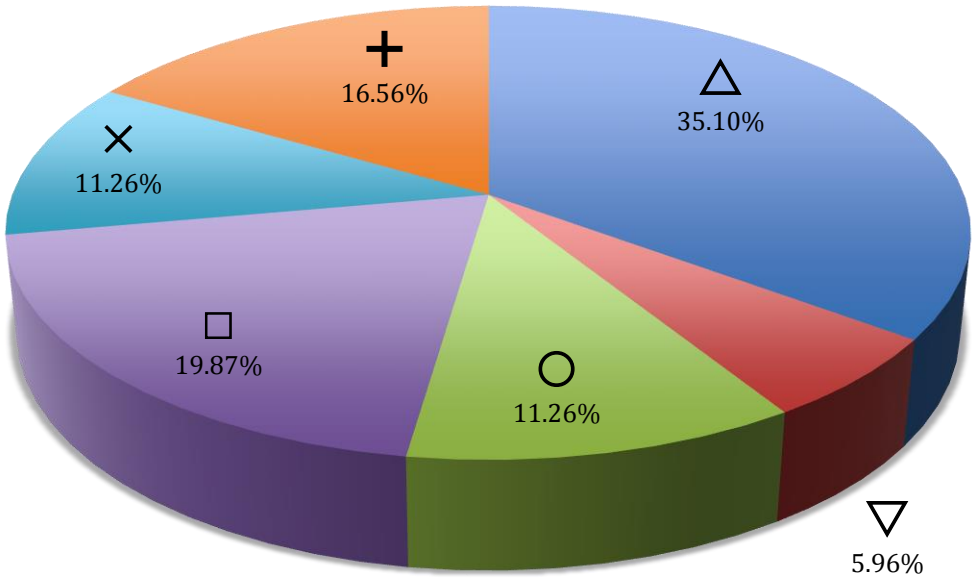


Fig. 5.9. The distribution of percentages of the floor-sittings frequency based on pilot analysis. [Self-creation].

Fig. 5.9 demonstrates the CLS [△] [35.10%] as the most preferable floor-sitting among six participants within home environment. S1KU [□] [19.87%] is the second preferable sitting posture [see LEGEND]. Other sitting postures such as LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] [16.56%][see LEGEND] were discovered as new postures that had never been found in any literature. LS [×] [11.26%], SKX [○] [11.26%] and LFS [▽] [5.96%] were the least sitting posture demonstrated. This subsequent change in floor-sitting posture shows the coherency of early survey data. The consistency of changing in floor-sitting style is 74.49% from 100 survey feedback. The pattern of changing in floor-sitting style also recorded via video surveillance approach. This researcher believed that the changing of individual floor-sitting preference changing was due to individuals' resting and sitting action in achieving maximum comfort. Survey data shows 78% of the respondents choose to sit on the floor even though the home is furnished with furniture. This action may due to the nature of human acclimatizing to the surrounding for comfort and, by sitting on the floor the body also connects to other architecture elements to achieve such objective. This significance demonstrates the open-chain system signification, that complemented with survey respond. Please refer to APPENDIX B for detail survey data.

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

5.3.2.2

Actual Behaviour Analysis

This section demonstrates the floor-sitting frequency patterns demonstrated by participants as justified in point 5.2.6.

Participant: P 1

Analysis:

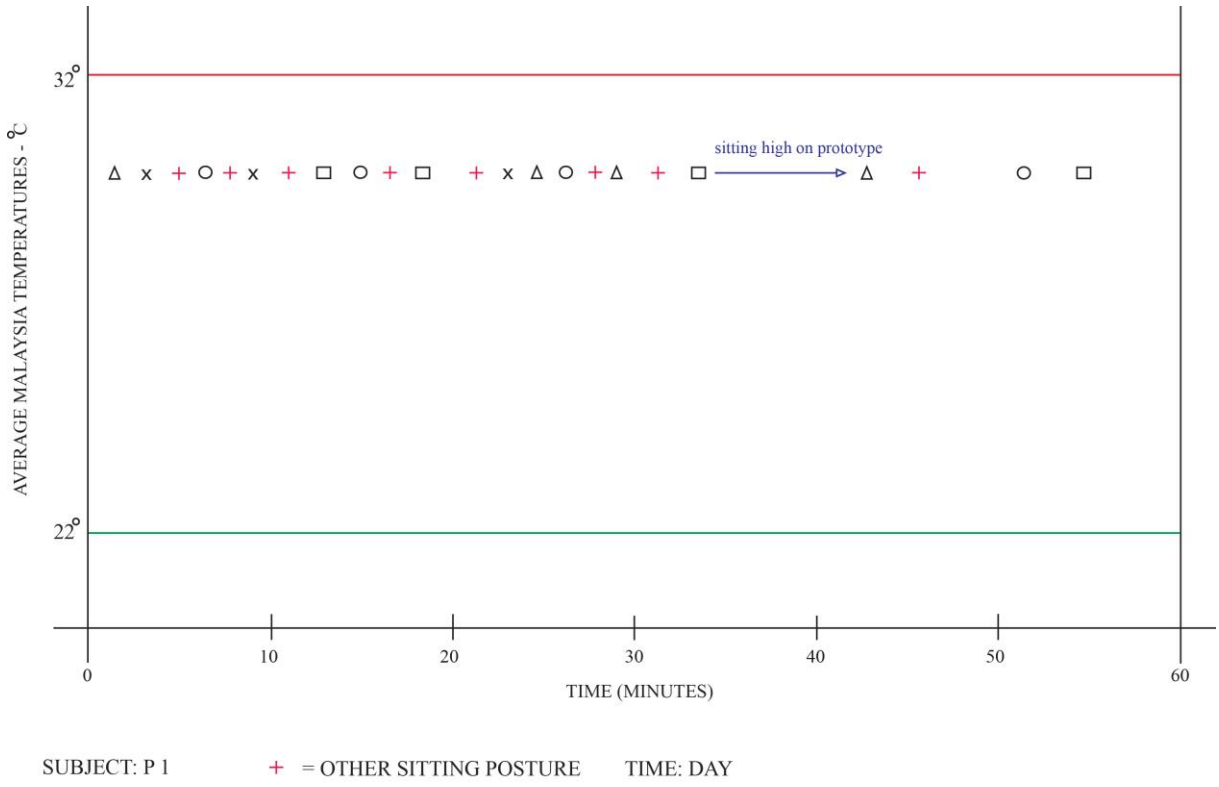


Fig. 5.10. The distribution of the floor-sitting frequency exercised in Malaysian home: Participant 1 [P 1]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in 5.3.2.2.1. [Self-creation].

Fig. 5.10 illustrates Participant 1 [P1] floor-sitting patterns in a home environment. Five floor-sitting styles established in the previous pilot analysis were demonstrated. The presence of floor-sitting furniture prototype have facilitated P1's postural need when sitting on the floor. There were few minutes' gaps between the changing of the sittings to another style where P1 took longer sitting time, perching and also sitting high on the stacking prototype cushions exploring the modularity features of the floor-sitting prototype. The length of sitting time in between the interchange of sitting style were expanded towards the end of the observation session. CLS [△] was established, complementing with S1KU [□] and SKX [○] consistently, followed by LS [×]. However, LFS [▽] was not preformed, which may be due to the prototype's modularity features that engaged P1 to explore comfort sitting further. This has consequently resulted the demonstrations of LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] sitting style frequency. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 2

Analysis:

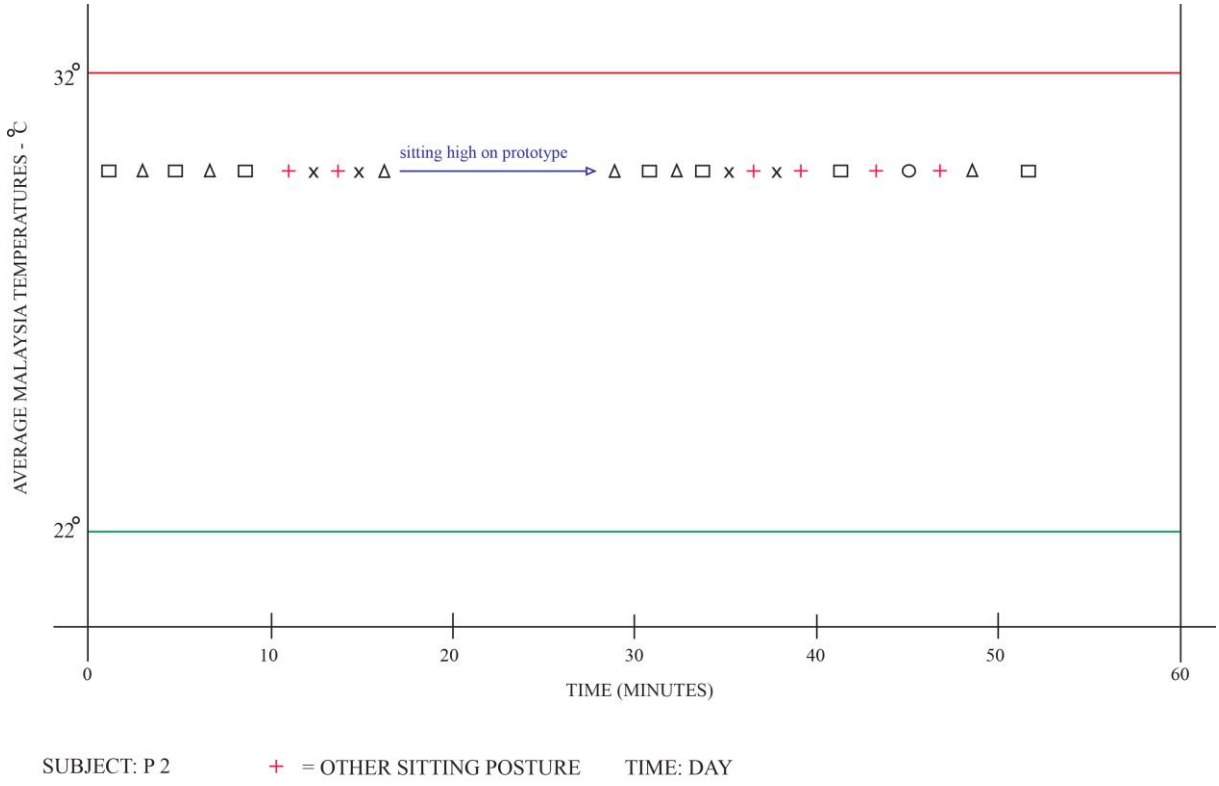
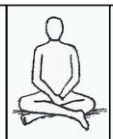


Fig. 5.11. The distribution of the floor-sitting frequency exercised in Malaysian home: Participant 2 [P 2]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in 5.3.2.2.1. [Self-creation].

Fig. 5.11 illustrates Participant 2 [P2] floor-sitting patterns in a home environment. Four floor-sitting styles constantly replicated the sitting style in previous pilot analysis. The presence of floor-sitting furniture prototype have facilitated P2's postural need when sitting on the floor. In correspond to P1 sitting length, there were few minutes' gaps between the changing of the sittings to another style, where P2 also took longer sitting time and, frequently perching against the stacked prototype cushions arranged at P2's preferred heights.

P2 also stacks the cushions higher and, sat on it to explore the modularity features of the floor-sitting prototype for 11 minutes. The length of sitting time in between the interchange of sitting style were expanded towards the end of the observation session. S1KU [□] was established as frequent floor-sitting style, complementing with CLS [△] and LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] consistently, followed by LS [×]. However, SKX [○] and LFS [▽] sitting style were not preformed. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 3

Analysis:

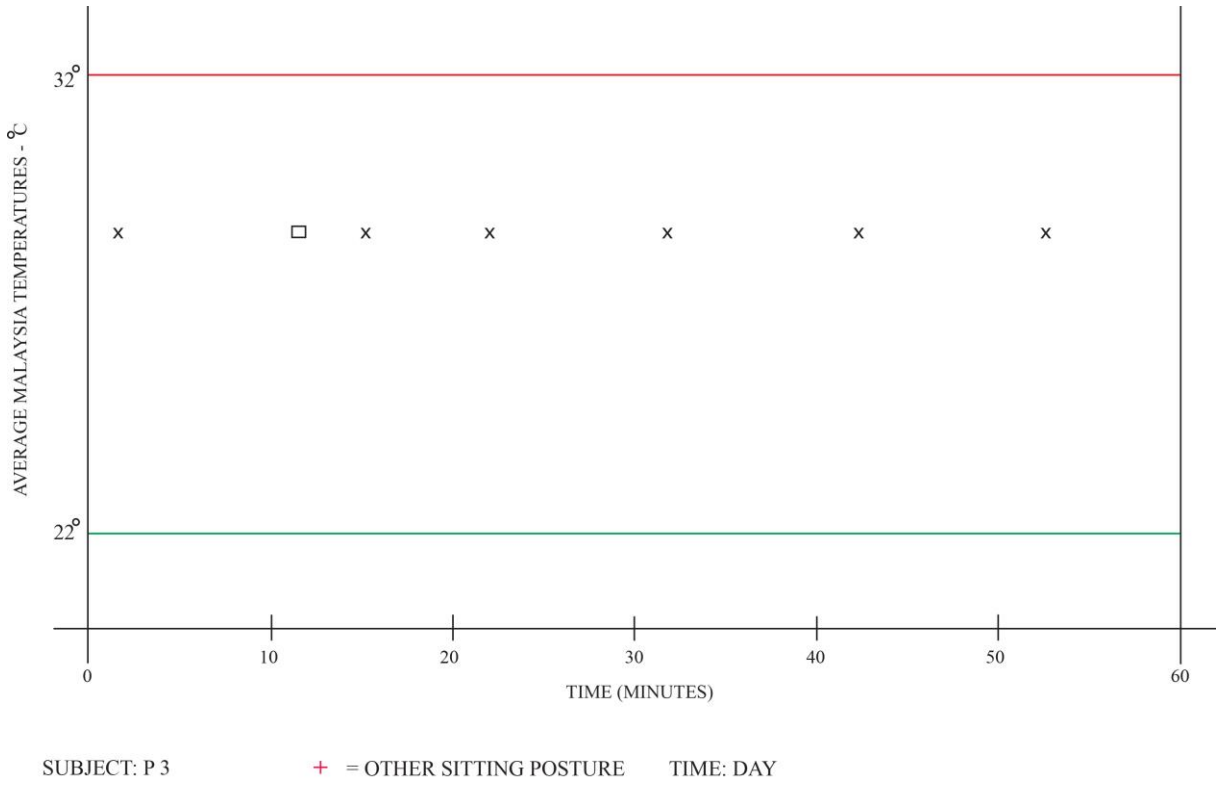


Fig. 5.12. The distribution of the floor-sitting frequency exercised in Malaysian home: Participant 3 [P 3]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in 5.3.2.2.1. [Self-creation].

Fig. 5.12 illustrates Participant 3 [P3] floor-sitting patterns in a home environment. Only two floor-sitting styles constantly replicated from the previous pilot analysis. The presence of floor-sitting furniture prototype have facilitated P3's postural need when sitting on the floor. In correspond to P1 and P2 sitting length, P3 took much longer sitting and perching time and, the time gaps between the changing of the sittings to another style were lengthy, which made the demonstrated floor-sitting styles limited. LS [×] were P3's preferred floor-sitting style

and, consistently performed throughout 60 minutes. S1KU [□] however, were only performed once. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	Δ	□	○	×	∇
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 4

Analysis:

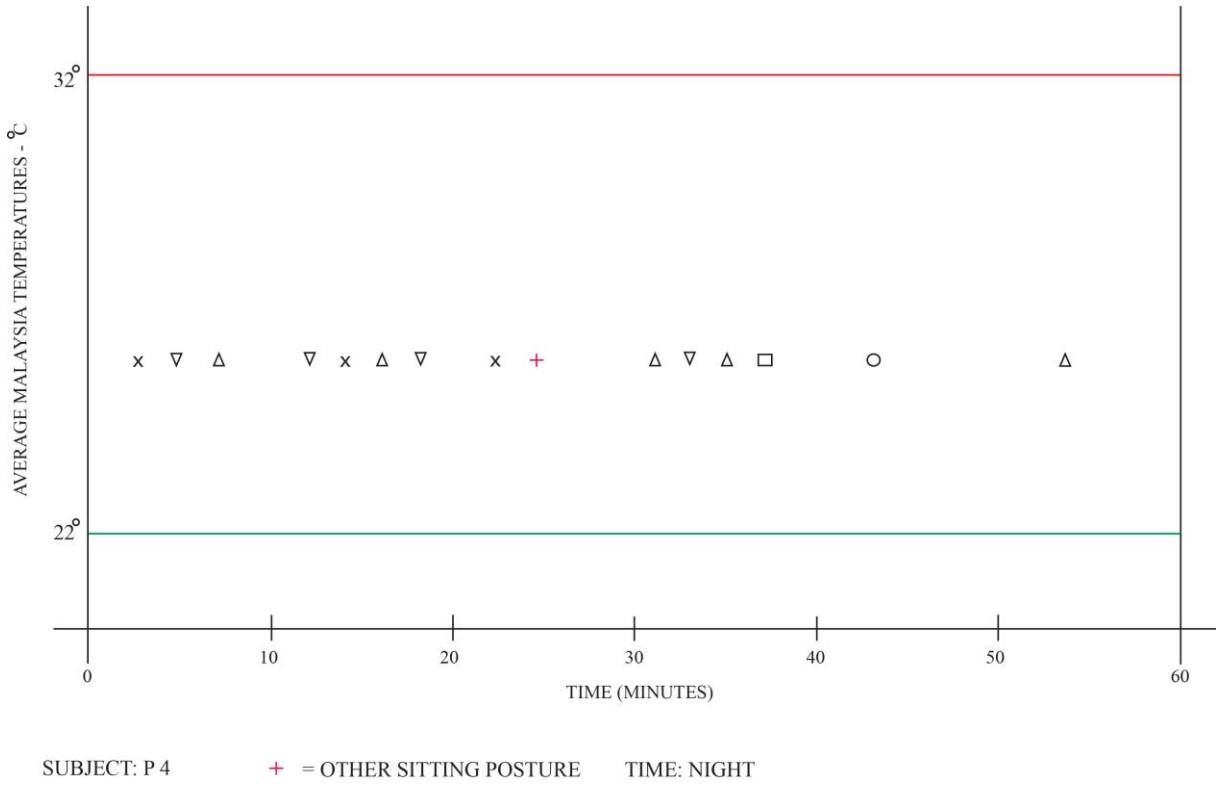


Fig. 5.13. The distribution of the floor-sitting frequency exercised in Malaysian home: Participant 4 [P 4]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in 5.3.2.2.1. [Self-creation].

Fig. 5.13 illustrates Participant 4 [P4] floor-sitting patterns in a home environment. Six floor-sitting styles constantly repeated as recorded in the previous pilot analysis. The presence of floor-sitting furniture prototype have associated P4's postural need when sitting on the floor. In correspond to P1, P2 and P3 sitting length, there were few minutes' gaps between the changing of the sitting behaviour. P4 took longer sitting time and, frequently perching against the stacked prototype cushions in seeking P4's maximum sitting comfort. This development has subsequently resulted in the equitable distribution of the frequent floor-sitting style within

60 minutes. Although P4 begun sitting in LS [×], CLS [△] was established as frequent floor-sitting style, complementing with LFS [▽] consistently. LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+], S1KU [□] and SKX [○] were the least floor-sitting style performed. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 5

Analysis:

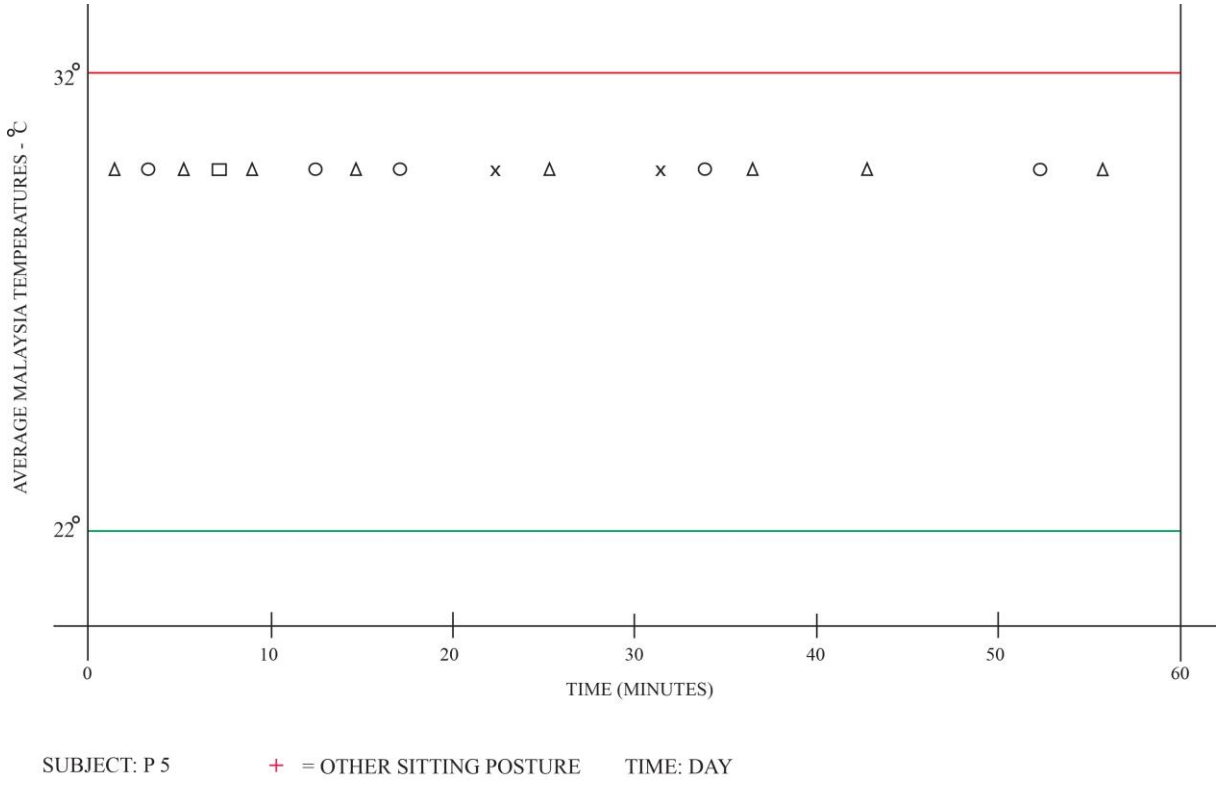


Fig. 5.14. The distribution of the floor-sitting frequency exercised in Malaysian home: Participant 5 [P 5]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in 5.3.2.2.1. [Self-creation].

Fig. 5.14 illustrates Participant 5 [P5] floor-sitting patterns in a home environment. Four floor-sitting styles were repeated from the previous pilot analysis. The presence of floor-sitting furniture prototype have facilitated P5's postural need when sitting on the floor, despite least exploration on the floor-sitting prototype modularity features. In correspond to P1, P2, P3 and P4 sitting length; there were few minutes' gaps between the changing of the sitting style. The length of sitting time in between the interchange of sitting style were expanded

towards the end of the observation session. CLS [△] was established as frequent floor-sitting style, complementing with SKX [○] consistently. The interchanged of LS [×] floor-sitting style were least performed, as well as S1KU [□]. LFS [▽] and LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] sitting styles were not demonstrated at all. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Participant: P 6

Analysis:

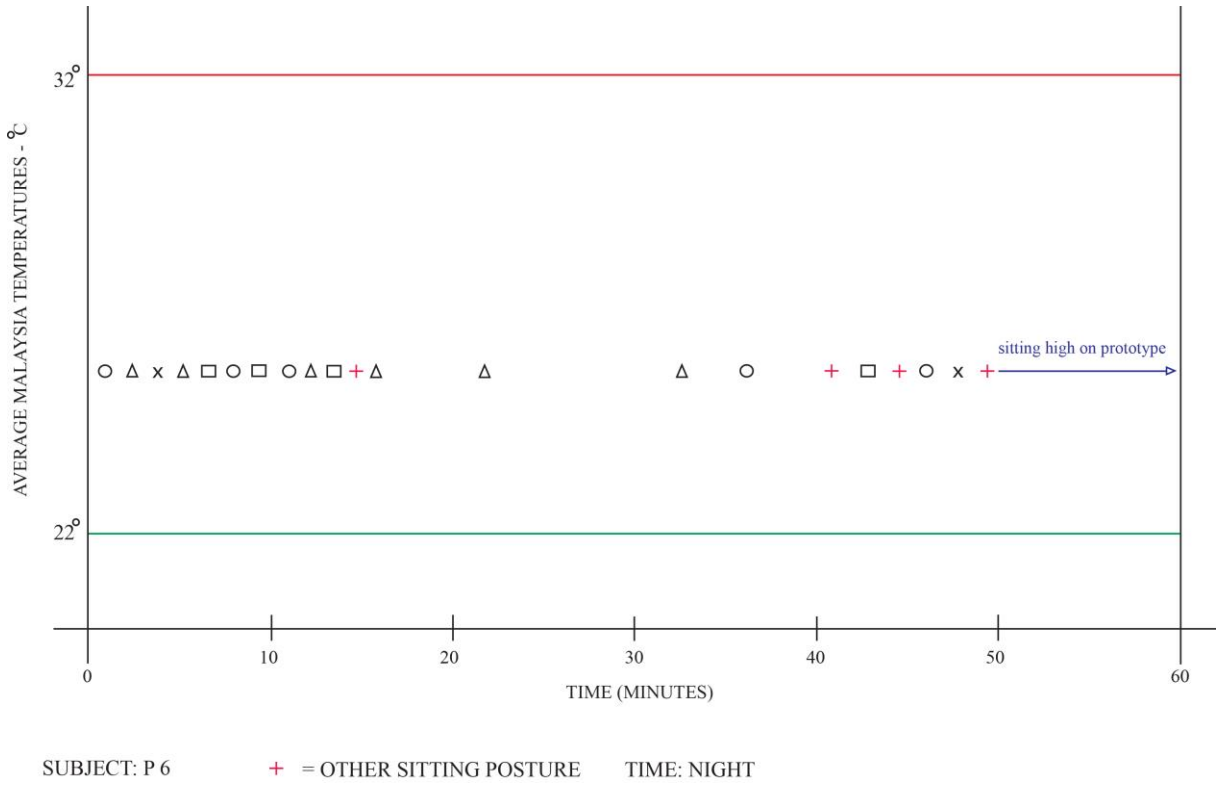
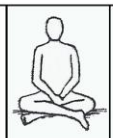


Fig. 5.15. The distribution of the floor-sitting frequency exercised in Malaysian home: Participant 6 [P 6]. Note that the above sitting behaviour frequency's results are distributed in cumulative percentage in 5.3.2.2.1. [Self-creation].

Fig. 5.15 illustrates Participant 6 [P6] floor-sitting patterns in a home environment. The presence of floor-sitting furniture prototype have influenced P6's floor-sitting postures. P6 also stacks the cushions higher and, sat on it to explore the modularity features of the floor-sitting prototype during the 50th minutes onwards. CLS [△] was established as frequent floor-sitting style, complementing with SKX [○] and S1KU [□] floor-sitting style. LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] were also demonstrated in between the three most

frequent mentioned floor-sitting styles. LS [×] were least demonstrated and LFS [▽] sitting style were not performed at all. [see LEGEND].

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

5.3.2.2.1 Actual Behaviour Analysis Results: The Distribution of the Floor-Sitting Frequency Summary:

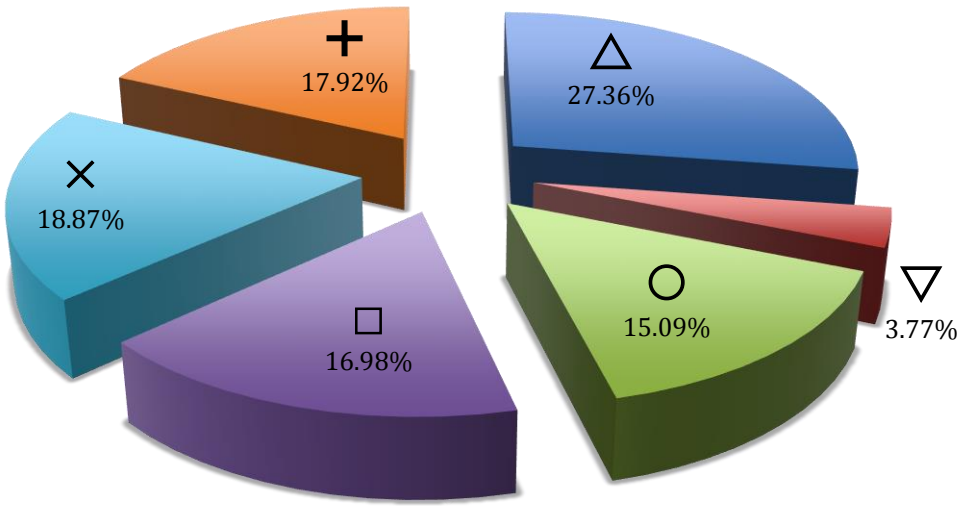


Fig. 5.16. The distribution of percentages of the floor-sittings frequency based on actual behaviour analysis. Further elaboration of the findings is elaborated in Chapter 6 [Self-creation].

In comparison to Fig. 5.9, the designed floor-sitting furniture prototype increases the floor-sitting posture of SKX [○] [15.09%], LS [×] [18.87%], LS1U 1, LS1U 2 [+] and SqX 1, SqX 2 and SqX 3 [+] [17.92%]. The CLS [△] [27.36%], S1KU [□] [16.98%] and LFS [▽] [3.77%] perpetuate [see LEGEND]. Different participants at different home settings unanimously exercised LS1U 1, LS1U 2 and SqX1, SqX 2, SqX 3 at different sequences. The increasing of the floor-sitting postures may due to the physical characteristic of the floor-sitting furniture prototype that is soft and cushioned with textured felt cover that subsequently engages participants to sit and experience the modularity characteristic of the prototype. The designed furniture able to provide tactility stimulation for users and proper support for the

head, neck, shoulder, as well as supporting the kyphosis to the lower lordosis; instead of finding a perching spot such as leaning against the sofa edge or low cabinet edge which may not bring pleasure to the body as demonstrated in the pilot analysis.

LEGEND

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	×	▽
POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

5.4 Summary

The human sensory system animates the sitting dynamics. The articulation as a whole of psychoanalytic thoughts and sitting biomechanics generates the projection of the body kinaesthesia in the floor-sitting behaviour. The environmental physics signification through the amalgamation of the space design significance [form, use, unused space], and the subtle association of the local atmospheric conditions coherently influences this relevancy. This accentuated feature is often associated with human postural behaviour as manifested within anthropology literatures. In addition, the individual locus that harmonizes into the body-link concept has demonstrated patterns of floor-sitting expressions on and off the floor. These are the significations that technically analysed the relationships which were decisively immanent to the development of the designed floor-sitting prototype. The floor-sitting furniture

prototype engaged the participants intimately to the seating object, and demonstrated a variety of sitting postures as being significantly illustrated through the relationships of the quantitative mechanism.

Chapter 6.0

FINDINGS & DATA INTERPRETATION

6.1 Introduction

This chapter synchronises the Chapter 5 analysis of data where the analysed results were interpreted through the association of theories applied to this research. It was determined from the analysis that the articulation of the ergonomics science elements steers significant understanding towards the embodiment of the floor-sitting behaviour within the home environment. Based on the research questions outline articulating this research, this chapter explicates the relevancy of that justification. The structure of this chapter includes the summary of major findings, the articulation of theoretical justification, and the findings' associations to other research where the connections of findings between this research data and that of others are highlighted. In addition, this chapter also covers the implications of the findings to the current theory, technical application, and professional practices.

6.2 The Major Findings

The ergonomics science elements' articulation into the embodiment of the floor-sitting behaviour was analysed in Chapter 5. In addition, the coherency of the theoretical articulations to the research questions and findings are justified in 6.3; *The Theoretical Articulations to the Major Findings* onwards. This study outlines the following based on the actual behaviour analysis:

a. Table 6.1 illustrates the preferred sitting style as documented by Hewes (1955). The new discovery of sitting style shown in Table 6.2. The sitting with legs stretched out, and alternating the right or left knee up is symbolized with +1 and +2. The ranges of this sitting posture can be seen its differences through the positioning of the arm. Postures resembling the squat but in which the legs were only partly flexed along with the sitting in which the leg is stretched out and the other partly flexed is symbolized with +3, +4 and +5. These are the sitting style practiced within the home environment and opposed to earlier ground-sitting data documented by Hewes (1955), elucidating as outdoor practice.

POSTURES					
CODE	CLS	S1KU	SKX	LS	LFS
SYMBOL	△	□	○	x	▽

Table 6.1. The typology of the floor-sitting postures' frequency and propensity. [Adapted and adjusted to this research context from Hewes (1955)].

POSTURES					
CODE	LS1U 1	LS1U 2	SqX 1	SqX 2	SqX 3
SYMBOL	+1	+2	+3	+4	+5

Table 6.2. The distribution of other floor-sitting postures frequently exercised based on the actual floor-sitting behaviour analysis. [Adapted and adjusted to this research context from Hewes (1955)].

b. In addition, some contrastive sitting style and lounging postures were found despite the discovery of +1, +2, +3, +4 and +5. Nevertheless, they were not regular and varied among the participants. This postural significance is observed as the adaptations of a person's sitting postures in the room that built by perceptual responses that its dynamics were affected by the environmental physics of the home environment, and tactility persuasions of the architectural elements.

c. In a dynamic sitting sense, a person will change from one sitting posture to another. He or she is more likely to change position when the lower body segments show discomfort from the length of the sitting. Often individuals folded, flexed and stretched the legs for comfort. Although individual postural experience varies, the similarities in terms of the body segment's comfort during floor-sitting are unanimous and noticeable among Malaysians.

6.3 The Theoretical Articulations to the Major Findings

It was understood from the literary signification discussed in Chapter 2 and Chapter 3 that the space or the environmental physics' context streaming from the ergosystems influenced human activities. In coherency to the design oriented research, the sitting behaviour was important in the beginning to be clearly understood in its relationship to the environment and space design significances, because it forms a foundation to the trajectory of the development of product/industrial designs or any operational system designs. The articulation of the five ergonomics science elements functioned as moderating variables to the interaction between the ergosystems and the human [floor-sitting] behaviour. The elements' signification were earlier analysed and navigated by the research questions in justifying the coherency of this research concept and context.

6.3.1 The Physic Signification

Based on the literary significances and observations made within Malaysian homes, the thermoregulation of the subject's body temperature was recognized as the key factor in contributing towards postural behaviour. The subject's compatibly was associated to the environmental physics significance that engaged the interaction of the human [dwellers], machine [objects/the architecture elements], and the ambience of a designed space. Upon observing further into the Malaysian living environment, temperature, and dwelling space design contexts as to where the thermoregulations significances thrived to the fine articulation of body kinesthesia, an instantaneous look at the retrospective of modern Malaysian architecture history was determined to be a prerequisite towards developing a clear comprehension on the whole body animation. Based on the architecture research conducted by Syed Ahmad Iskandar (2001), Lim (1984, 2008), and Mohd Tajuddin et al (2005) the

floor-sitting subject often connected to the construction of the Malay vernacular house. Aside from cultural aspects and having been taught certain sitting positions from infancy, the convergence to the embodiment of the floor-sitting weaved to the magnitude of materiality where, since the 1950s, modernist architecture in Malaysia has reinvigorated the installation of sustainable building materials for housing construction based on the regionalist orientations for thermal comfort replacing timber materials. Wan Hashimah (2005) expounded this relevancy in her writings on the construction of the modern Malaysian homes. Particularly in the 1980s she wrote, Malaysian houses started the use of tinted glass for windows and sliding doors for purposes of replacing clear glass, and by complementing the installation of good insulators such as marble and ceramic floor tiles (Gençoglu, 2007). Wan Hashimah (2005) observed that through the connection of the concept of materials and floor-sitting towards thermal comfort they were proven to be mellifluously coherent. These significances are relatively connected to the propagation of ergonomics within the climatic design of the Malay vernacular house. Also, to the ergonomics of its dwellers that consequently moulds the postural behaviour in relationships to the context of sitting. As a reflection to the nature of tropical conditions, this type of installation has become standard in the majority of modern houses in Malaysia. The nature of cool surfaces can be quite pleasant and comfortable for floor-sitting in order to achieve thermal balance. Philosophically, the building concept and the installation of materials promote both a measure of possession, and surrounding for dwellers. This allows dwellers to integrate their sense of interiority through the manifestation of the body dynamics where the floor is defined as the alternative body resting and sitting mechanism to achieve comfort. It was discovered that through the addition of other materials, various textures and forms, and manipulation and utilization of objects within the environment that a range of varying postural sitting positions were produced.

6.3.2 The Psychology Signification

Based on the survey conducted by this researcher, it was discovered that 78% of the respondents sat on the floor even though there were chairs and sofas installed in their dwellings. Additional findings showed that 58.59% of respondents took the floor-sitting position as a bodily strategy to comfort their lower body parts due to the ample space provided for free postural expressions. This allowed them to experience the cool surface of the floor for optimal thermal comfort. These significances were graphically evident through the demonstration of the sitting expression in which the legs are folded to the side, sitting flexed with one knee up and the other down, sitting with one knee up and the other stretched, and sitting with both legs stretched out. In addition, these sitting postures were not consciously planned, and the dynamics were not unanimously moved in the same patterns as individual comportments are subjective with unpredicted kinaesthesia.

We can relate the body kinaesthesia significances to the articulation of the human sensory system that particularly relating to the senses of touch to which evidenced through the influence of the dwellers' dynamics. While sitting on the floor, the normal demeanour of finding a place to perch was demonstrated to adjust the constrained sitting posture through the dynamics of the said sitting expression, and consequently signified the relevance of *body-image* propagation by the psychologist James J. Gibson (1966) into practice. It stimulates one's imagination to find a comfort zone, and a sensation of feeling at home. The individual sensory experience through the projection of floor-sitting expressions is integrated mellifluously in order to achieve such aim. Objects such as pillows, roll-up futon mattresses, and short stools are examples of the architectural elements or machines in accordance to ergonomics justification, and are utilized by users within the home environment in many inspired ways. The utilization of objects around an individual is often used as a comfort

mechanism. This was shown through the connection of body movements, as well as various body orientations such as; leaning with the legs stretch, laying down, and sitting symmetrical or asymmetrical. Pallasmaa (2005) in his writings states:

> Our bodies and movements are in constant interaction with the environment; the world and the self-inform and redefine each other constantly. The percept of the body and the image of the world turn into one single continuous existential experience; there is no body separate from its domicile is space, and there is no space unrelated to the unconscious image of the perceiving self. The body image …..is performed fundamentally from haptic and orienting experiences early in life. (p. 44)

Our senses form the indicator to constant body interactions within the environment from the coordination of the psychoanalytic thoughts that in addition, work towards the remembrance and imagining of places. The floor locus ignites the sense of dwelling or home, and creates the space satisfaction.

People will generally use what is made available to them; the dweller utilizes the space they occupy due to the need of feeling pleasant, and having a sense of security when attached to the dwelling space. The psychoanalytic thoughts articulate with what this researcher describe as ones' 'space of imagination', where the unused spaces they observe when finding a perching spot was explored and freely expressed through floor-sitting postures. The sitting is repeated voluntarily even though criticism underpins sitting on the floor sitting's ergonomics, as opposed to the standard 45 centimetres above floor-sitting. Again, the issue of comfort sitting was observed as being rather subjective, and there is no exact definition towards comfort. Therefore, another stream of comfort definition was defined at this point of research (de Looze, Kuijt-Evers, & Dieën, 2003; Helander & Zhang, 1997;

Lueder, 2004). For example, the flat surface of low cabinet doors could be used as a backrest, as well as table legs, or even wall surfaces for the same reasons albeit the elements were not intentionally designed for such purposes while sitting on the floor. The designed prototype embodies this coherency (see *Plate 6.1* and *Plate 6.2*), and the space satisfaction was cherished and experienced, even though the individual was not initially seeking such satisfaction.

Plate 6.1. The grain texture shows what this researcher identify as the 'space of imagination' where one normally utilized for perching. [Self-creation].

Plate 6.2. The coloured lining and squares indicates another example of the ‘space of imagination’ that the significance is closely associated to the concept of the unused space where the participant’s sitting periphery signifies the comfort zone for postural expressions. The prototype of the floor-sitting furniture design is based on this coherency. [Self-creation].

6.3.3 The Anatomy and Physiology Significations

Observations are clearly indicated that all subjects habituated to floor-sitting positions posing similar patterns of behaviour, although there were only minor individual differences. Based on the application of the principles showing the body-link concept, the sitting's kinaesthesia was involuntary, continuous, and in constant movement. During floor-sitting, the unused space that encompasses the participants' sitting periphery was extensively utilized. The attitude towards the utilization of the unused space is however, unpredictable due to the subjective human behavioural context that depends on the individual locus. By using the video surveillance technique, uncertainty of to what the sitting postures might be posed individually was ascertained, and came into convergence. The predominant sitting style such as [1] sitting with the knee flexed and one leg stretched [SKX], [2] sitting with one knee up the other down and flexed [S1KU], [3] cross-legged sitting [CLS], [4] sitting with the legs folded to the side [LFS] and [5] sitting with legs stretched out [LS] was established. Such postures were intertwined in different sequences when the body was connected to the floor, and supported by the sections of the surrounding furniture. The sitting postures signified that the definition of comfort in floor-sitting is *mélange*. Sitting with the knee up or flexed poses a much more leisurely body-image. Whereas other such postures indicated the strategy of balancing the open and closed-chain system by releasing leg muscle tension through flexing and stretching the legs regularly. The body kinaesthesia was observed as the response towards the stabilization of the lumbar, thoracic, and cervical muscle activity when sitting on the floor [see *Plate 6.3* for example]; showing the relevancy of the open-chain system within the body-links concept.

Plate 6.3. The utilization of the unused space and the architecture elements to fit the need of achieving comfort sitting. All participants posed similar dynamics and their body-image embodies the ergonomics of stabilization of the lumbar, thoracic and cervical muscle activity to support the natural *S-curvature* [lumbar lordosis and thoracal kyposis] when perching on the floor. [Self-creation].

6.4 The Relevance to Other Research

A strong relationship of the environmental coherency to the phenomenological of the human behaviour was reported in connection with Hewes's (1955) *World Distribution of Certain Postural Habits* that illustrated coherent foundation to the trajectory of this research. With the initial objective of this research being an emphasis on the furniture design context, and the application of the ergonomics science elements to unfold such relationships has clearly been evidenced within technical justification in this research results.

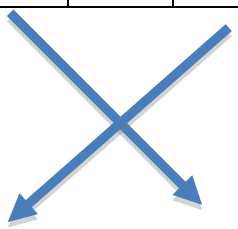
The result of this study shows that the articulation of the ergonomics science elements manifested the embodiment of the floor-sitting behaviour aside the factor of culture. Furthermore, the projections of the floor-sittings' body image, propagated Gibson's (1966) propagation on the incontrovertible interconnection of the body, and the movement through our haptic and body orienting experience. The current study found that, although an individual's postural experience varied, all subjects that habituated to floor-sitting had similar

patterns of behaviour [see *Table 6.3*], which was similarly obtained from Guha's (1979) research in *Body Movements and Muscle Activity In Sitting Cross-Legged*. In parallel to the context of the floor-sitting furniture, the designed prototype varied the users' floor-sitting expressions as the instrument that promoted the interplay of users, and objects within the occupied space. The designed prototype that was based on the local anthropometry repudiates the standards and static anthropometry that is still applied in universal furniture design, especially in Malaysia. The standards are relevant guidelines, that is undeniable, and as mentioned by Dolmjan et.al (2010), that it should be considered only as dimensional recommendations. He added that people do not generally sit with "90° flexion of the hip joint, and a concavity in the small of the back". Another important finding was that the increase of variations between symmetrical and asymmetrical sitting, and lounging postures was due to the prototype design features that allowed free movements. The increasing dynamic of the asymmetrical postures [SKX [○], LS [×] and LS1U [+1, +2] and SqX [+3, +4, +5]] signifies the relevancy of the application of local anthropometry for comfort that fits within the designed floor-sitting furniture. One unanticipated finding was that every piece of the designed prototype supports the participants' postural needs. This ramification is opposed to universal furniture design which promotes constrained posture as the "function and situation are fixed in a single place where the user is certain" (Kim & Choi, 2004).

a. Pilot Analysis

POSTURES/ SITTING BEHAVIOUR	△	□	+	×	○	▽

b. Actual Behaviour Analysis



POSTURES/ SITTING BEHAVIOUR	△	×	+	□	○	▽

Table 6.3. The pilot analysis and actual behaviour analysis table. [Self-creation].

Table 6.3 illustrates frequent dynamics of the floor-sitting behaviour demonstrated by 12 Malaysians in sequence layout. The comparison of findings betwixt the [a] pilot analysis and [b] actual behaviour analysis are illustrated. Note that the patterns of the floor-sitting behaviour from left to right were similar with minor differences in the second and forth point sequence. The differences showed in the red-tagged symbols involve the substitution of predominance component.

Again, this finding is in agreement with Gibson's (1966) theory findings which showed individual psychoanalytic thoughts and the perceptual system mellifluously articulate to such coherency towards the propagation of the body image expression. Through the body link concept demonstrated in the body kinaesthesia, the projected body image is interwoven to create balance through friction in the open-chain system towards achieving sitting comfort. The projection of the CLS, LFS, S1KU, SKX, LS, LS1U and SqX in random sequences illustrates the postural example that articulates the body-link concept. Based on theories propagated in the literatures, the ergonomics science elements such as the physic, psychology, anatomy, physiology, and engineering were verified as the determinant to the whole understanding of the interaction of the body kinaesthesia when immersing into the closed environment. These results pertaining to the sitting postures and behaviour differ from some published studies that relate the office chair sitting design and transportation sitting, as researched by Jurgens (1980), Richards (1980), Van Deursen et. al (2000) and Springer (2009) to name few. They are principally, however, consistent with those of Bhatnager et. al (1985), Fleischer et al. (1987), and Branton and Grayson (1967) where the signification of individual sitting behaviour through the free postural expressions and constant motions in leisure sitting situations are highlighted towards developing furniture design.

It is encouraging to compare that the finding reinvigorated earlier complied postural data by Hewes (1955) where the body image of the sitting that involves alternating the right and left knee up while other leg stretched [LS1U] was an established practice among the studied Malaysians. This result has not previously been described. The reason for this may have something to do with the research method applied and conducted at the time, which may have been constrained by the factor of accessibility to appropriate research instruments resulting in the inability to record postural data. In addition, with this research that was

centred at the floor-sitting furniture design context, the integration of the technical ergonomics signification consolidates further into detail of human behaviour studies, particularly towards the postural aspects. Based on such coherency, a reproduction of the postural typology is successfully constructed in *Plate 6.4*. The plate demonstrates the floor-sitting posture typology in home environment setting. Five discovered sitting postures at the bottom row of the typology were symbolized and coded with + 1 LS1U, + 2 LS1U, and + 3 SqX, + 4 SqX and + 5 SqX.

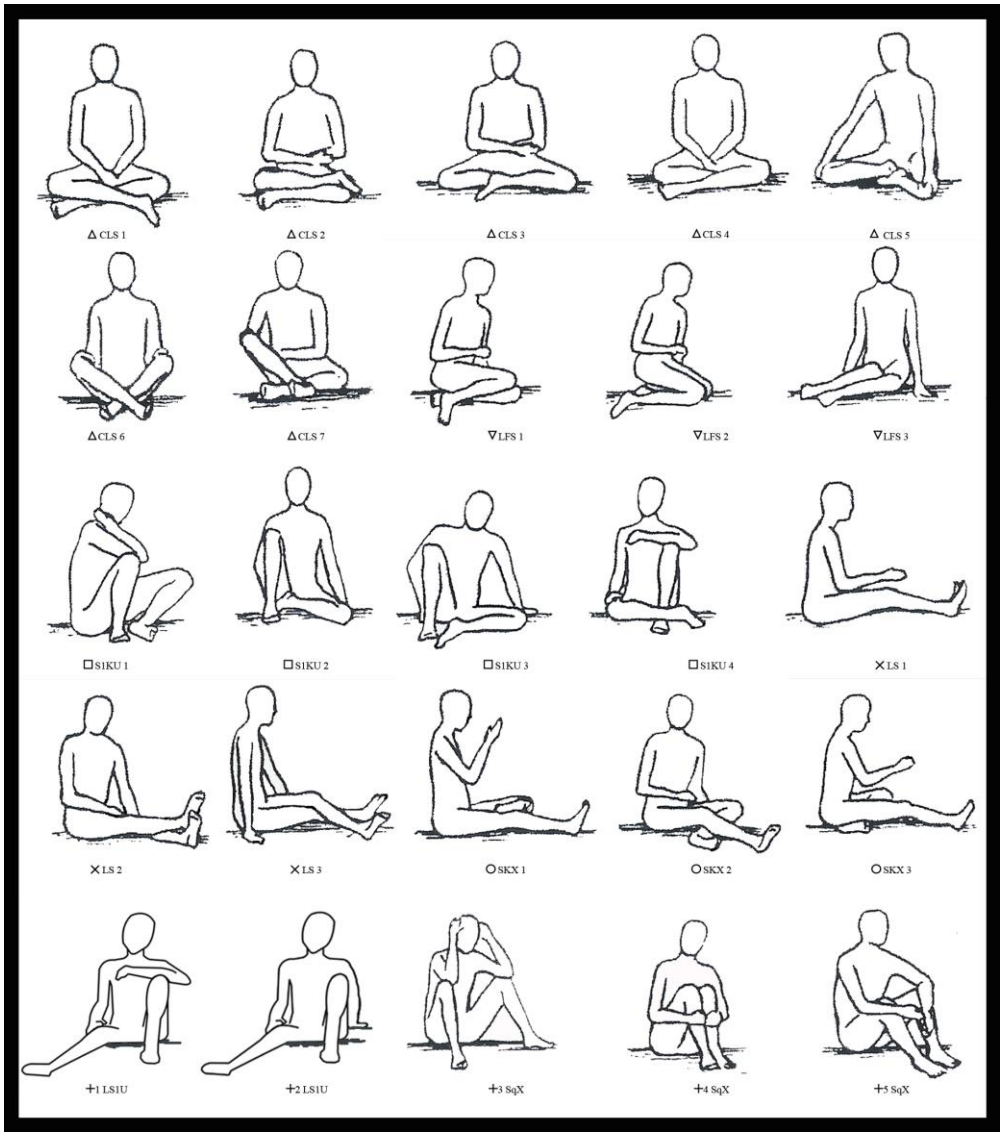


Plate 6.4. The postural typology of the floor-sitting behaviour frequently exercised by Malaysians at home. [Adapted and adjusted to this research context from Hewes (1955)].

6.5 Implications of the Findings

This combination of findings provides some support for the conceptual premise that incorporates:

a. The technical application:

The postural data and the designed prototype appear to support the relevancy of the incorporation of the developed Malaysian anthropometric database into the development of designed objects within the Malaysian user's centric significances. The design of *Lapis* illustrates the various dimensional uses of anthropometry for the Malaysian floor-sitting, in contrast to the sitting dimensional use in developing universal sitting seats that is often engaged to western anthropometry. The consistent development of the Malaysian anthropometric research made by Baba (2009), and Mohamad (2010) at the Universiti Kebangsaan Malaysia, viably demonstrates the threshold to the design exploration within Malaysian context as opposed to theoretical data.

b. The current theory:

The incorporation of the ergonomics science elements illustrates the signification of the ergonomics theory in threefold: [1] Generates the understanding of the phenomenology of the human [floor-sitting] behaviour through the articulation of theories propagated by Gibson (1966), Pallasmaa (2005), and Weinstock (2010) that relevantly indicated a framework of a *scholar-triangle* for investigating the phenomenon [see *Plate 6.7*]. [2] The integration of ergosystems signification established a coherent foundation in diversifying design context. [3] Contribute to the

diversity of scholarly knowledge through the demonstration of theories amalgamation in association to the educational research.

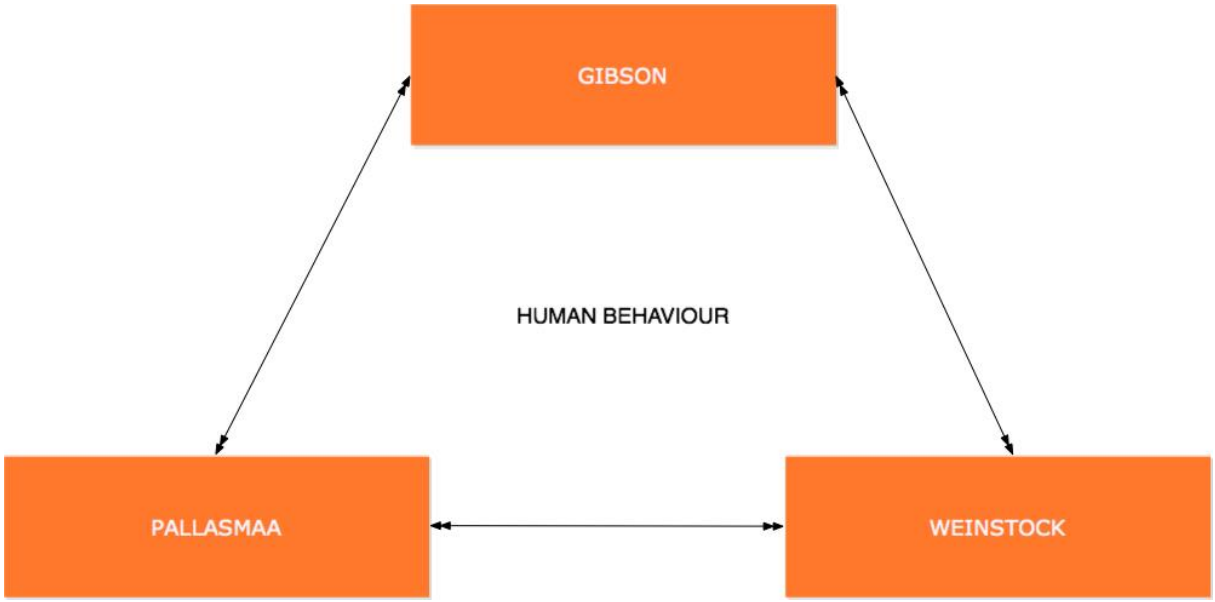


Plate 6.5. The scholar-triangle framework for observing human behaviour. [Self-creation].

c. The professional practice:

With the signification of the design that was demonstrated in this research, it is possible that the findings would suggest potential development in human studies and design extensively within the association of the field of education, design, and anthropology.

6.6 Summary

These findings will undoubtedly have the potential to be explored extensively, but there are some immediate dependable conclusions that establish significant justifications in relationship to this thesis. The findings have [1] embedded the paradigm for researching the human postural [sitting] behaviour based on the synchronization of the ergonomics theories signification connected to the ergosystems. With the application of the ergonomics science elements by this researcher as the moderating variables, the relevancy and establishment of comfort sitting [through the variety projection of postural behaviour] was integrated mellifluously within the justification of physics, physiological, and psychological elements, as well as the distribution of the frequent sitting behaviours that were demonstrated. The floor-sitting such as the CLS, LFS, LS, SKX and S1KU are the sitting postures that are often associated to the study of anthropology, were frequently practiced [2] the scholar-triangle indicated as the determinant mechanism in observing and assessing the phenomenology of the human [sitting] behaviour. [3] With the amalgamation of local anthropometry, it permits the exploration of form design to accommodate the postural needs within the Malaysian user context as opposed to its theoretical propagation on its practical dimensions. The presence of the designed seating prototype signified the creative design coherency with the influence of anthropometrical signification. It also varied the pattern of ‘comfort postures’ through the projection of the sitting behaviours, and increased the frequency of the standard fives sitting postures practiced by Malaysians at home.

Chapter 7.0
CONCLUSION

7.1 Introduction

This chapter discusses the main conclusions of this research by summarizing the work completed in the overview of the study. The chapter also summarises the major findings and the implication to the research conceptual framework. The contribution to knowledge achieved through the amalgamation of the ergonomics and design into the cultural related studies on the floor-sitting behaviour and the future research directions are discussed, followed by the epilogue.

7.2 An Overview of the Study

The theoretical background discussed in Chapter 2 and Chapter 3 provided sufficient ground for this research to amalgamate the technical ergonomics study with the cultural related study of the human floor-sitting behaviour.

The research involves an intensive observational investigation of the relationships of the ergonomics science elements within the foundation of the ergonomics ergosystems to the embodiment of the floor-sitting behaviour. The coherency of the theories to these ergonomics elements were adopted, integrated, and fit within this research context necessitating the Malaysian dwellers in the modern dwelling space. In response to the research objectives and the rose research questions, the research work involved a video investigation, the analysis of theories and philosophies connecting to the floor-sitting practice, ergonomic of space and the

behavioural synchronizations, and the coherencies of seating design signification complementing the sitting practice were carried out. The most significant task of this research was to present the collection of recorded videos, along with the pictorial and graphical information collected of the fifteen selected participants' individual postural data in the most systematic and articulate manner possible. With the completion of the data summary, the task of interpreting the data and drawing out the findings from them was carried out. The obtained findings highlight the most significant floor-sitting postures that are frequently practiced within the perimeter of a home environment with a compilation of updated postural data based on the Malaysian dwelling practice as opposed to the postural distribution documented in 1955. The construction of the floor-sitting furniture prototype assembles the function based on the human sitting behaviour characteristics from the articulation of the discussed ergonomics elements. The research design is structured mainly by the combination of research questions, a pilot study, pilot analysis, and actual behaviour analysis steering the process and research activities on the track to the intended direction.

7.3 Major Findings and the Implication to the Research Conceptual Framework

The present study was designed to determine the Malaysian floor-sitting behaviour within the perimeter of a home environment in synchronization for the development of the floor-seating design. The articulations of the ergonomics ergosystems as foundation of the human-machine [objects] interactions within the environment have steered into the establishment of the major findings on the frequent floor-sitting practiced, and the postural relationships to the designed floor-sitting furniture. These have consequently illustrated the links and accomplishments of

the outlined research objectives. The evidence from this study suggests that the amalgamation of technical ergonomics significations into the cultural related study for the development of design-oriented research is viable. The study has gone slightly towards enhancing our understanding of the embodiment of the floor-sitting behaviour within the ergonomics perspectives at which the theoretical justification applied within this research has established the fine line between the cultural and technical ergonomics signification. Although the current study is based on a small sample of participants, the findings have demonstrated a decisive coherency of the applied technical theories connecting to the ergonomics science elements' signification, that is strongly articulated to the triangular link of Gibson (1966), Pallasmaa (2005), and Weinstock (2010) epistemological manifestation. This relevance has subsequently demonstrated the capability of extensive exploration within the human sitting behaviour study for design context.

Although the study has successfully demonstrated the amalgamation of cultural related studies into the ergonomics signification with the outcome of the findings, the study has nevertheless established certain limitations in terms of the coverage of research groups at which this significance was not fully covered within this thesis. In addition, with the establishment of the theoretical link elucidated above, the sitting behaviour observation scope has the potential to be examined extensively within further biomechanical studies including, comfort and discomfort posture justification. These relevancies will be further elaborated upon in the next Future Research Directions point.

7.4 Contribution To Knowledge

This research provides an explanation of the articulation of the ergonomics science elements' characteristics to the embodiment of the floor-sitting behaviours, and the connection to the context of seating design. It is hoped that the explanation given of the ergonomics relevancies could provide a larger spectrum to the body of knowledge, and lead to further investigations based on the integration of cross-disciplinary studies into other cultural behaviour related studies. Furthermore, the studies presented here can hopefully help:

a. Recommend future designer and furniture manufacturer with the new sitting style of floor-sitting typology. Hence this data can be applied for future furniture design works. The floor-sitting typology is compiled in Plate 6.6.
b. Model the development of culture-linked research through the integration of the philosophical and technical context of human behaviour, and other cross-disciplinary studies into future design research.
c. Setting a foundation for Malaysian researchers among the ethnographers to further research the postural behaviour subject extensively.

In compliant to this, the amalgamations of cross-disciplinary studies taken into account of this research demonstrates the clear methodologies, and exploration of key concepts to the process of design and postural studies that conceivably contribute to the benefit of researchers and educators at the academia level.

7.5 Future Research Directions

It is acknowledged that it is impossible for this research to cover every single aspect of postural behaviour studies, and the design work as the two subjects cover a wide spectrum of potential research areas to be developed. In relation to this research context and findings, the potential could be the extension of this study and the manipulation of sitting behaviour concept to be put forth for further exploration, or in setting up a new influent of research based on the application of similar methodologies:

a. The floor-sitting subject has the capacity to expand its research width by researching the local aborigines, or the *Orang Asli* postural behaviour. The Orang Asli hold a variety of occupations, and practice a unique way of life. For example, the *Temuan, Jakun* and *Semai* people live in forested areas influencing their involvement in agriculture; the *Orang Laut* and *Mah Meri* live near the coastal areas connecting them to fishery. These are the examples of the activities that mould postural behaviour at different contexts of practice, and these properties could be explored and documented for new information and knowledge.

b. With the vast development of current design, the issue concerning style, varieties of production technology and materials involved, opens the direction for the sitting behaviour concept to evolve simultaneously with the universal sitting movements. By intensively investigating further into the biomechanical relationships those being: the comfort and discomfort posture significations compared to form-design, the expanding the measurements of the Malaysian anthropometry, and synchronizing the material science coherency, these connections can potentially create alternative dimensions of

design solutions that could benefit future researchers in the design and production field.

c. It might also be possible to apply same methodology to uncover other cultures in other regions postural behaviour.

7.6 Epilogue

The articulation of the ergonomics and design subjects unfolds a prismatic range of knowledge underlined within the platform of cultural behaviour research. Hopefully, it connects to the subjects understanding comprehensively, through what this thesis has furnished. The cultural behaviour subject should thrive by becoming the foundation, as there is potential to launch from its niche that would contribute and benefit other areas such as: industrial engineering, industrial design, spatial design, and even phylogenetics. The richness of cultural behaviour research should not be neglected, and if it is the cultural knowledge influence is sparse. This thesis embodies that concern; meaning that the outcome could reinvigorate the knowledge and the study of the cultural behaviour.

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