LAWI AYAM : AESTHETIC EXPERIENCE AND DESIGN-USER SYSTEM ASSESMENT OF A MALAY WEAPON ARTEFACT

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INSTITUTE OF GRADUATE STUDIES
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ABSTRACT

There is a need of Malay cultural product knowledge preservation for establishing the product design development in the new culture environment. Although many researches on Malay cultural artefacts in Malaysia, none of these documents has extensive information on susta inable user aesthetic experience knowledge. In fact, much documentation lingers on certain popular artefacts that typically known in Malay cultural design environment. Consequently, narrow understanding in local designers on Malay applied artefact due no rigorous research and limited documentation employing the design and the human science in user experience. This research shows that this knowledge comprehension can be expanded to higher level in both contexts of tangible and intangible for a new paradigm of Malay cultural product design. The purpose of this study is to systematize design-user interrelationship through aesthetic experience assessment on Malay *Lawi Ayam* (LA) artefact as a case study for establishing the Malay cultural product design knowledge. This study employed literature review and analytical observation on Malay *Lawi Ayam* weapon to document the characteristic of physical design and intangible knowledge for syntactic analysis. Then, this study conducted full participant observation and semi-structured interview to comprehend the aesthetic experience (AE) of the weapon user through pragmatic analysis and artefact usability evaluation. Finally, the study further undertook eye tracking test to investigate the eye behavioural responses and cognitive feedback in user pre-existent AE experience towards Malay *Lawi Ayam* design evaluation to amalgamate the knowledge between the artefact context (syntactic dimension) and the user context (pragmatic dimension). Drawing on Petersen's methodology (2004) and Locher's approach (2010) in relation to aesthetic interaction, the findings from the data analysis would include the; 1) design characteristic (physical and non-physical) and artefact terminology as factor that affects artefact effectiveness, 2) pragmatic knowledge and artefact usability of

Malay *Lawi Ayam* user to understand the artefact usage through the body movement efficiency, and 3) cognitive knowledge from eye tracking evaluation to support the understanding of users' eye behaviour on artefact design preference. These result expected to be a pioneer approach for Malay cultural product (MCD) knowledge preservation to assist the development of design in a new environment purposes. This research will present the literature on Malay *Lawi Ayam*, Aesthetic Experience, and design-user interaction. Then, the research methodology describes a comprehensive data acquisition strategy before presenting the expected results. This study contributes in; 1) Artefact classification knowledge of Malay *Lawi Ayam* from the comprehension on design characteristic, terminology and intangible knowledge (design philosophy), 2) Aesthetic experience knowledge through the understanding of artefact typology of Malay *Lawi Ayam* and user physical behaviour (movement) by integrating the syntactic findings into the pragmatic analysis, and 3) the development of a design-user interrelationship system (DUs) with the implementation of Malay design knowledge from artefact classification and artefact user's aesthetic experience using technology of eye movement test. Findings from this study benefits the product designers, behavioural researchers and ethnographers for the field of design and the cultural artefact research relating to design-driven and cognitive-driven to provide holistic understanding for Malay cultural design (MCD).

ABSTRAK

Pelestarian terhadap pengetahuan produk kebudayaan Melayu adalah amat perlu bagi memantapkan pembangunan reka bentuk produk dalam era budaya baharu. Walau pun banyak kajian mengenai artifak budaya Melayu di Malaysia, namun tiada informasi yang terperinci tentang pengetahuan mampan pengalaman estetik penggunanya. Malah, kebanyakan dokumenstasi sering menjurus kepada konteks tertentu artifak popular yang sudah begitu lazim dalam kebudayaan Melayu. Akibatnya, pereka tempatan mempunyai pemahaman yang rendah tentang artifak gunaan Melayu kerana kurangnya kajian rapi yang mengambil kira reka bentuk dan sains manusia dalam pengalaman pengguna. Kajian ini memaparkan pemahaman pengetahuan tersebut boleh dikembangkan ke peringkat yang tinggi dari segi ilmu aset ketara dan juga tidak ketara untuk diberi paradigma baharu dalam konteks reka bentuk produk budaya Melayu. Tujuan kajian ini adalah untuk membangunkan sistem reka bentuk-pengguna melalui penilaian terhadap pengalaman estetik pada artifak senjata Melayu bagi memantapkan pengetahuan reka bentuk produk budaya Melayu dengan artifak Lawi Ayam sebagai kajian kes. Kajian ini menggunakan kajian literatur dan pemerhatian analitikal pada artifak LA Melayu untuk mendokumentasi karakteristik fizikal reka bentuk dan ilmu tersirat untuk analisis sintaktik. Seterusnya, pemerhatian penuh dan temu bual separa-berstruktur digunakan untuk memahami pengalaman estetik pengguna LA melalui analisis pragmatik dan evaluasi kebolehgunaan artifak. Akhir sekali, kajian ini menggunakan ujian pengesanan mata bagi menyelidik respon tingkah laku mata dan kognitif melalui pengalaman estetik pra-wujud oleh pengguna ketika mengevaluasi reka bentuk artifak LA dengan gabungan dua pengetahuan oleh konteks artifak LA (pengukuran sintaktik) dan konteks pengguna (pengukuran pragmatik). Berdasarkan metodologi Petersen et. al (2004) dan pendekatan Locher et al. (2010) berkaitan interaksi estetik, hasil dapatan dari analisis

membincangkan tentang; 1) karakteristik reka bentuk (fizikal dan non-fizikal) dan terminologi artifak yang mampu menjadi faktor kepada kadar keefektifan pengunaan LA, 2) pengetahuan pragmatik dan kebolehgunaan artifak dalam pengalaman pengguna LA membantu untuk memahami kelakuan pengguna ketika penggunaan artifak melalui kecekapan gerak tubuh badan, dan 3) pengetahuan kognitif dari evaluasi pengesanan mata terhadap artifak bagi memahami kelakuan mata pengguna berdasarkan pilihan utama reka bentuknya. Semua hasil dapatan ini dijangka dapat memantapkan sistem reka bentuk-pengguna sebagai perintis dalam pelestarian pengetahuan produk budaya Melayu bagi membantu pembangunan reka bentuk dalam keperluan persekitaran yang baru. Literatur kajian ini merangkumi hal artifak senjata Melayu iaitu Lawi Ayam, pengalaman estetik dan interaksi reka bentuk-pengguna. Penerangan metodologi kajian yang terperinci dibuat untuk memastikan pemerolehan data adalah komprehensif sebelum data bakal dibentangkan. Kajian ini mampu menyumbang dalam; 1) Ilmu pengklasifikasian artifak LA Melayu dari pefahaman jitu tentang karakteristik reka bentuk, terminologi dan pengetahuan tersirat (falsafah reka bentuk), 2) Ilmu pengalaman estetik berdasarkan pemahaman terhadap tipologi artifak LA Melayu dan gerak tubuh pengguna dengan integrasi hasil dapatan sintaktik artifak ke dalam analisis pragmatik, dan 3) pembangunan sistem hubung kait reka bentuk-pengguna (DUs) dengan implimentasi ilmu reka bentuk Melayu dari pengklasifikasian artifak dan pengalaman estetik pengguna artifak dengan penggunaan teknologi ujian pergerakan mata terhadap artifak. Ia memberi faedah kepada para pereka produk, penyelidik tingkah laku dan ahli etnografi untuk bidang reka bentuk dan bidang penyelidikan artifak budaya yang dipacukan oleh reka bentuk dan pengetahuan kognitif bagi menyediakan pemahaman yang holistik untuk reka bentuk budaya Melayu (MCD).

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LIST OF SYMBOLS AND ABBREVIATIONS

For example:

AE	:	Aesthetic experience
LA	:	Malay weapon artefact of *Lawi Ayam*
DUs	:	Design-User system
MCD	:	Malay culture design
SPSS	:	Statistical package for social science
AI	:	Aesthetic interaction
RQ	:	Research question
RO	:	Research objective
TP	:	Theoretical proposition
POD	:	Point of departure
CM	:	Compound Movement
ART	:	Artefact typoplogy and philosophy
ACT	:	Action technique and philosophy
RiMV	:	Reaction movement
HCI	:	Human Computer Interaction

Additional:

LA usage philosophy	:	(Page 161-162)
Codes of technique typology	:	(Page 177)
Codes of components in inherent information	:	(Page 186 -187)

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The understanding of user's motor skill or user behaviour in product interaction is dependent upon the basic reference implementation of a well-designed and an ergonomic product. Studies on user experience have gradually evolved from isolated topic in the process of designing to vantage point of intangible design understanding. Likewise, much has been written concerning the factors that contribute to the understanding of aesthetic experience in a user-product interaction. These factors have triggered challenges on how aesthetic experience in product interactions is measured. Therefore, in order to understand the aesthetic experience, clarification of the controversial measurement in the user and design discussions is necessary to enhance understanding, acceptance, positioning and use of a product by addressing the challenges in cultural aspects.

One of the clear challenges is to carry out research to develop improved models of interrelationship between the user and the product to add into the process of designing. Laurans et al. (2009) have identified several issues concerning the measurement of user experience such as finding appropriate ways to study aesthetic feeling and emotion experienced during product interaction. He also highlighted how to measure the reaction on product appearance and sensory experience.

However, little research has been done to integrate the behavioural action input and psychological part of ergonomics in such a way that can relate to the higher-level aspects of the user-product system. The picture is still vague due to uncertain understanding of the actual concept of user body movement and the artefact

information. In fact, the distinction of user body factor actively involved in both intellectual and physically dimension should not be posited as an outer role. Thus, it is vital to explore the science behind the human knowledge on aesthetic value to address the lack of design information involving the user of the artefact.

1.2 Research Background

This section provides the general definition and fundamental understanding of aesthetic experience. It discusses the case study of artefact traditional Malay *Lawi Ayam*, the purposes of the local knowledge preservation and how the tangible and tacit knowledge serve as medium for today's contemporary culture environment. It also explains the issues of selected artefact to justify its importance in the development of cultural knowledge.

1.2.1 Aesthetic Experience the traditional artefact

Aesthetic experience knowledge obtained from the analytical research of traditional artefact that is culturally invented could upgrade the design quality of the local cultural concept. To explore this theme further, the researcher returns to the topic of action and bridge it in relation with user experience. Actions in user experience are seen as an important accumulative physical communication with the artefact used. Margolin (1997) emphasised that one of the factors to locating accumulative action of user experience is the acknowledgement of important product information (origin). Meanwhile, the product information leads to focus on product use rather than just concentrating on the form or appearance. Stacey and Eckert (1999) propose that incorporation of appropriate usability procedures in creative exploration has to be from the artefact itself.

Previous researchers inspired this study to focus on traditional artefact or anthropological product inducing several measurements such as physical anthropology

(body dimensions and physical strength), cultural anthropology (value systems) and cognition (Aschraft, 2002; Wisner, 2004). The link between these anthropological approaches to the ergonomic analysis has to be acknowledged as another option in a pragmatic study. Lack of knowledge on design artefact interactions instigated this study to make further assessment based on two contexts which are behavioural study and ergonomic technology. These two contexts provide deeper insights on the essential characteristic of what they portray in the behaviour of interaction, which requires a reciprocal human-product interaction.

Hence, this study attempts to fill the knowledge gap on aesthetic experience from a useful and first-hand data source of an indigenous invention such as traditional artefact. Therefore, preservation of practical technology and expansion of artefact usability could support data mining for designers and stakeholder who are involved in a cultural product design development. However, this study has found that most prior researchers gave a special focus on more popular Malay artefacts such as *keris* in terms of physical information (design) and fabrication (Gardner, 1936; Wooley, 1998; Zakaria, 2007; Khamis et al., 2013), whereby there are a lot more artefacts to study at various points of user and artefact interaction. For instance, the Malay traditional weapons are categorized to three types according to use such as weapons for thrusting, weapons for slashing and weapons that are meant to be hidden, and they interrelate to user factor. However, weapons in hidden category were less discussed. Therefore, this study selected *Lawi Ayam* (Figure 1.1), a weapon artefact from the Malay hidden weaponry list as a case study to provide complete understanding of the three contexts:

i. Artefact context including the artefact terminology, type classification, the design characteristic, design philosophy and affecting factors of artefact effectiveness,
ii. Artefact typology, usage effectiveness and movement efficiency, and

iii. Person context; the involvement of physical and cognitive factor in user behaviour.

The detailed literature on *Lawi Ayam* is presented in Chapter 2.

Figure 1.1: Traditional Malay *Lawi Ayam* weapon artefact. (Source: Siti Mastura, 2014)

1.2.2 Justification of *Lawi Ayam* artefact as a focus of study

A preliminary overview of Malay artefacts has led to the identification of several reasons to choose *Lawi Ayam* as a pioneering research topic for Malay user knowledge and these are:

i. Written information and sources are sparsely available from the late nineteenth century. Most of the records are done by colonial administrators and further on by western students of Malay culture who made an incomplete documentation of the various valuable information of the Malay weaponry system (Che Husna, 2000).

ii. A stereotype data of the *Lawi Ayam* cause ambiguity in the knowledge of artefact classification, terminology and pragmatic understanding of the artefact effectiveness, user movement and behaviour and the usage efficiency. (Che Husna, 2000; Hill, 1956; Wan Mohd Dasuki, preliminary interview, January 12, 2012; Wan Yusmar, preliminary interview, January 13, 2013; Siti Mastura, 2013a).

iii. Limited discussion on the analytical detail (size, form, ornamentation) and the intangible knowledge (philosophy and tacit knowledge) has caused difficulty to justify the proper terminology for *Lawi Ayam* by the younger generation of blacksmiths (*pandai besi*[1]).

iv. The preserved knowledge on the important aspects of *Lawi Ayam* design and usage seems to be disappearing among the new generation of Malaysians. Therefore, Eco-tourism and creative industry should put more effort to promote interesting information of almost forgotten artefacts such as *Lawi Ayam* in the context of Malay local culture and technology.

Given the reasons above, the researcher undertook a rigorous literature review to identify the body of knowledge on the topic of research. As the researcher has found limited literature on Malay *Lawi Ayam,* the available literature has not critically investigated scientific information. This led to a preliminary search to establish the research problem and objectives by having in-depth discussion, interview and personal observation with identified expert and informants which are the researchers, the users and the blacksmiths.

Therefore, this study conducted an ethnographic research with close communication with Wan Yusmar Mat Yusof @ Wan Yusof (starting from 13th January 2013 until 29th April 2014). He is a *Lawi Ayam* and *Kerambit* expert user and also a Malaysian *silat* master (*Silat Tuo, Silat Kuntuo, Silat Harimau Berantai, Silat Tongkat*). He stated that the interaction between a user and a specific artefact such as Malay *Lawi Ayam* weapon elicits an entire set of effects of operational setting and the user action that causes the behavioural reactions, the expressive reactions and the physiological reactions.

[1] A Malay blacksmith who expert in metal works.

Wan Yusmar agreed that the lack of documentation on Malay *Lawi Ayam* artefact has been lowering various aspects of information on both extrinsic and intrinsic knowledge. He believes the local artefacts have a great potential to elicit and enable a new paradigm for cultural product. Extrinsic knowledge of Malay *Lawi Ayam* covers the context of artefact and user such as design features, terminology, artefact usage, technique used and body movement. Meanwhile, the intrinsic knowledge of the Malay *Lawi Ayam* includes the artefact philosophy, the movement philosophy, the analogic thinking and the concept of design. These potential intrinsic issues benefit concerned stakeholders (designers, behavioural researchers and ethnographers).

Rigorous discussion with the key informant, Wan Yusmar led to the meeting of several more martial artists and informants to understand the issue arising from the artefact and weaponry system documentation. They are associated with various organisations such as universities, *silat* schools and cultural organisation. The artefact users also gathered at the same time which resulted in a group discussion revealing the issues faced during the artefact usage. Meanwhile, the blacksmiths introduced to the researcher contributed crucial undocumented information. Also, the preliminary fieldwork conducted helped the researcher to identify various locations for further ethnographic fieldwork.

1.3 Problem Statement

According to the literature and the preliminary interviews with the gatekeeper Wan Yusmar Wan Yusof (expert user and *silat* master), the researcher identified three componential problems as follows:-

i. There is no extensive documentation on Malaysia's sustainable development of aesthetic experience information that materialises local creative thinking based on a cultural product. On the other hand, western researchers who have extensively

studied this scope of user knowledge believed that the aesthetic experience system could bring benefits to certain local design productivity (Petersen et al., 2004; Dewey, 1934; Shusterman, 2000; Desmet & Hekkert, 2007; Wright et al., 2008). Therefore, there is a demand to have specific research on the convergence of artefact design and user interaction through aesthetic experience assessment to bridge the main components of psychomotor, user cognition, product usability and social value.

ii. There is a narrow understanding of user aesthetic experience towards Malay cultural artefacts that are supposedly sustained by local designers' creative thinking. Due to the limited documentation of our own local source, these local designers tend to depend on the style and identity established by foreign culture (Syed Ahmad, 1979; Zakaria, 1984) such as Baroque, Post-Modernism, Modern, Minimalism, Scandinavian, and etcetera. The same concern was expressed by previous scholars to improve the understanding of design innovation though particular interest in design history (Heskett, 1988; Margolin, 1992).

iii. There has been no rigorous research done on the topic of aesthetic experience employing a user experience on artefact design converged with Malay human science. Based on the preliminary interviews conducted, the informant highlighted that most of the written works are repeated without detailed discussion on tangible artefact inquiry, user state of mind and the user behavioural evidence, (Wan Mohd Dasuki, personal communication, January 12, 2012; Razak, personal communication, December 20, 2012; Wan Yusmar, personal communication, January 13, 2013). Hence, a proper pragmatic study is important to understand the adaptation of scientific knowledge in every unique relation between user and design.

Therefore, by staying close to the identified issues above, the researcher proposes that there is a need for Malay cultural product knowledge preservation for establishing the product development in the new culture environment. The statement of the problem led the researcher to set a plan to document all the erudition of the design characteristics and intangible knowledge of traditional Malay hand combat artefact, analogical thinking, user behaviour and perceptual-motor skill to create a complete behavioural ergonomic database. Hence, this research took the traditional Malay *Lawi Ayam* weapon artefact as the unit of analysis from the vantage point of the user experience perspective to document the user knowledge in the context of product usability and behavioural ergonomic. This effort to fill up the gap of user cultural knowledge and design information to systematise a design-user system.

Previous studies raised the issue of the limited documentation of Malay cultural product, which could contribute to discontinuity of knowledge comprehension (Wan Hashim and Jasmin, 1991; Wan Ramli, 1990; Che Husna, 1997, Che Husna, 2000; Mohd Zainuddin & Mohd Sharim, 2007). The potential knowledge can be expanded to a higher level through tangible and intangible approaches to develop a new paradigm for Malay cultural design. The study focused on observing the artefact and user behaviour aspect. The data analysed and developed a system to benefit the bodies of knowledge. Further discussions are in Chapter 2.

The specific abbreviations to signify the bodies of knowledge in this thesis will be written in keywords in the following Table 1.1 below:

Table 1.1: Abbreviations of bodies of knowledge

Bodies of Knowledge	Keyword
aesthetic experience	AE
Malay weapon artefact, *Lawi Ayam*	LA
design-user system	DUs
Malay culture design	MCD

1.4 Research Questions

The main research question and four sub-research questions formulated to achieve the objectives are:

Main Research Question:

How can the Malay *Lawi Ayam* (LA) weapon artefact systematize design-user system (DUs) for establishing Malay culture design (MCD) through aesthetic experience (AE) assessment?

i. Sub-RQ1:

What are the design characteristic of Malay *Lawi Ayam* through analytical assessment of syntactic dimension?

The study will capture data on design characteristic and intangible information (artefact philosophies) of Malay *Lawi Ayam* during the analytical assessment of syntactic dimension. It can also enhance the understanding on how the artefact is

composed (physical characteristic) in terms of structure, component details and respective material and, functional relationship. (See Chapter 4)

ii. Sub-RQ2:

What are the aesthetic experience dimensions of Malay *Lawi Ayam* usable for the development of design-user system?

The study will focus on comprehending the aesthetic experience knowledge of Malay *Lawi Ayam* user involving the artefact typology, usage effectiveness and physical movement of psychomotor skills (ability to learn and demonstrate manual dexterity; skilfulness in the use of hands or body using pragmatic analysis. An answer to this question could contribute to the crucial understanding of how aesthetic experience is involved when the user perceives the Malay *Lawi Ayam* design while he is using it. Artefact usability experience was observed to determine the content of intangible knowledge (philosophies of movement and usage) to integrate with the knowledge in artefact classification (RO1). The data were collected based on full participant observation (verbal descriptions gathered through the in-depth semi-structured interview). (See Chapter 5)

iii. Sub-RQ3:

How can the artefact design information and the user aesthetic experience of Malay *Lawi Ayam* be used to systematize design-user interrelationship for Malay culture design?

The study will amalgamate the knowledge between physical information of Malay *Lawi Ayam* from RO1 and the aesthetic experience knowledge of user

psychomotor skills from RO2 to investigate the user cognitive feedback towards artefact design evaluation through eye tracking technology. A set of artefact images was used as stimuli to obtain the participant behavioural responses based on their pre-existent experience or cultural memory of Malay *Lawi Ayam*. Meanwhile, the recorded data in eye-tracking test using the eye fixation (duration and count), empirical data of time to first fixation, heat map visualization and retrospective think aloud with eye tracking (RTE) on Malay *Lawi Ayam* images were used for syntactic analysis. Also, the knowledge gained in this section is the third component in triangulation process to validate some of the findings from RO1 and RO2. (See Chapter 6)

iv. Sub-RQ4:

How can Malay culture design benefit from design-user interrelationship guideline developed from Malay aesthetic experience knowledge?

The study will establish the design-user interrelationship guideline application to pioneer the development of tacit knowledge and behavioural ergonomic knowledge for the design community in the new culture environment. This sub-RQ is accomplished when the researcher has experienced such understanding from mutual observations and testing experience. Therefore, it would suffice to cover this aspect when discussing the problem statement. (See Chapter 7)

1.5 Research Objectives

The goal of this study is to obtain an understanding of the design information and user experience toward the subject of study. The following study objectives were necessary to achieve the research goals:

i. To document the design characteristic and intangible information of Malay *Lawi Ayam* during the analytical assessment of syntactic dimension.

ii. To analyse the aesthetic experience of Malay *Lawi Ayam* user through pragmatic analysis for the development of design-user interrelationship knowledge.

iii. To recommend the usage of artefact design information and user aesthetic experience of Malay *Lawi Ayam* to systematise a design-user system for Malay culture design.

iv. To establish the application of design-user system in Malay culture design as a pioneering approach to establish cultural product development in the new culture environment.

1.6 Limitation of study

A review of the literature shows that information concerning the details of artefact terminology, artefact classification, artefact typology and usage effectiveness is limited. Margolin (1992) supports that contemporary situation must consider any design with powerful theme related to specific history to organize product information. It is also found that aesthetic experience relating to local architecture invention such as functional traditional invention is less discussed particularly in the person context. By the same token, Locher et al. (2010) provide clear direction on how to understand information processing between the personal context and the artefact context to build dynamic interaction in aesthetic experience.

In this research context, the researcher argued that the previous finding in Malaysian literatures lacks focus on creative thinking and the socio-cultural background of the Malay design inspiration. The focus should cover the elicitation of tacit knowledge and aesthetic interaction while creating and using a functional artefact. This contention

supported by Hekkert and Schifferstein (2008) and Dewey (1934) suggests that the development of skills and expertise are defined in relation to an outside world through the interaction with their surrounding environment. The increasing demand for the interaction knowledge development occurs in the internal assimilation of usage and design when people accept things such as utensils that enter their domestic setting. Therefore, this research is limited to:-

i. The analytical dimensions to analyse how the artefact was composed in terms syntactical characteristic such as structure, component details, respective materials and functional relationship to understand the effectiveness of the design.

ii. The chosen Malay *Lawi Ayam* samples from the users' and makers' collections (*silat* practitioner) are to understand the close connection in terms of usage between the user and each artefact. A selection of artefact samples is based on prominent variables such as design criteria, version and syntactical quality. However, this study considers the Museum samples as a general reference.

iii. The identified Malay *Lawi Ayam* samples in classification process used as a pictorial stimulus for eye tracking lab testing (see Chapter 3).

iv. The Malay *Lawi Ayam* users (experts) were selected according to the variables such as achievement, background, skill and experience. The context of use based on one to one close hand combat during training and demonstration.

v. The observation of user movement, how the artefact functions and how it is used constitute the analysis of pragmatic dimensions. It includes a study of the action and reaction, functions of techniques and ergonomic rapport.

vi. Active participant observation conducted with the informants who are closely involved in Malay *Lawi Ayam* artefact practices; 1) Gatekeeper (*silat* and Malay

weapon master), 2) LA artefact blacksmiths, 3) Expert users (identified *silat* guru or master).

vii. Due to the establishment of local Malay *Lawi Ayam* design development and local user as main knowledge resource, the overview of historical analysis is limited to related documents only.

viii. As this research gathered mostly qualitative data, the use of statistical analysis software (SPSS) is insignificant. However, empirical results in eye tracking test projected as descriptive statistical data using mean score, frequencies and percentage. This study also presents the descriptive analyses of behavioural data of Malay *Lawi Ayam* cultural artefact.

1.7 Significance of Study

The previous researchers have found that cultural artefact and users experience are significant as the central unit of analysis for studying human activity in cultural settings, (Dewey, 1934; Shusterman, 2000; Parrish, 2008). Nevertheless, the scholars have not been discussing the narrower components such as cognition, behaviour or physical activity. Therefore, this research attempted to identify this useful tacit information to form a system for Malay culture design industry by putting in a plan for the understanding of Malay cultural invention to pioneering the establishment of design guideline (culture concept) with revitalised method, particularly in Malaysia.

This research is also significant in the understanding of user pragmatic knowledge through the physical aesthetic experience, the descriptive data analysis and the user value translation of the Malay innovation to a prestigious level such as body movement in *silat* martial art. Also, syntactic analysis and pragmatic analysis are applicable methods to converge both main topics of artefact design and user (Petersen et al., 2000; Hekkert & Schifferstein, 2008; Locher et al., 2010). Relatively, documenting significant

erudition of Malay descriptive knowledge is useful for the current design environment, but there is still a lack of empirical evidence that can help product designer and other stakeholders have a better understanding of user experience and the artefact. Therefore, an empirical evidence of tacit knowledge must be captured to support the matched pattern that will be found in final validation process.

This research does not only benefit the design community (product designers, design student, behavioural researchers and ethnographers) but will also assist to capture and appreciate the usefulness of the tacit knowledge. Also, the study will further develop new ideas without excluding the innovative traditional idea by the locals. Therefore, this study targets to sustain and to systematise the identity of cultural product design to educate the design community to be more culture sensitive. Also, it will equip their designing skills with high critical thinking based on local knowledge in future design challenges. Simultaneously, it would complement the previous studies to expand the functional aesthetic knowledge and indigenous technology of the Malay studies.

1.8 Research process

The Eagle table in Figure 1.2 was used to set up combined information of the research sub-questions (Sub-RQs), research objectives, strategies of enquiry, expected output and knowledge contributions after the identification of research questions' constructs. According to Ibrahim (2011), the Eagle Table form is a visualization tool for providing a quick overview of a study. Therefore, the researcher has established each construct in the research inquiry which is useful for directing her preliminary literature surveys.

Main Research Question: How can the Malay Lawi Ayam (LA) weapon artefact systematize design-user system (DUs) for establishing Malay culture design (MCD) through aesthetic experience (AE) assessment?				
	DESCRIPTION OF SUB-RQ	**STRATEGY OF INQUIRY**	**EXPECTED OUTPUT**	**EXPECTED KNOWLEDGE CONRIBUTION**
WHAT1 **Malay weapon artefact, *Lawi Ayam* (LA)**	Sub-RQ1: What are the design characteristic of Malay Lawi Ayam weapon artefact through analytical assessment of syntactic dimension? RO1: To document the design characteristic and intangible information of Malay Lawi Ayam weapon artefact during the analytical assessment of syntactic dimension.	L/R	LITERATURE ANALYSIS & ANALYTICAL ANALYSIS Output 1: Documented data of physical feature (syntactic dimension), non-physical feature of philosophies and design concept to build the product classification and to structuring user knowledge (RO2).	Knowledge 1: Theories of artefact classification for traditional Malay LA artefact (a determined term and design criteria) elicited from artefact knowledge comprehension, design characteristic capacities and the understanding of design philosophy through syntactic understanding and intangible knowledge.
WHAT2 **Aesthetic Experience (AE)**	Sub-RQ2: What are the aesthetic experience dimensions of Malay Lawi Ayam weapon artefact usable for the development of design-user system? RO2: To analyse the aesthetic experience of Malay Lawi Ayam weapon artefact user through pragmatic analysis for the development of design-user interrelationship knowledge.	L/R	PRAGMATIC ANALYSIS Output 2: Evaluated Aesthetic experience structures components in LA through pragmatic analysis (psychomotor skill) and artefact usability experience to be integrated with the artifact classification (RO1) in order to systematizing design-user interrelationship knowledge (Ro3).	Knowledge 2: Theories on Malay AE of weapon artefact through the understanding of product usage typology and user experience knowledge (psychomotor skill) integrated with the LA artefact classification to establish the pragmatic and syntactic analysis for design-user system (DUs).
HOW1 **Design-User System (DUs)**	Sub-RQ3: How can the artefact design information and the user aesthetic experience of Malay Lawi Ayam weapon artefact be used to systematize design-user interrelationship for Malay culture design? RO3: To recommend the usage of artefact design information and user aesthetic experience of Malay Lawi Ayam weapon artefact to systematise a design-user system for Malay culture design.	**ETHNOGRAPHIC CASE STUDY** 1) ARTEFACT ANALYSIS (LA) 2) ACTIVE INTERNAL PARTICIPANT OBSERVATION 3) LAB TEST	COGNITIVE ANALYSIS Output 3: Knowledge from verbal and computational method to support the knowledge of users' behavior by the understanding the interrelationship between inherent information, functional information and syntactic information during the eye movement testing in order to systematize the design-user.	Knowledge 3: Theories of the design-user system (DUs) with implementation of integrated theories; Malay LA artefact classification and LA user's AE using computational approach of eye tracking test to provide more holistic understanding based on users' preference and cognitive response on cultural product for Malay cultural design (MCD).
WHO1 **Malay culture design (MCD)**	Sub-RQ4: How can Malay culture design benefit from design-user interrelationship guideline developed from Malay aesthetic experience knowledge? RO4: To establish the application of design-user system in Malay culture design as a pioneering approach to establish cultural product development in the new culture	N/A	REMARKS: This sub-RQ has a secondary priority when the design researcher has experienced such understanding from mutual observations and testing experience. Therefore, it would suffice to cover this aspect when discussing the problem statement.	

Figure 1.2: A complete eagle research design table outlaying the summary of quick overview of this research based on Ibrahim (2011).
(Source: Siti Mastura, 2014)

1.9 Research Structure

The introduction and literature review of this research reveal related documents such as journals and books as vital sources to excavate relevant information. Moreover, the analytical approach focused on Malay *Lawi Ayam* artefacts in the context of physical typology to get a better in-depth view of the design and usage. Also, a preliminary interview with identified gatekeeper of Malay *Lawi Ayam* led to a better knowledge organization of needed information for this research (Chapters 1 and 2).

After data was obtained from the preliminary interviews, full participation observation was then carried out by the researcher to have further understanding of the research constructs. The observation was conducted at the identified location around Peninsular Malaysia within sufficient time duration of one and half year period. Then, in-depth interviews were comprehensively conducted with the gatekeeper (s*ilat* master and *kerambit* and Malay *Lawi Ayam* expert user), expert or trained user and blacksmith. The researcher also physically participated to get an overview of conception of Malay *Lawi Ayam* artefact and its uses.

Chapter Three discusses the preparation plan to avoid any negative consequences during the process of data collection. Simultaneously, the chapter discusses the applicable theory that is Aesthetic Interaction (AI) frameworks by Locher et al. (2010) in conjunction of understanding the contexts needed in this artefact-user studies. Meanwhile, the two distinctive approaches suggested by Petersen et al. (2004) which are analytical dimensioning and pragmatic assessment are also included in the chapter. This research employed an ethnographic case study method, which includes structural strategy to obtain the data from artefact analysis, document analysis and active participant observation with selected informants.

In Chapter Four, various informant quotes were compiled and chosen as vital primary data to triangulate with artefact analysis and the literature review finding. Physical and non-physical definitions used in the Malay *Lawi Ayam* community were closely investigated and documented to enable the proper classification during artefact observation to include the understanding of Malay *Lawi Ayam* artefact philosophies. Towards the end, agreement and similarity in triangulations for pattern matching became vital as the secondary data.

Chapter Five looks into the close interaction with Malay *Lawi Ayam* community conducted with the informants and participants. Along with the full participation observation, the researcher investigated the similarity and matched pattern between the terms of artefact definition and artefact typology from experiential evidence of aesthetic experience physical evaluation. Both intrinsic and extrinsic value of body movement structure is vital information for the following pragmatic analysis in Chapter Six.

Chapter Six looks further into the interrelationship of user aesthetic experience behaviour and cultural memory with artefact design information through eye tracking. In this section, data from Chapters Four and Five were used and validated by eye-tracking lab test. Data visualization in descriptive analyses involving the qualitative feedbacks and empirical result from eye tracking test were conducted based on user preference and sets of verbal responses towards Malay *Lawi Ayam* images. To provide a deeper understanding of the engagement or interrelation of their aesthetic experience elements, aesthetical preference in eye behaviour analysis covers the artefact context, artefact use and user pre-existent experience (collective cultural memory of artefact usage).

Chapter Seven discusses the research questions and conclusion, which are based on the entire findings of artefact observation, participant observation and lab test. The

researcher experience was included as it provides her perspective in interaction context between the units of analysis. This chapter also presents recommendations on potential avenues for future research. Towards the end, the amalgamation of both constructs (Malay *Lawi Ayam* and aesthetic experience) led the researcher with design-user systematization process. It ends with suggestions to improve the research methodology, limitations of the research and final conclusion based on ethnography finding. Figure 1.3 shows the summary of research flow.

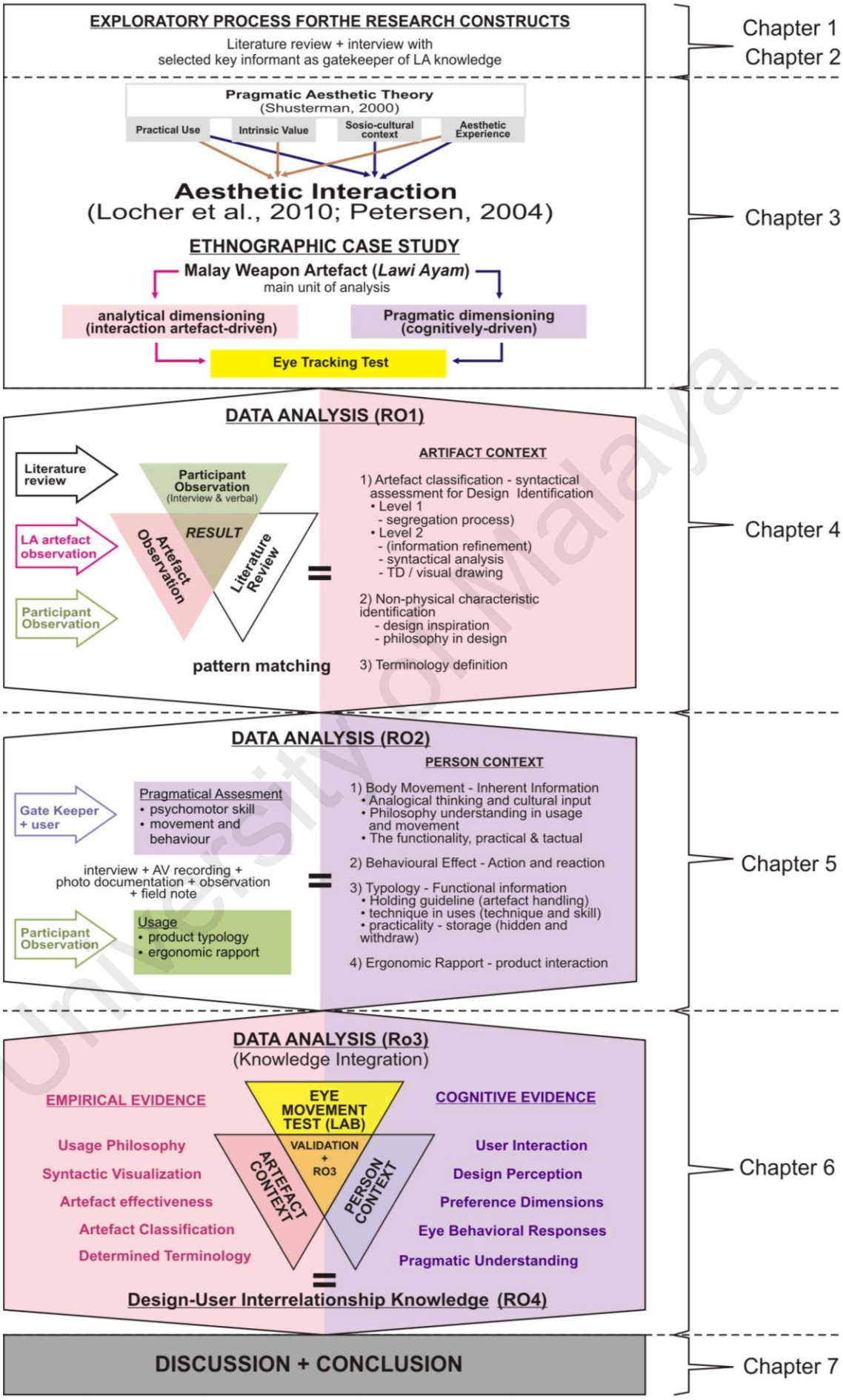


Figure 1.3: Summary of the research structure. (Graphic: Siti Mastura, 2014)

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

As mentioned in the previous chapter, the sub-topics leading to the structure of knowledge elaboration as well as the underlying theories and principles related to the subject of study constructs are vital to be understood. In this chapter, the researcher undertook a review of the literature to understand why this study treats Malay *Lawi Ayam* (LA) as a vantage point for analysis.

Thus, in the first section, a review of extant literature about LA itself is documented in every context of artefact criteria. The literature review aims to seek significant information on artefact context in Malay weaponry system. The second section discusses the aesthetic experience (AE) structures to understand the components involved in the experience and the cognitive interaction of the designed object towards its usability. The third section provides a review of the user and artefact involvement in artefact interaction to understand the interrelationship of both contexts, specifically, the user's behaviour towards the artefact design. Finally, this study identifies the theoretical framework of Aesthetic Interaction (AI) (Locher et al., 2010) and the significant approaches of analytical analysis and pragmatism (Petersen et al., 2004).

Four levels identification for point of departure are used to segregate the gained ideas from the identified gap in the previous literature. In this review method proposed by Ibrahim (2011), the inferences and amalgamations in every level of literature produce significant point of departures as a driver or vehicle to extend the body of knowledge. Each inference on every four levels identifies the main title of topic and sub-topic. Inferences from first until third sub-constructs are to ensure that each of it will not be

left out. Towards the end, a much consolidated theoretical proposition is established. Finally, this study provides a diagram summarizing the key point of discussion as a developed knowledge framework.

2.2 BACKGROUND OF STUDY: Malay *Lawi Ayam* (LA) as an Artefact Study

The researcher focused on the base of terminology issues, physical features, intangible knowledge as well as product function. This research complements previous research by adding a new revision on product particulars.

The existence of weapons system in the Malay world was driven by diverse knowledge in artefact creation. In the beginning of steel product making, the technology was brought by Middle Eastern people to the Malay Archipelago in the 15th century (Gardner 1936, cited in Shahrum, 1967); Hill, 1956; Wan Abdul Kadir, 2000). The Malays have since equipped themselves with technological skills and played a major role in the development of steel blacksmithing through their inventiveness and responses to local needs. Experts in blacksmithing are called *'pandai besi'* or craftsmen (Farish & Khoo, 2003; Gardner 1936, cited in Shahrum, 1967; Hill, 1956; Ismail, 2009; Mubin, 2011; Zakaria, 2007). They are capable of making any metal craftwork and inventing tools that reflect their system of measurement, symbols, and identity inspired from the earth (Farish & Khoo, 2003). Their involvement in making practical tools such as a weapon plays an important role in the cultural product design realization that is distinctively important to the Malays.

In some literatures, LA was described in two sizes, a longer version for men user and a smaller version intended for women user. However, it lacks specific categorizations to differentiate the artefact characteristic. Commonly, the previous scholars described LA artefact as a personal protection tool for women which is hidden inside the woman's

hair bun or under her clothes (Gardner, 2009; Hill, 1956; Ku Ahmad & Wong, 1978; Mohd Zainuddin & Mohd Shahrim, 2007; Mubin, 2011; Shahrum, 1967). A scholar stated that initially, LA was used by village people as a survival tool (Zakaria, 2007). However, it is argued that the LA does have the prequel history of development in terms being transformed from everyday usage tool to one of the practical weapons in Malay hand combative art.

The transformation of its function was believed to happen in wars between the 15th and 19th century in certain states of the Peninsular Malaysia such as Kelantan, Pahang, Johor, Selangor and Perak. This artefact was identified as a heritage asset of the Malays along with other weapons such as *keris, lembing* (javelin), *tombak* (lance), *golok* (cleaver), *tumbuk lada* (a type of dagger), *beladau* (dirk) and the like (Mokhtar, 1985; Gardner, 2009; Mokhtar, 1985; Shahrum, 1967; Zakaria, 2007). In Hikayat Pahang (MS937), the writer, Muhammad Noor (1857-1895) reveals that the usage of this artefact was categorized under the third type of close range weapons, or a last resort weapon to protect oneself against an attack (Wan Mohd Dasuki, 2004). For instance, in the Pahang War in the 19th century, Wan Embong was mentioned as one of the Pahang Malay warriors who used the LA as a hidden weapon. The text describes the LA as hidden or concealed in the warrior's cloth fold, head gear, or *tanjak*.

In contrast, Newbold (1839) in his preliminary study about the origin of a similar artefact posits that metal spur in Malay folk game of '*sabung ayam'* (cock fighting) is connected to the development of an effective tool. Through his ethnographic study with the Malays in East Coast states where the game was practised, he observed how the Malay created an effective weapon as to give awe inspiring effect function. The spur he meant is called *taji benkok* or curvy spur, tied on the legs of the cocks fighting. This spur was known to bring effectiveness in the fights to injure and eventually to kill the

opponent cock, depending on rules and conditions. Razak (2000) supports that the remodelling of the spur made it more tangible for human use. However, these claims have no further explanation on the design evolution of this cock's spur to the LA form. Therefore, the researcher questions whether this notion was a personal interpretation only.

In the current cultural setting, LA can still be found in several state museums in Malaysia such as Muzium Kuala Terengganu (Terengganu), Muzium Pekan (Pahang), Muzium Senjata Kota Bharu (Kelantan) and several more. However, the researcher found that the exact local name of this tool differs significantly from place to place. In fact, there is a slight difference in physical characteristics, too. Sadly, inaccurate information on the artefact was given in the display shelves by the person in charge in these museums.

As an alternative, missing information can be obtained from the user of the LA artefact in Malay s*ilat* martial arts. The Malay martial art is a comprehensive entity, with higher-order needs, goals, and inspiration, as well as spiritual development that could support the understanding of artefact usage (weapon). A new systematic paradigm between man, culture, artefact and society was anticipated through weapon usage in martial arts (Hekkert & Schifferstein, 2008; Hekkert & Leder, 2008; Cynarski & Obodynski, 2011), especially when the psychophysical progress is associated with a functional artefact. Research on similar contexts in design categorization is often based on referral extensions, whereas the lack of user and usage information impaired detailed analytical elucidation.

Similarly, improper artefact classification has led to ambiguous documentation which caused confusion and negative attitude towards preserving traditional knowledge. Furthermore, the anthropologist and design researcher raised the issue of proper

classification that is supposedly based on the design character and usage context during the artefact identification (Che Husna, 2000; Khamis et al., 2013). However, most literatures on traditional Malay weapon agree on the similarity of type of material usage, for instance, tampered steel (*besi tempa*) for the blade, wood, horn or ivory for the sheath and the hilt. Sometimes, silver also used for decoration purposes. Therefore, this study gives detailed insight into the syntactical characteristics and intangible knowledge of LA and constructs a proper artefact classification of this traditional weapon.

Meanwhile, in previous historic documentation, little is known about design cognition involving both form and abstract meaning. Previous scholars suggest using the same LA term for all kind of similar artefacts (Draeger, 1972; Hill, 1956; Gardner, 2009; Mokhtar, 1985; Shahrum, 1967; Zakaria, 2007). However, the researcher believes that strategic observation is needed in order to segregate the reviewed information into a structured data for proper terminology. Furthermore, this research extends previous findings (Gardner, 2009; Hill, 1956; Mubin, 2011; Shahrum, 1967) to compile and analyse both extrinsic and intrinsic data from ethnographic approaches. In short, the researcher expects that the finding of this study would establish a pioneering cultural artefact classification by both comprehension of design characteristics and intangible knowledge. The artefact classification should be structured as the determined terms and detailed layout of design criteria. This would reveal the ambiguity of the culture design concept to boost interest in artefact labelling for the culture tourism industry.

2.3 The Terminology Issues for Artefact Identification

The terminology of the artefact as defined in previous documented findings must be clarified to avoid confusion. Previous scholars have documented various terminology of LA such Gardner (1936) who made several artefact identification through his research. However, Hill (1956, p.60) argued that what passes among Malays for

technical terminology for their traditional weapons *'may be far-fetched to the point of fantasy'*.

Based on Table 2.1, the inconsistency of the term used led to variants for which it is better to justify the artefact name in current cultural settings. Scholars have produced conflicting definitions. The term varies from *kerambit, karambi*t to *kuku ayam* (cock's claw) (Gardner, 2009; Ismail, 2009; Shahrum, 1967; Zakaria, 2007). Likewise, some documents use other terms that are rarely used such as *rambai ayam, lambai ayam* and *kurambi ayam* (Gardner, 2009; Shahrum, 1967). Most of these terms are derived from the rooster's feature.

Table 2.1: Different terms used to refer to LA in previous documentation by scholars

Scholars	Year	Term Given
Hikayat Pahang (MS937)	1857-1895	*lawi ayam*
winstedt	1925	*lawi ayam*
Gardner	1936	*lawi ayam, kerambit, kuku ayam*
Hill	1956	*lawi ayam,*
Shahrum	1967	*lawi ayam, kuku ayam, rambai ayam, kerambit, kurambi*
Draeger	1972	*karambit*, tiger's claw
Ku Ahmad & Wong	1978	*lawi ayam, kerambit*
Sofian	1984	*lawi ayam*
Mohd Zainuddin & Mohd Shahrim	2007	*lawi ayam, kerambit*
Zakaria	2007	*lawi ayam, kerambit, kuku harimau*
Ismail	2009	*kuku ayam, lambai ayam, kerambit*
Mubin	2011	*kerambit*, tiger claw dagger

Commonly, LA artefacts are largely defined from the idea of a cock's tail feather (Gardner, 2009; Hill, 1956; Mubin, 2011; Shahrum, 1967; Winstedt, 1925). Meanwhile, the term 'Tiger Claw' dagger and *kuku macan* used by some scholars (Draeger, 1972; Mubin, 2011) might not accurately define LA. The term is derived from the physical shape of tiger's claw which may be erroneous, due to the size difference. For instance, the usage of tiger claw terminology is perhaps more closely related with what the Royal

Asiatic Society (1829) called '*Wagnak*' described as a weapon found in India. Although similar idea was used for the terminology which was derived from the prominent physical feature of the *Wagnak* (four sharp blades), there is a major contrast with the LA characteristic (one or two sharp-edges single blade). This information lacks in depth explanation about the aspects of the weapons other than their historical and geographical background. Hence, it led to misinterpretations of the essential information of LA artefacts in the context of physical features and idea inspiration.

Therefore, the inconsistencies in the data that is continuously used in current documentation of LA have encouraged the researcher to focus on the issue of LA artefact terminology, physical properties and intangible knowledge to elucidate and leverage every criterion. Detailed discussion covers the; a) syntactic properties such as specific dimensions, decorations and material, b) definite types of users, pragmatic information and psychological or behavioural responses, and c) the artefact typology and the art of usage in Malay hand combative movement.

2.3.1 Inspiration of LA Terminology

The terminology context plays a significant role in justifying any cultural artefact by signifying its unique attributes via a social identity. This represents the conscious desire of the designer of the artefact to create great impact by its name alone (Bloch, 1995). Several literatures have shown that design inspiration is sometimes derived from the influential idea of implementing the symbolic source. For instance, Mohd Zainuddin and Mohd Shahrim (2007) observed that the shape of LA was inspired from the letter '*wau*'[1] in Arabic. According to the stone inscription found in Terengganu, Malaysia (*batu bersurat Terengganu*) dated 1303, the Malays have started using Arabic calligraphy after Islam reached the Peninsular Malaysia between 1326 and 1386.

[1] wau is the 27th character of Arabic letter.

Another opinion relates the origin of LA shape to the number '9' (Zakaria, 2007). This shows how the local community try to interpret the design concept to specific epistemology of specific event. However, the elucidation on how the design was derived is still vague.

Most scholars state that LA resembled or is modelled after *jembiah*, the Arab dagger (Draeger, 1972; Hill, 1956; Ku Ahmad & Wong, 1978; Mubin, 2011; Winstedt, 1925). These statements present an alternative terminology to LA that is debatable since there is no historical and physical evidence to support this statement. The scholars should have made a precise elucidation between LA and *jembiah* because both are significantly different artefacts.

Based on these literatures, the researcher found that creative thinking and foreign influence on the socio-cultural background of the Malay craftsmen have possibly developed their design knowledge and elicited design inspiration and symbolic representation in creating this artefact. The inspiration for design is internally assimilated when people accept things that enter their domestic areas such as utensils (Dewey, 1934). The assimilation developed much with the symbolic influences of their surroundings to suit the domestic needs.

Fachruddin et al. (1992) posits four symbolic aspects of the weapon in the Malay community: (1) weapon as a symbol of pacification; (2) weapon as a symbol of manliness; (3) weapon as a symbol of a man; and (4) weapon as a symbol of strength. Wan Mohd Dasuki (2013) states that the conception of symbolism gives abstract interpretation to the physical form of certain weapons. These symbolisms are synonymous with the Malays as they see every intricate human life and activities driven by natural environment. In other words, symbolism is used to justify the abstract meaning of concept representation that stands for the adopted idea (Korg, 1959;

Muhammad Afandi, 1995). However, the researcher argues the lack of discussion on the source of terminology for the design and artefact function which should not be posited as outer feature to understand featured concept representation. Therefore, the researcher strongly suggests elevating the artefact knowledge more starting with defining the category and term so that description of terminology of LA could be elucidated correctly.

2.3.2 The Physical Characteristic of LA: Form, Size, and Material

A doctoral study suggests that visual characteristics in product design which is also known as visual aesthetic characteristics is the term given to the shape of a product and the materials used (Raja Ahmad Azmeer, 2011). The term is closely related to the interaction between the context of product personality and materials regarding aesthetics and expressions to assist in determining specific segment and decision. Therefore, the researcher finds that the comprehension of the physical characteristics is a crucial stage in order to obtain quality information.

Previous documented description covers brief information of physical characteristics of LA, its design outlook and handling techniques (Che Husna, 2000; Draeger, 1972; Gardner, 2009; Hill, 1956; Ku Ahmad & Wong, 1978; Mubin, 2011; Shahrum, 1967). Somehow, previous scholars identified the physical characteristics of LA according to general design features such as the blade, hilt, and sheath. However, the data on the specific criteria still remains incomplete. In the support of classifying product types and characteristics of product forms, Chang and Wu (2007), Lin (2007) and Siti Mastura (2011) suggest considering the types and characteristics when developing pleasurable products in order to give understanding about interwoven experience of design and cultural artefact function. Hence, this section will discuss further on the physical characteristic of LA artefact based on these variables.

2.3.2.1 Form and shape

Generally, LA is defined as a curvy weapon (but not a sickle), sharp along at both the inner and outer edges of the blade (sometimes only single edge is sharpened as a personal preference), equipped with a hole to insert finger at the hilt, and used with specific movements to wound, immobilize and even kill the opponent (Draeger, 1972; Gardner, 2009; Hill, 1956; Ku Ahmad & Wong, 1978; Ismail, 2009; Mohd Zainuddin & Mohd Shahrim, 2007; Mubin, 2011; Shahrum, 1967; Winstedt, 1925; Zakaria, 2007). The hilt normally has a hole or ring on it so that the forefinger, middle finger or ring finger can be inserted for better grip (see Figure 2.1). In some literature, LA artefact was illustrated complete with a sheath. The smaller version (female user version) sometimes was designed without the ring hole. The researcher finds that the ring hole was repeatedly mentioned as a prominent identity of LA physical criteria.

Figure 2.1: The ring hole can be inserted on the forefinger, index finger or ring finger. (Source: Siti Mastura, 2014)

2.3.2.2 Size

Previous scholars state that LA is a small weapon that can be hidden in specific places on the user's body such as woman's hair bun or man's cloth fold (Gardner, 1936; Hill, 1956; Shahrum, 1967; Ku Ahmad & Wong, 1978; Mohd Zainuddin & Mohd Shahrim, 2007; Mubin, 2011; Wan Dasuki, 2004). It shows that LA could be disguised

easily due to its small size. However, this statement lacks exact classification of LA to fit with the terminology and the physical characteristic especially the type of LA used for different gender and event. The researcher strongly agrees that LA has specific criterion to fit in proper categories.

There is a more recent text explaining that LA is commonly found with 4¾ inches to 12 inches in size (Mubin, 2011; Zakaria, 2007). The width of the blade varies from 15/16 inches to 1 1/16 inches (Shahrum, 1967). However, there is no further information on size other than the general illustrations of LA artefacts. According to Mohd Zainuddin and Mohd Shahrim (2007), each LA is traditionally created based on the owner's eye size and the width of blade is based on the forefinger. Using the owner's body measurements was believed to be the best way to make the weapon. Every LA was specially designed with a specific measurement of the user, thus highlighting the knowledge of the Malay blacksmiths on logical calculation of human body parts. In this instance, the researcher posits that the importance of understanding the measurement factor of the LA would enable the making of effective method for cultural artefact design identification.

2.3.2.3 Material

The review of the literature shows that the material selection in LA production has not been critically discussed even though the factor of material application also affects LA durability or endurance. In the context of materials, the hilt of LA was made of wood or horn (Zakaria, 2007; Ibrahim, (unpublished)). There are also samples of LA produced with a silver cap at the end of the curved wooden sheath (Mohd Zainuddin & Mohd Shahrim, 2007). Meanwhile, some of the hilt and sheath designs are finished with rattan string and metal ring (Mohd Zainuddin & Mohd Shahrim, 2007; Shahrum, 1967). There is also a basic design that normally uses leather sheath without any decoration.

On the other hand, the materials used for blade are from forged iron for strength and durability purposes. In forged iron, the usefulness and the beauty of the blade are emphasized. Even though most LA blades were made of forged iron to emphasize the edge sharpness, there is a technique that produces unique weapons by capturing the beauty of *pamur*[2], which is normally featured on Malay *keris* (Abdul Mua'ti, 2015; Frey, 1986).

However, these physical characteristics of LA such as the form, size, and material usage in LA identification still linger even after a few decades of its establishment in Malay weaponry artefact collection. Therefore, a structured definition of the design inspiration and physical characteristic of LA artefact could elevate proper analytical dimensioning for object identification to avoid ambiguity in LA artefact knowledge.

2.3.3 Artefact Function

LA's good design in term of the ergonomic form shows its effectiveness during usage. However, the handling typology was only generally explained in previous literature. Users insert either the forefinger or the other fingers depending on the individual holding style, whereby in Malay a martial art, how the user moves the weapon complements the weapon's design. In the current martial art scenario Razak (2000) states that a variety of LA techniques was used to elicit the best jaw dropping impact from dynamic position that can be seen from the *kerambit* initiation technique. Even though *kerambit* is another variation of curvy weapon range, literature about the artefact is the closest in context to LA artefact that can be examined.

In this research, to understand the technique and the user's skill as pragmatic discussion is crucial. Firstly, the technique reveals the grip variations and tactical

[2] Damascene or natural pattern formed during forging process and soaked in acidic substances such as lime, banana tree resin or even thinner (Abdul Ghani, personal communication, January 8, 2014).

movement during the *kerambit* initiation. A standard grip, third & second-finger hold, flipping (retracted and extended) and transitions securing the control hold allow maximum articulation of hand and fingers (Tarani, 2003). Similar with LA, the *kerambit* user cannot easily be disarmed because it literally becomes an extension of the user's hand (Neilsen, 2006; Razak, 2000). According to Ong (2009), LA handling and movement is similar to *kerambit* technique, which is the most vicious strike among all *silat* moves.

> *…Swings low and rapidly behind the enemy knee. The key target is tendon and hamstring muscle that hold the enemy upright….then, the upward .strike towards the neck. Deep enough cut will slice through the jugular vein. Next, a knee to the chest drop the enemy head to perfect position for the final strike, the rapid strike to left eye-socket In four lightning fast moves the enemy is blinded, unable to stand and bleeding up…*
>
> (Ong, 2009, t.24:46)

Ku Ahmad and Wong (1978) highlight the importance of understanding the handling technique for LA: (1) a suitable hole size for the index finger to ensure a firm grip for the user; (2) the product handling of LA is designed for effective use; and (3) it is important to keep in mind that LA are mere tools of man and should be used with discretion. The scholars emphasize that LA artefact has an effective design that causes death through an upward stab (*radak*) and swing-slash (*rambit*) tactical movement. The movement in LA application could rip open the abdomen, slash the limbs, and inflict fatal wounds (Draeger, 1972; Gardner, 2009; Hill, 1956; Ismail, 2009; Ku Ahmad & Wong, 1978; Mohd Zainuddin & Mohd Shahrim, 2007; Mubin, 2011; Shahrum, 1967; Zakaria, 2007). The movement illustrates how LA is used by men during aggressive movement of intimidation, such as war (Hikayat Pahang (MS937); Wan Dasuki, 2004).

As mentioned previously, most of the researches explain that small LA was a protective weapon in emergency or intimidating situation among female users (Ismail, 2009; Gardner, 2009; Hill, 1956; Ismail, 2009; Ku Ahmad & Wong, 1978; Mohd Zainuddin & Mohd Shahrim, 2007; Shahrum, 1967; Zakaria, 2007). Several types of other small weapons of Malay daggers also serve the same function and user (e.g. *badik* (straight one-edged dagger), *tumbok lada* (a type of dagger) and *lading terus* (spear blade, fitted into dagger hilt)). The woman uses LA by allowing the attacker to approach close enough to her body. Then, she secretly draws out the weapon to stab or rip the stomach or genitals of the attacker.

Pragmatically, it is shown that different techniques are used according to the gender of the user. Karana and Hekkert (2010) also state that women showed greater intensity of both positive and negative affective responses to outside stimuli than men. The scholars posit that users (male and female) experience things differently based mainly on their physical abilities and social and cultural norms. However, the researcher foresees a distant cry from the usage perspective in user experience understanding when those operational information of the artefact are still written up as a similar context of single type of user (women) by the scholars. The literature also shows that the LA usage in Malay war represents how men used LA in an effective manner and in a variety of techniques. Therefore, the researcher posits that the identification of functional characteristics, user type and ease of use (technique) could facilitate implicit information in LA artefact function.

2.4 Intangible Knowledge: Understanding the Philosophical Concept of LA Artefact

The terminology context and artefact identification play a significant role in justifying any cultural artefact by signifying its unique attributes via symbolic

representation. Therefore, intangible knowledge of the LA covers the context of philosophy, too.

2.4.1 Artefact Philosophy

The conscious desire of the designer of the artefact is to be able to create great impact by incorporating influential idea of symbolic source. In turn, Hill (1956), Mohd Zainuddin and Mohd Shahrim (2007) and also Ismail (2009) propose the exact way to identify the artefact term. The researcher found that their statements in searching the symbolic explanation associated with the physical form of LA relates to philosophy of artefact including the analogic mapping ability. This demonstrates how people may see different analogies and unconsciously start to establish at least two simple related structures. This statement is supported by scholars who suggest that skill, ability and adaptation from natural surrounding give major influence to cultural community in mapping analogic representation (Dewey, 1934; Wan Mohd Dasuki, 2013; Hekkert & Schifferstein, 2008; Lin, 2007). For instance, Mohd Zainuddin and Mohd Shahrim, (2007) argue that LA philosophy has a unique analogical explanation from the human anatomy in LA making and usage. Some of the blacksmiths believe if these traditions are disobeyed, the LA will cause injuries to the owner such as self-stabbing, self-wounding and even poisoning by one's own LA.

Meanwhile, Fachruddin et al. (1992) who suggest four symbolic aspects of the weapon in the Malay community argue the importance of positioning the cultural artefact (e.g traditional weapon) in appreciable paradigm through application of natural representation idea. For instance, Razak (2000) highlights the concept of 'twin of four *kerambit'* (*Rafil Mayang Mengurai*, *Rafil Melur*, *Rafil Cempaka* and *Rafil Kembang*), which was designed based on the concept of flower petals.

These theories show how symbolism plays an important part in Malay artefact and how it is used which is related to the concept of LA. These symbolisms resonate with the Malays' philosophy as they relate their human lives and activities closely to the natural environment. However, the researcher also believes that these contrasting statements may be redefined in this research to include awareness of Malay analogic reasoning that can be obtained from ethnographic findings. Thus, this research will define the involvement of philosophical meanings to support the tacit knowledge and intangible qualities of the artefact. Therefore, the understanding of artefact symbolism in Malay weaponry could support detailed elucidation on analogical thinking in LA weapon philosophy.

2.4.2 Usage Philosophy

The researcher finds that most discussions regarding usage philosophy in Malay traditional weapon cover the *keris* artefact. In the context of LA, the artefact is supposed to have the same attention due to its similar significant value that interrelates with the Malay critical thinking. As the techniques of LA weapon are inherited from the expert of Malay martial art, *Guru Tua* (old master) (Razak, 2000), description of usage philosophy is worth to be highlighted. In the technique application, western users agree that *kerambit* is the most ergonomic and effective artefact weapon within the knife or dagger range (Neilsen, 2006; Tarani, 2003). However, they only see these techniques in a very tangible perspective such as usage skill, whereby users in Malay world emphasize the need for philosophical usage and techniques to result in effectiveness and efficiency (Siti Mastura et al., 2013b). This contention is supported by Ku Ahmad and Wong (1978) and Ong (2009) as they highlight the importance of understanding the handling technique for LA.

Some literatures also highlight the importance of understanding the implementation of philosophical movement in Malay *silat* martial art. Scholars stated that social philosophical concepts are the idea on creation of a new science about man in martial art as a form of psychophysical progress (Cynarski, 2000; Cynarski & Obodynski, 2011). In terms of bodily movement, there is a study by Farrer (2006) about Malay mysticism via performance ethnography of the transnational *silat* organization; *Seni Silat Haqq* in Malaysia combines the elements from the anthropology of art and performance that provide a theoretical framework to address *silat* through social practice, performance and enchantment. The study also highlights the representation of becoming animal versus the shadow of the Prophet to explore the creation of *silat* through spontaneous bodily movement. Farrer stated that divination and initiation rituals and *silat* in relation to its deathscapes.

Similarly, the philosophical application in the weapon usage concept that interrelates between a human dimension and logical thinking based on analogic representation in user movement is vital to prove the knowledge of human science (anatomy dimension and neural system) in Malay worldview (Zakaria, 2007; Razak, 2000; Ong, 2009; Mohd Zainuddin & Mohd Shahrim, 2007). For instance, vital target points on opponent's body are sometimes assimilated to analogic representation. Therefore, when the user used a certain Malay weapon in close fight such as LA, *kerambit* and small hatchet (*kapak kecil*), his mind is already equipped with the knowledge in order to move accordingly.

Meanwhile, different scholars have intrinsically defined the blade as the eye that sees and observes, meanwhile the finger that hold and grip signifies fast reaction and precision (Mohd Zainuddin & Mohd Shahrim, 2007; Ismail, 2009). However, the scholars rarely discussed the interrelationship between both intrinsic and extrinsic

values of LA, whereas both values are important to result in dynamic effective usage. Petersen et al. (2004) suggest two approaches to overcome this challenge which are analytical dimensioning and pragmatic assessment. These approaches will guide this research in capturing the information of artefact and user context. Meanwhile, Chang and Wu's (2007) suggestion is to use in-depth interview method to obtain the user's responses to artefact that could facilitate these values (usage and movement philosophy). These methods are useful to answer the research inquiry and to elicit knowledge on LA artefact.

To note, throughout the literature review, the researcher finds that intangible knowledge (artefacts philosophy) could elicit the LA analogic thinking and usage effectiveness with the support of design information. Therefore, the researcher posits that philosophies in LA usage comprising extrinsic and intrinsic value have pragmatic potential that could leverage the knowledge of LA usage effectiveness.

2.4.3 Artefact Function Led to Technical Knowledge Understanding

The functional characteristic of LA artefact compliments the cultural artistry that highlights the art of movement. Some scholars explain that specific user shows greater intensity of both positive and negative affective responses to stimuli using various styles of dynamic techniques through the understanding of movement of aggressions (Razak, 2000; Karana & Hekkert, 2010). They highlight that user experienced things mainly based on their physical abilities, social and cultural norms. Locher et al., (2010) propose that the physical properties of artefact are important factors in human-product interaction. However, knowledge inferences between functional characteristics, type of user and ease of use (technique) with the artefact terminology should be facilitated through implicit information of LA function to bridge an efficient interaction. Therefore, the researcher agrees that the inferences of LA function with terminology

definition could facilitate the implicit technical knowledge understanding of LA the Malay weapon artefact.

2.5 Evolution and Integration of Knowledge

In the context of local design thinking, intellectual dimensioning by the Malays produces acceptable idea to serve the knowledge evolution in artefact philosophical understanding. It defines the worldview of a particular community on how they see the differences and similarities.

2.5.1 Enhancement of LA Artefacts Knowledge

Analogical thinking is related to human cognition that is important in creativity and scientific discovery. There are few attempts to capture implicit analogy making such as psychological processes. For example, anthropologists have compared the uses of limes used by shaman in traditional medication to the medicine prescription given by a doctor (Norresah & Siti Mastura, 2011). Such persuasive analogies are meant to explain new evidence that has a degree of adaptability that predicts which inferences are made from the analogy (Keane, 1996). This study also found Structure-mapping theory is useful to capture the psychological processes that carry out the analogical mapping (Gentner, 1983).

In other research, Hristova (2009) found that people may see different analogies when different relations are unconsciously 'highlighted'. She supports Gentner's Structure-mapping theory that she found people unintentionally start to establish a mapping between two simple structures, which analogical mapping may be initiated automatically and influence human cognitive and behavior. Although her finding obtained through empirical experiments, the research could not disambiguate the process of analogy as people are able to starts analogies spontaneously.

Based on these analogical theories, this study agrees with several studies, which symbolism also plays a major influence in Malay artefacts. For example, Zakaria (1984) affirms that the Malays are innovative to infer the idea projection to specific design subject through symbols. He proposes the concept of terminology based on nature which shows how they see their role in conserving traditional knowledge. Meanwhile, Fachruddin et al. (1992) explain that symbolism is an important factor in positioning the cultural artefact (e.g traditional weapon) in appreciable paradigm.

In LA context, Mohd Zainuddin and Mohd Shahrim, (2007) extends Zakaria's (1984) notion of analogical representation by revealing the knowledge of body anatomy in the LA making and usage. For example, the size of the LA must follow the owner's certain body parts for ergonomic handling and effective impact. In addition, Petersen et al. (2004) and Wan Mohd Dasuki (2013) highlight the importance of understanding the usage effectiveness and the artefact information in user's perspective to contribute to the understanding of any tangible concept. By the same token, some scholars strongly suggest that in-depth interviews and active participant observation could help obtain the user's responses towards artefact features and facilitate the philosophical knowledge of usage experience for this study (Ross & Wensveen, 2010; Lin, 2007; Siti Mastura, 2011).

Based from the above scholars however, the researcher finds the relation of analogic thinking and artefact effectiveness not explained in a wider perspective. For instance, if they are looking at the tangible factors alone that would cause prolonged incomplete understanding of artefact function to effectiveness. Therefore, the researcher posits that LA artefact knowledge enhancement would enable the establishment of analogical thinking and artefact effectiveness by tangible properties and intangible knowledge.

2.5.2 Integrated Understanding of Artefact Usage & Cultural Knowledge

In line with comparing the new paradigm of cultural artefact of LA, this study foresees the need to infer cultural knowledge and usage effectiveness of artefact function. For example, although most scholars agree that LA design could contribute to its usage effectiveness (Gardner, 1936; Hill, 1967; Tarani, 2003; Neilsen, 2006), there is less emphasis on how the details of analytic context of LA could contribute. Hence, knowledge inference is important to provide transferable evidence for artefact behavioural knowledge. This transferrable evidence of Malay traditional knowledge among the generations could reveal crucial information on the attribute of effective cultural knowledge.

Locher et al. (2010) note the importance of both tangible and intangible information in artefact context. Boucharenc (2008) extends Locher et al.'s notion by suggesting a syntactical analysis strategy to look into the physical feature. As both types of information were part of the missing information, this issue can be avoided if appreciation on design is sustained which includes the technical knowledge of LA design and the philosophical information of the idea that contributes to usage effectiveness. Ismail (2009) expresses same concerns that the appreciation of Malay local design and technology of artefact is slowly fading away amongst young generation that may result to a missing link. Therefore, due to this decreasing appreciation of knowledge, the data improvement for LA artefact must consider the integration of cultural knowledge and technical information to identify the relationship between artefact effectiveness and the design characteristic including syntactical measures.

2.6 Summary of Theoretical Proposition One: Artefact Classification

This section has synthesized three aspects of LA including artefact terminology elucidation which are: i) intangible knowledge of the philosophical, ii) analogical

thinking and artefact function; and iii) enhancement of LA artefacts knowledge. An emerging trend among knowledge of cultural artefact research is the utilization of physical evaluation to simulate product identification. For this research, the type and characteristic framework serve as a fundamental basis for understanding the concept of invention to define the design of artefact in proper classes. Petersen et al. (2004) point out two statements distinguishing between analytical dimensioning and pragmatic assessment in positing the AI framework as important perspective on interaction which are: 1) An analytical dimensioning approach to aesthetics interaction focuses on the product that technically employs typology dimension to get a better in-depth view of the body movement and product usage; and 2) Pragmatic assessment or pragmatism normally sees aesthetic as a specific kind of experience that interrelates between engagement with cognitive skills, emotional values and bodily capabilities.

The researcher strongly agrees to include specific syntactic data during the operational process for extending the LA artefact classification because it will support cultural artefact documentation in Malaysia. This study attempts to ameliorate LA artefact classification through: 1) terminology justification through cultural understanding; and 2) syntactical measurement of method such as component, size, material and design structure. Thus, the researcher supports the upgrading of traditional Malay weaponry artefact documentation for a new environment on design appreciation. In conjunction with reforming the LA artefact classification in the Malaysian context, there is a need to clarify every perspective of tangible and intangible information through syntactical analysis of the existing findings from previous documentation.

In addition, the context, culture, history and the user are potential dependent variables (Dewey, 1934; Locher et al., 2010; Lin, 2007) as they play a major role in amalgamating the identified inquiry. Chang and Wu (2007) propose the key of point

method to be considered: 1) the specific artefact; and 2) in-depth interview with the user to obtain their responses to the artefact. Analytical evaluation is crucial in constructing product classification without positing Malay analogic reasoning as outer features. Thus, the researcher sees that ethnography and case study are valid to obtain crucial data based on the artefact itself.

At this point of departure shown in Figure 2.2, the researcher inferred both artefact information and intangible knowledge into an appropriate guideline of term and design criteria in artefact classification of the Malay LA weapon artefact. This establishment of theory could lead to the identification process to fill the knowledge gap in Malay design setting. Structuring this guideline would allow to answer several inquiries on the Malay cultural design innovation, artefact characteristic in pragmatic observation, design evaluation, usage effectiveness & cultural knowledge understanding to pioneering product classification for cultural design stakeholders. In short, the researcher posits that the success of pioneering the Malay artefact classification would depend on the comprehension of artefact knowledge that should be structured as determined terminology, design characteristic identification and intangible knowledge in LA artefact classification. This is would unveil the ambiguity of culture design concept for early inventions.

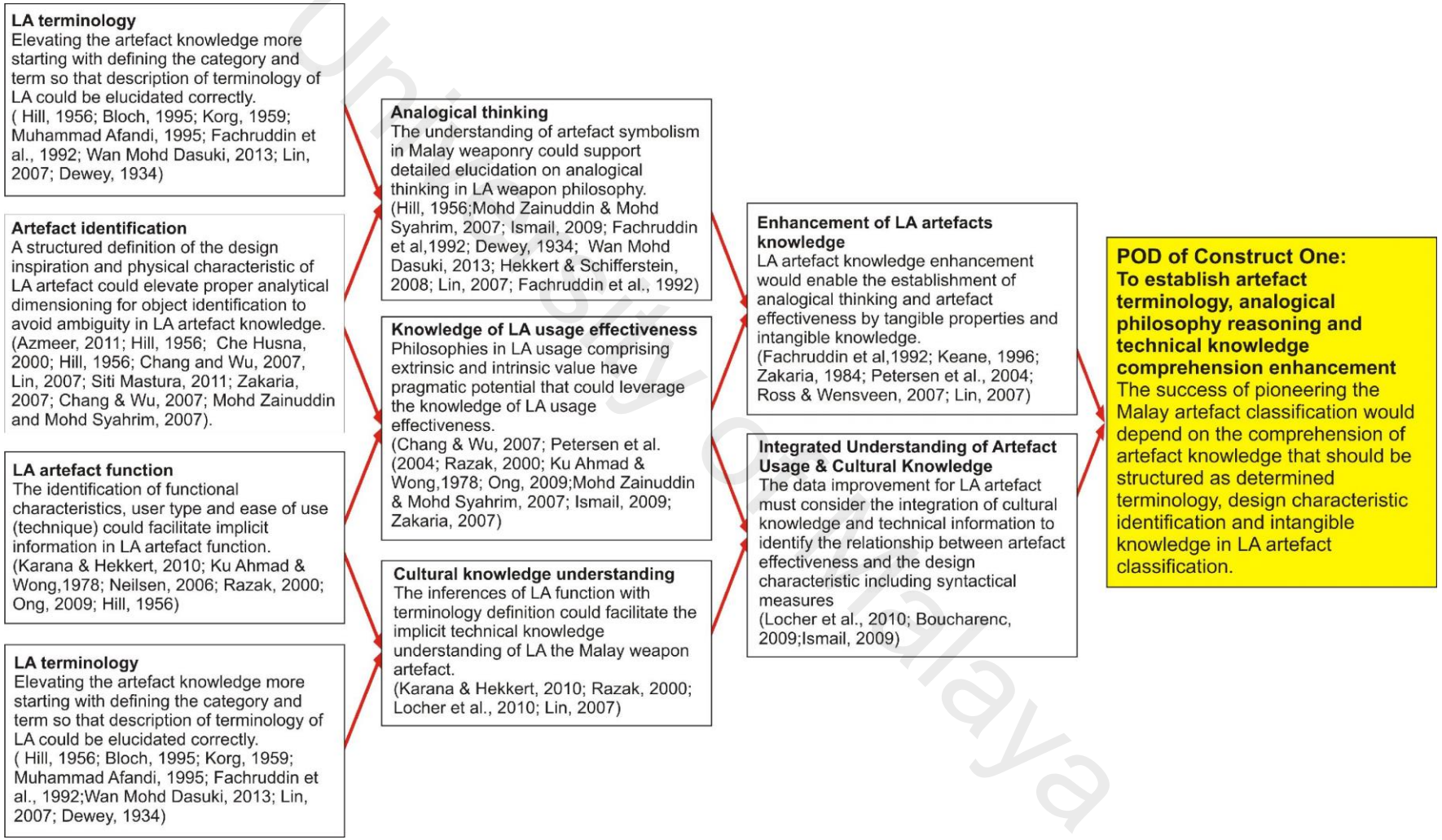


Figure 2.2: Theoretical development of LA design information and intangible value embedment in knowledge reformation for LA artefact classification. (Source: Siti Mastura, 2014)

2.7 Visualizing AE and Pragmatist Aesthetic to Establish Pragmatic Communication for LA Artefact

In order to configure the user-design knowledge comprising aesthetical product experience, the challenge is on how to visualize user experience which is once seen as controversial in previous design discussion. This research heeds initial recommendations to focus on vast discussion on aesthetic experience (AE) that engages the pragmatist theory (Dewey, 1934; Shusterman, 2000), Aesthetic Interaction framework (Petersen et al., 2004; Hekkert & Schifferstein, 2008; Locher et al., 2010), principles of AE (Desmet & Hekkert, 2007; Leder et al., 2004; Ross & Wensveen, 2010) and product experience (Hekkert, 2006; Laurans et al., 2009). This section describes the contribution of AE in relation to pragmatic understanding (users' motor skills), which is expected to facilitate new ways of understanding user behaviour through product interaction.

2.7.1 User Pragmatic Experience

In relation to senses and responses of individuals, the researcher sees experience as juxtaposing form of psychological involvement. However, a scholar defines the term 'aesthetics' as our senses and our responses to an object as a work of art which is mostly produced to gratify our AE (Hekkert, 2006). In psychology, the researcher found that the experience effect is generally used to refer to all kinds of subjective experiences that are valences such as experience that involved a perceived goodness or badness, pleasantness or unpleasantness (Desmet & Hekkert, 2007), common sense understanding and audience's personal responses coexist (Wright et al., 2008), helping conceptual approach in analysing experience between interactive stimulus (McCarthy & Wright, 2004; Wallace & Dearden, 2004) and interpreting the personal experience of the spectator as a mental ability to elicit affective experience (Hekkert & Schifferstein, 2008).

AE includes main degrees of experience elements consisting a psychological process or mental event and knowledge such as sensation, feeling, beauty, objectification, emotion, judgement, attitude, pleasure, taste, culture, understanding and interpretation of meaning although these elements intertwined positively and negatively (Parker, 2004; Aschraft, 2002; Hekkert, 2006; Lin, 2007; Domínguez-Rué & Mrotzek, 2014). Hekkert (2006) supports that these elements must intersect to explain the AE. He emphasizes the underlying process that plays an important role to understand our own experience with things around us.

Through these considerations, design elements of AE requires understanding of users' bodies and bodily action processes such as body senses, body behaviour, action meaning and movement. This research is encouraged to study particular close source (LA artefact) to provide vital information such as artistic faculty in user's mind (Margolin, 1997; Locher et al., 2010) and functionality of the artefact (Lin, 2007; Chang & Wu, 2007). Thus, a study of design (artefact driven) shall concern predominantly the element of user experience towards artefact usability to obtain pragmatic understanding of mental activity and body movement (action) that could contribute to AE knowledge.

2.7.2 Visualization of AE

AE was uniquely discussed by American philosophers in Pragmatism theory that has flourished to appreciate what has been perceived in human mind whenever a viewer see or interact with both tangible and intangible aesthetic of art. As aesthetic cannot be detached from an art, Dewey (1934) states that restoring continuation between refined and intensified forms of experience in art, event, activity and suffering are universally recognised to constitute experience. The experience includes how to measure the viewer's reaction and sensory experience on product appearance as it is one of the ways to understand the aesthetic feeling and emotion experienced in product interaction

(Laurans et al., 2009). This could be done through the exploration in cognitive neuroscience and evolutionary psychology on art artefacts that could leverages the empirical evidence for aesthetic experience research beyond the theoretical evolutionary considerations (Smedt & Cruz, 2010). Hence, the obtained empirical evidence and cognitive reaction towards aesthetic element is highly important as part of the AE system. On the other hand, AE supports that "close attention to objects" can play an important role in data acquisition of aesthetic knowledge and concepts (Gomez, 2007, p. 1). However, if there is ignorant information elevated in viewer's mind that is supposedly a potential to reveal the AE during product or artefact interaction, it could lose the vital idea of creation especially the philosophy (Trela, 1974; Gomez, 2007; Sirois, 2008).

To understand the human-product interaction, this study agrees that AE structure must be used to comprehend the actual design concept of artefact to support the debate. Figure 2.3 presents Leder et al. (2004) AE model consisting of five stages to impart AE involvement: perception, explicit classification, implicit classification, cognitive mastering and evaluation. As the model provides valuable information-processing stages which might reveal object specific AE, the researcher finds the model useful to differentiate between aesthetic emotion and aesthetic judgments as two types of output to help structure the AE knowledge.

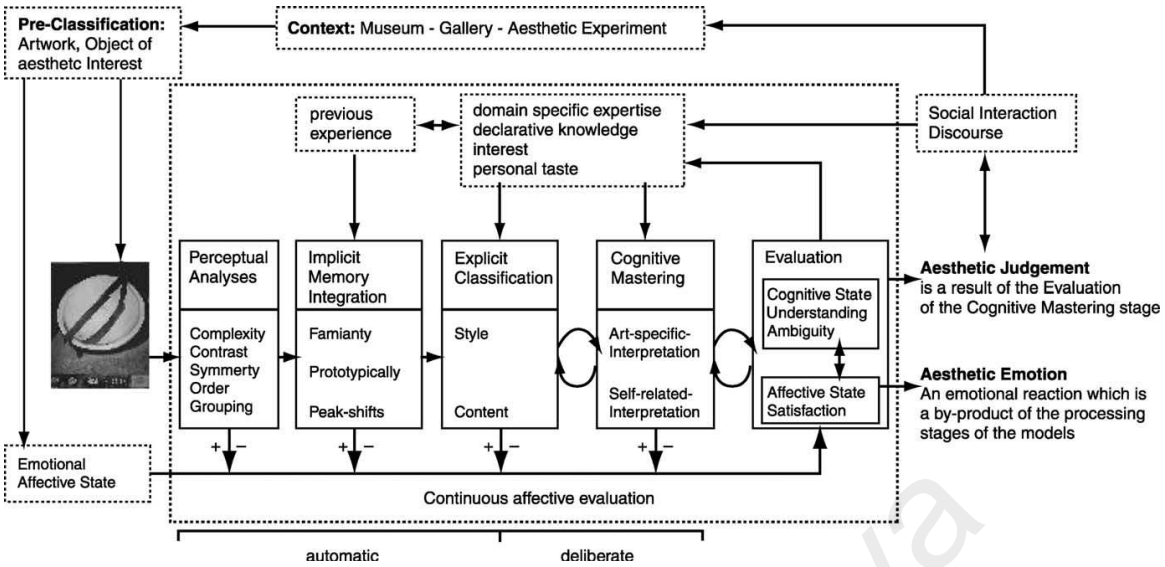


Figure 2.3: Aesthetic experience (AE) model by Leder et al. (2004)

However, AE knowledge is supposedly understood by focusing on AE principles especially to convey essential understanding of user experience. Table 2.2 shows important principles of AE developed by several scholars as a guide in seeking information processing in AE (Ross & Wensveen, 2010; Salem et al., 2006; Hekkert, 2006). These scholars have identified principles to impart AE in their model that includes user mind activities such as perception, explicit classification, implicit classification, cognitive mastering and evaluation into physical action and bodily movement.

To help understand the user's internal state and to support the elaboration of AE, this study concurs with these scholars that principles are important when assessing a cultural object. In summary, bringing AE principles into traditional artefact assessment requires understanding of information processing to have sufficient level of interaction details. Thus, this study posits that principles of AE remain crucial to aid efficient AI between the user and LA artefact to understand and establish psychological communication in cultural design concept.

Table 2.2: Principles of AE by 3 scholars

AE Principles	Functions
• the aesthetic has intrinsic value for practical use • AE of an object cannot be understood without its socio-cultural context, • form is inextricably linked with the AE, • both intellectual and bodily dimension of human being is active	To implement body movement data in user experience. (Ross & Wensveen, 2010)
• the aesthetics of the perception (AoP) • the aesthetics of cognition (AoC); the aesthetics of the action (AoA)	To assist the degree to which all senses are gratified, the meaning attached to the product and the way the user feel comfortable, satisfied or pleasant through bodily action. (Salem et al., 2006)
• maximum effect for minimum means • unity in variety • most advanced, yet acceptable, • optimal match.	To reflect universal psychological mechanism and cultural individual manifestations highlighting the underlying characteristic; sensitivity, perceived typicality and originality (the quality focused on). (Hekkert, 2006)

2.7.3 Pragmatist Aesthetic

In addressing Dewey Pragmatism theory, Shusterman (2000) highlights interaction as a fundamental characteristic of experience. He puts interpretation as a non-important note and that interpretation contributes problem in Pragmatist Aesthetic. However, Wilkoszewska (2012) disagrees as she believes he misleads pragmatism. She argues against Shusterman's interpretation notion and suggests to present both aspects of interpretation and interaction together along with the consequences of the pragmatist concept of experience. Nevertheless, the researcher concurs with Shusterman's idea of interaction in Pragmatist Aesthetic theory to convey the interpretative character as reconstruction of interaction to establish the person's experience using an artefact.

Furthermore, this study finds that the interpretation contexts of interaction in the Pragmatist Aesthetic theory are applicable to analysing the user perspective towards art object. It is proven when many design scholars use Shusterman's Pragmatist Aesthetic

in assessing a work of art, designing new product, providing new framework and establish the theory of aesthetic interaction (AI) into new paradigm (Petersen et al., 2004; Wright et al., 2008; Shusterman, 2008; Fenko et al., 2009; Locher et al., 2010; Ross & Wensven, 2010; Georgiev & Nagai, 2011). The scholars' agreement encourages this study to understand further Shusterman's Pragmatist Aesthetic theory to drive the overview for initial understanding of the principles in AE.

In two studies, the scholars extended Shusterman's notion on AE as a central to Pragmatist Aesthetic through their studies defining AE as a dynamic on-going interaction between two main units (Ross & Wensven, 2010; Locher et al., 2010). The two units that are person context and artefact context could provide massive information in expanding the interaction process. Locher et al. (2010) state that information gained in the process of interaction is vital knowledge on user mind, to which this study agrees that responses gained in the process of interaction shows how a user infers the tacit knowledge while expressing their experience towards an artefact they use. Therefore, his suggestion on visualizing the interaction by visual perception on artefact and person body performance could positively interact through feed forward and feedback direction in AE acquisition, simultaneously useful to support the understanding of human-product interaction in LA artefact.

In this study, the argument lingers on how the users of LA traditional artefact integrates with their internal AE, which is still vague due to the fact that the person operating the product does not usually understand the actual design concept. Furthermore, a product philosophy supposedly could help in reviewing the user's AE of LA artefact for establishing product classification (Lin, 2007). Therefore, the researcher posits that user experience of LA artefact would depend on pragmatic experience (behaviour of action) and tacit knowledge in the early stage of usability understanding.

2.8 Interactions in AE

This study finds that AI refers to the beauty of use, that one experiences beauty when physically interacted with product (Overbeeke & Wensveen, 2004), which is a nature in AE (Locher et al., 2010). In a pragmatist perspective, AE speaks a close link between analytic mind and bodily experience (Petersen et al., 2004; Desmet & Hekkert, 2007). Meanwhile, interaction is better known in the AE field and can be elaborated based on three main components in Pragmatist Aesthetic theory. It starts with attention to the relation between user and artefact: human (user), product or artefact and mind-body engagement. Nevertheless, putting AE at the centre of theorizing about user-design interaction is not just about how this study analyses and evaluates people's interaction with artefact, it affects the approach in understanding the artefact function, too (Locher et al., 2010). Moreover, in this study, conservation of cultural artefacts is important to define the bodily and intellectual dimensioning of user's nature.

On the other hand, Norman (2004) and Boorstin (1990) (in Wright et al., 2008) propose visceral, behavioural and reflective levels of design through the expression of user impression upon engaging with certain product. This notion, agreed by several scholars, is about the relevance of bringing back the topic of action into its relation with experience to recognize the value of user experience to support interrelationship when a device provides influences for the user to respond accordingly (Margolin, 1997; Ross & Wensveen, 2010; Verbeek, 2005). This study also agrees that engagement to certain object associated with traditional identity somehow provides particular input on how user can react with it according to their cultural mind ability. For example, combining the aesthetic of use (tactual experience) and the visual aesthetic in interaction is a vital point of departure to obtain the potential feedbacks for interrelationship understanding. This section further discusses insights on the user-design-experience interrelationship to understand the interaction.

2.8.1 Human-Product Interaction

Previous scholars proposed the relevance of bringing back the topic of action into its relation with experience during interrelation between user and his artefact (Margolin, 1997; Laurans et al., 2009). Locher et al. (2010) agree with these notion that any experiences developed within the process of interaction indicates the need for two constituents (the 'user' and the 'product'), which ascribes to the human-product interaction. For instance, the same method was adapted in the case study research by Ross & Wensveen (2010) wherein they employed specific value principle involving human's value in AI (Schwartz, 1992 in Ross & Wensveen, 2010). These scholars also suggest combining the aesthetic of use, (tactual experience) and the visual aesthetic in product interaction which is a vital point of departure for this research.

Hence, this study concurs to what has been presented by Petersen et al. (2004) in making distinct approaches between analytical and pragmatic aesthetics to support the point of departure of this research. An analytical approach to aesthetics focuses on the artefact and employs particular typology dimension to get a better in-depth view of its usage. Meanwhile, pragmatism sees aesthetic as a specific kind of experience that interrelates between context, history, culture and the user. By the same token, Sato and Chen (2008) emphasize that cyclical relationship between culture and artefact design in specific sub-areas could establish area-specific common foundations that allow research output to be cumulative and transferable.

Thus, this study agrees with Sato and Chen that culture should include as a vital variable in the research data acquisition of analytical and pragmatic approach. In general, both analytical and pragmatism approaches supposedly emerge in the constructing of the user-design systems to capture the important nodes in product

interaction research. Therefore, this study is recommending both approaches into the process of LA usage assessment to amalgamate it in user-design interaction.

Table 2.3 shows the three types of interactions to describe back-forward interaction and actual consequences of user and LA artefact interaction that could generate affective responses and provide feedbacks in pragmatic experience. In this argument, the interaction between the user and the traditional weapon artefact need to be enhanced with new reflection of human-product interaction (Desmert & Hekkert, 2007). By the same meaning, the cognition factor would expose useful user information considering the human psychomotor ability (Hekkert & Schifferstein, 2008). Locher et al. (2010) explains that "*... artefact interaction, mainly focused on opening up the functionality of product, toward a broader approach that seeks to enhance interpersonal and societal values, including personal, aesthetic and socio-cultural ones through the application of intelligence of artefact*." (p. 70)

In this study, the researcher is looking for concise approaches of experience dimensioning for bridging two interrelated contexts; user and artefact (Margolin, 1997; Shusterman, 2000; Hekkert & Schifferstein, 2008; Ross & Wensveen, 2010; Locher et al., 2010). These are summarized in Table 2.3.

Table 2.3: Type of interactions in AE (adapted from three scholars)

TYPE OF INTERACTION	COMPONENT	FUNCTION
Human-product interaction (Desmert & Hekkert, 2007)	• Instrumental interaction	• Refers to using, operating and managing a particular product.
	• Instrumental interaction	• The interactions that do not directly serve a purpose in operating a certain product.
	• Non-physical interaction	• To fantasise about, remember, or anticipate usage.
Aesthetic Interaction Framework (Hekkert & Schifferstein, 2008)	• Motor system	• To act upon the environment
	• Sensory system	• To perceive changes in the environment
	• Cognitive system	• To make sense of the environment and to plan action.
Artefact Interaction (Locher et al., 2010)	• Person context	• Users need information from the product to guide their physical response towards the coupling act between action and function. • Understanding the nature of a user's AE with design products
	• Artefact context	

These 3 types of interaction show that actual consequences of human-product interaction could generate affective responses in pragmatic experience. On the other hand, the absence of an expected consequence will be able to elicit affective experience. By this degree, Hekkert and Schifferstein (2008) suggest that intertwining the component of human-product interaction between experience and interaction should be understood thoroughly (Figure 2.4).

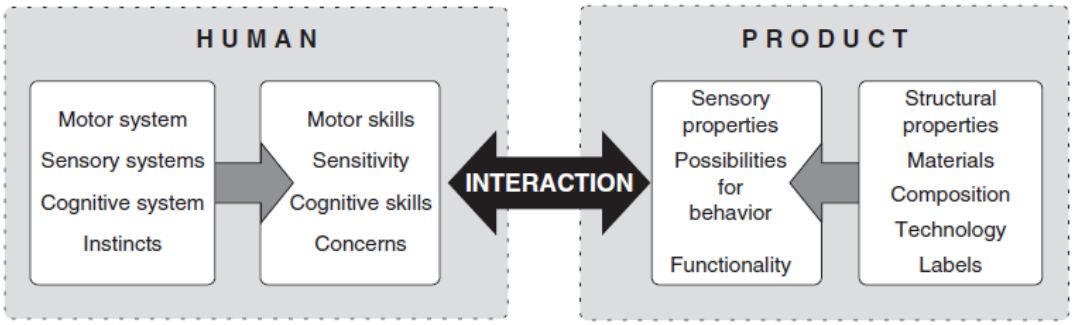


Figure 2.4. Model of Human–Product Interaction adapted from Hekkert and Schifferstein (2008)

However, Hekkert and Schifferstein's model lacked emphasis on the influence of cultural perspective in the interaction of the intangible input of philosophical performance in both components (human and product). The researcher finds that this gap allows the Malay AE system enhancement to fit the understanding on how people experience the LA artefact. Therefore, this researcher agrees that visualization of interaction, visual perception and body performance would allow the understanding of human-product interaction in LA artefact AE acquisition to tailor the pragmatic experience and user cognition.

2.8.2 Aesthetic Interaction (AI)

This section discusses the details of the theoretical framework of AI to see how it fits into the interaction aspect. According to Hekkert & Schifferstein (2008), three systems work interactively allowing human (users) to provide feedbacks of their experience through product interactions and user actions. The 3 systems are: 1) a motor system to act upon environment; 2) a sensory system to perceive changes in the environment; 3) a cognitive system to make sense of the environment and to plan action. The researcher finds these three systems require a distinctive approach to understand further the context of user-product interaction.

Therefore, in line with getting feedback from the user, this study employs interrelated approaches proposed by Petersen et al. (2004) that are analytical and pragmatic aesthetics. Hence, the gained experiences in artefact usage are potentially broadened in a way to amalgamate it in user-design interaction through both approaches. It also provides a philosophical framework compiling structured cognition, emotion and affect (Wright et al., 2008) which encourages us to explore the interplay between LA user and the design.

Meanwhile, in the concept of interaction of two contexts of person and artefact, the researcher finds that Locher et al.'s (2010) AI framework is developed based on the information-processing flow in vertical interaction useful (Figure 2.5). They indicate every dynamic interaction of user and product interaction both in the form of feed direction to guide the physical response toward the couplings between actions and functions. They defined inherent information as the information provided by the natural consequences of taking an action by touching an object while simultaneously observing it visually, whereas inherent feedback as the information returned from acting on a product's action possibilities.

As proposed by Petersen et al. (2004), pragmatism approach supposedly stays at first level of person context. The researcher was encouraged to look into Locher et al.'s AI framework to obtain both user context (cognitively-driven) and artefact context (artefact-driven) to elicit pragmatic information on local culture and its artefact. The researcher concurs with Locher et al.'s AI framework that was proven to enable and increase the knowledge coordination by managing it through information-processing to obtain the positive or negative values assigned to products based on pre-existing knowledge in the users (cognitively driven).

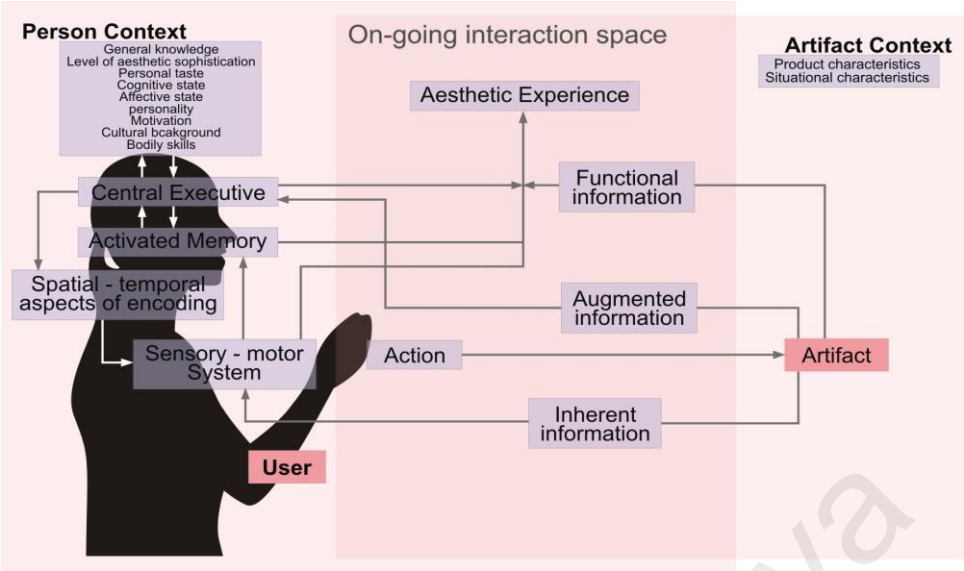


Figure 2.5: The sample framework of AI by Locher et al. (2010) describes the coupling of user's actions and a product function

However, in Locher et al.'s discussion, the framework tends to lack emphasis on the intangible psychological information such as the cultural behaviour measured in dynamic interaction between both person and artefact contexts. Alonso et al. (2011) support that psychological information also offers inherent feedback to subconscious interaction, which could allow updating the AI system to fit with the understanding on how people experience the LA artefact. Thus, this study recommends the involvement of users' tactual behaviour and psychological responses in LA artefact to aid the demystification of the intangible knowledge such as philosophical measure of body movement, artefact typology and usage dimensioning in AI.

2.8.3 Experience Integration of Body and Artefact Elicits Cognitive Responses

Previously, many scholars used Dewey's Pragmatist theory to develop design framework as an integral perspective on user-centered assessment through product interaction context (Shusterman, 2000; Petersen et al., 2004; Ross & Wensveen, 2010). Then, it led to the next level; how can the user bodily react to complement user cultural experience towards effectiveness and efficiency in artefact usage. Therefore, since the

need for an artefact experiences amalgamation for AI has not been met yet in cultural type object, this study turns to the involvement of memory and physical practice in human-product interaction to find clues in the design-user interrelationship. For instance, the user pragmatic behind traditional object that is rarely discussed in cultural artefact context contains potential massive information that could establish the understanding of artefact experience (Siti Mastura et al., 2014). It is supposedly involved in LA artefact evaluation to see how it affects the AI.

The scholars highlight the use of appropriate ways to study aesthetic feeling and emotion experienced in product interaction and how to measure the reaction on product appearance and sensory experience (Laurans et al., 2009; Spradley, 1980; Fetterman, 2010). In two studies, the scholar finds that both aesthetic feeling and emotion dominate product experience at each stage of user-product interaction to create a long-lasting positive experience in user's mind (Fenko et al., 2009; Georgiev & Nagai, 2011). However, this study foresees a far cry from the user pragmatic knowledge and user cognition in measuring the reaction of usage application that should be applied in cultural artefact study if positive experience is anticipated.

Hence, the process of obtaining data on user participation in artefact usage could be efficiently comprehended. By the same token, apart from AI Framework of Locher et al. (2010), the researcher also agree with the suggestion by Spradley and McCurdy (1972) and Fetterman (2010) that cognitive responses are referral idea towards the interaction in specific cultural heritage product. In this study, the investigation on interaction underscores the Malay philosophy and describes the representational idea. Therefore, due to the potential of pragmatic cognition, the researcher recommends the amalgamation of physical practice of artefact experience into LA integrative memory to establish the design-user responses.

2.9 Utilization of AE Knowledge in User Context and Artefact Context

Previously, most scholars further posit combining the method and experience rather than the method alone by acknowledging person context and artefact context (Petersen et al., 2004; Locher et al., 2010; Margolin, 1997). This study sees that the AE knowledge and product information could facilitate the user pragmatic experience to mitigate the limitation of the narrow information of LA artefact and evoke the identification of functional cultural design characteristics. This section explains how to utilize user pragmatic context and artefact context in AE knowledge development.

2.9.1 Artefact-User Pragmatic Knowledge

Ross and Wensveen (2010) extended Locher et al.'s (2010) framework with similar remarks to further discuss user bodily skills in AE. They note that the evaluation involving bodily dimension consists one's skill especially in operating some particular tool. Thus, the findings from the literature review points that user participation in LA artefact assessment is a vital method to comprehend the pragmatic experience in artefact application. Data is gathered by multi-level observation approach (Spradley, 1980; Fetterman, 2010). In this study, if the design stakeholders are accustomed to understand the real experience of beauty that comes from mastering the LA technique, the proven user pragmatic information and justified knowledge of design effectiveness will help to boost future development of Malay cultural design innovation.

However, user cognition is also important as experience and bodily dimension that also require attention. In this instance, the researcher argues that AE in most AI framework mutes the intangible connection in user creative mind and artefact philosophical information, whereas the connection helps stabilize the design-user knowledge enhancement to amalgamate into pragmatic knowledge (Siti Mastura et al., 2013a). Due to this importance of knowledge integration, the researcher posits that

artefact-user knowledge (cultural experience and bodily dimension) could ameliorate the pragmatic AI evaluation of LA artefact design.

2.9.2 Alignment of Design-User Experience Knowledge

By the same token, the establishment of mutual relationship bridging two components (user and artefact) to understand user cognition in LA knowledge is to mitigate ambiguity of product function and how it affects the user, especially in cultural innovation as they are always seen to contribute to design society. This is what Wright et al. (2008) strongly suggests in constructing a philosophical framework that compiles structured cognition, emotion and affection to support the knowledge alignment process.

In line with developing design-user interrelationship, this study foresees the need to amalgamate the potential philosophy context to complement both person and artefact contexts in AI framework for wide scale reference for cultural product design using the analytical dimensioning and pragmatic assessment proposed by Petersen et al. (2004). Moreover, Laurans et al. (2009) encourage this study to use the Malay scholars' propositions to set analogical thinking in line with design-user interaction system due its potential in visualizing a cultural concept. Therefore, the alignment of artefact experience and user interaction is vital to augment the philosophical idea of LA artefact context and LA user context for establishing the relationship of AE knowledge.

2.10 Summary of Theoretical Proposition Two: AE

This section focuses on the document reviews for identifying the specific contexts of AE contribution including the user's mind and pragmatic experience, interaction between user and artefact, and utilization for pragmatic understanding in artefact usability that play a major role in design-user interrelationship system. The affecting components were understood as they are well established in artefact design and user AI but no studies have been done yet to explore the additional context that is the intangible

knowledge of user mind. The above discussion has analysed two suitable AE approaches including Pragmatist Aesthetic and AI and potential Aesthetic Interaction Framework to drive the LA assessment. To increase the internal validity for LA artefact research, the amalgamation of user philosophical pragmatic knowledge into AI would enhance the future AI theory, especially in Malaysian design culture.

(a) ***AE approaches for LA assessment***

To achieve the study proposition, two consecutive approaches (Pragmatist Aesthetic and AI) of analytical dimensioning and pragmatic assessment will be the fundamentals for LA assessment procedure. The two approaches required ethnographic method consisting active participant observation and open-ended interview to obtain both data accordingly. The researcher found that both approaches are the best to gain understanding of the expert user behaviour when experiencing real artefact usage in real environment settings with pragmatic dimensioning (technicality of design feature typology of LA artefact usage and tactual behaviour). On the other hand, pragmatic assessment on these categories of user context has been a relevant process to convey idea and interrelation between LA artefact context, culture influences (analogical thinking and cognition), and the user factor (practices and pragmatic; psychomotor skill).

(b) ***Aesthetic Interaction (AI) theory for LA assessment***

The researcher identified Aesthetic Interaction Framework as an essential platform to achieve the research data proposition that couples person context and artefact context. The review suggests that every component of principles and characteristics in AI is able to support the knowledge exploration in user and artefact contexts for establishing Malay cultural design. This is vital to Malay cultural product knowledge preservation applicable to establish local product development in new culture environment. As

human-product interaction process explaining the implicit information to mitigate ambiguity, the user's intangible knowledge could affect better influences in cultural design industry.

(c) ***Amalgamation of LA philosophical knowledge for AI theory enhancement***

Interestingly, the argument on intellectual performances and bodily dimension in human-product interaction highlights the potential of philosophy issue and interconnection between AE with components in user dimension. The researcher recommends that artefact-user philosophy context be literally elicited in enhancing the often-ignored role of the body movement in aesthetics assessment. Thus, extending the AI framework theory with interference in philosophy knowledge is a vital step in developing user-design theory because it will support in systematizing a new paradigm of cultural design guideline as valid reference in Malaysia.

These affecting components were understood as they are well established in product design and user AI but no studies have been done to explore the additional context that is the intangible knowledge of user's mind, especially in Malaysian local artefact. A knowledge consisting three components (user, artefact and usage) is proposed to coordinate cultural knowledge preservation while documenting the past experience of local expertise. Making use of the local information inspired by creative thinking in cultural heritage innovation could elevate the long ignored knowledge to be well received. The knowledge elicitation will certainly benefit the design industry across the cultural region especially Malaysia. Finally, the researcher concludes that the establishment of design-user (DU) interrelationship system in Malay culture design would depend on pragmatic understanding of expert user AE (action movement) and amalgamating intangible information of cultural artefact (LA) towards designing a behavioural ergonomic product. Figure 2.6 summarized the key discussion points.

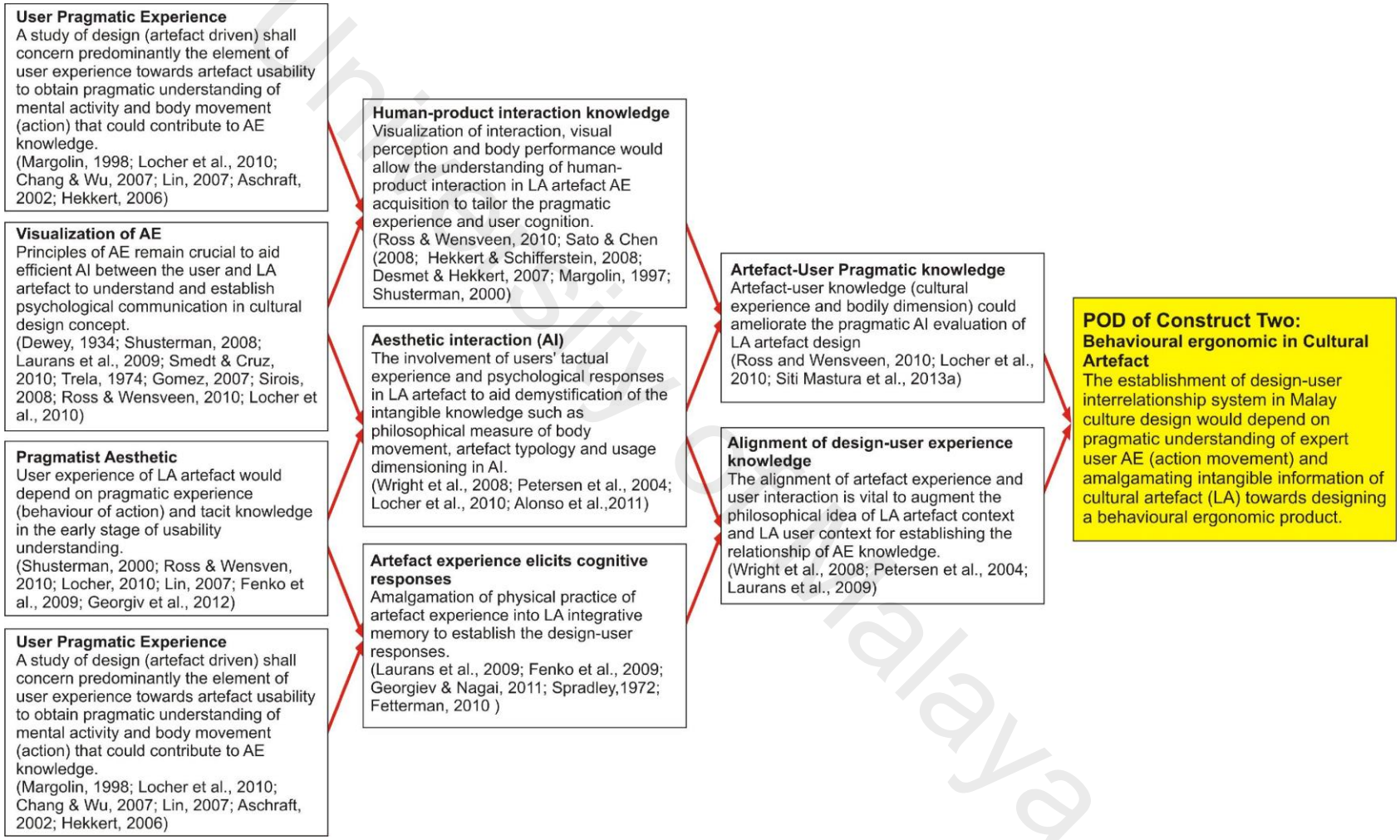


Figure 2.6: Theoretical development of on pragmatic understanding of expert user behaviour (action movement) and amalgamating AE information to establish design-user system (DUs) in Malay cultural design . (Graphic: Siti Mastura, 2014)

2.11 Measuring User factor for Design-user Interrelationship

In the previous discussion, the AI is comprised of AE elements and principles that have been established by art and design scholars. The discussion included the user psychology in artefact design. This study aims to investigate the interrelationship that arises between user and artefact and to use the finding of behavioural analysis towards the development of an innovative cultural design. This study considers finding a new approach to make use of the obtained descriptive information from the ethnographic approach efficiently. The third construct includes a review to understand the user's characteristic to measure the cognitive and psychomotor performance in the process of establishing the aesthetic interrelationship in LA artefact.

2.11.1 Knowing the User Characteristic

In selecting the suitable user, several aspects will be considered to ensure relevance and these are experience, cultural background, education, familiarity, motivation and personal taste (Margolin, 1997; Norman, 2004; Massaro et al., 2012; Locher et al., 2010; Shamsul, 2013). Although, Norman (2004) asserts that the reflective level does not have access or control over sensory input or behaviour, Locher et al. (2010) posits that along with the behavioural level of processing, central executive corresponds in reflective level, too, which is very sensitive to the factor of experience, training, culture, and education. In this respect, the researcher agrees with Locher et al. (2010) that these four factors are the closest in evaluating the cognitive and behavioural response in LA artefact. Therefore, these four variables (experience, training, culture, and education) will be used in identifying user characteristic to provide sufficient information to understand the pragmatic and the cognitive ability to justify user participation within the LA artefact context.

By the same token, the user participation in product interaction could explain the factor in design-user relations and their AE (Margolin, 1997; Hekkert & Leder, 2008). The literature highlights that there is a need for new theoretical model that can help designers to use the power of the collective user experience to create a product milieu (Margolin, 1992; Locher et al., 2010; Shamsul, 2013). In artefact assessment, both experience and user dimension are ways to fill out the researcher's understanding about user pragmatic responses (ergonomic rapport) and psychological purposes. In addition, Margolin (1997) suggests four dimensions of relationship that will help designers to elevate the essential point user context that includes:-

i. The social dimension - understands the product's contribution to social and environmental impact, either positive or negative. It shows that what the users do with the product is important. In a community park, for example, a group of teenagers are stimulated to misuse the park facility without thinking that it will cause vandalism. Therefore, consideration of what possible actions are taken with the artefact availability brings social concern whether the value of design will enable destructive or constructive behaviour;
ii. The inventive dimension - the inventor use his/her ability to conceive new functional artefact that will be valued by the user. They envision product possibilities based on the perception of what people need or find useful;
iii. The operational dimension - the designer does not understand well enough how their users learn to operate the device. For example, *klewang* (single-edge longsword) tool usage does not seem familiar to modern young people. It is a tool originally used for domestic farming instead of weapon. Thus, the design of the product has to be labelled; and
iv. The aesthetic dimension - the social perception of a designer is changing from emphasizing on the form to focus on the use.

In Malay artefact context, the lack of data provides the opportunity for this study to fill the gap for a new cultural setting. Hence, human skills are important to be infused during the interaction between design and user context (Ross & Wensveen, 2010; Alonso et al., 2011; Locher et al., 2010). The scholars highlight four categories of human skill; cognitive, perceptual-motor, emotional and social skill. Locher et al., (2010) explain that these human skills are dynamically interrelated during interaction between person context and artefact context, which is called information-processing in AE. The researcher agrees with previous scholars that the constructed information-processing in Aesthetic Interaction framework highlights the importance of AE on an artefact to understand what is happening when user perceives an artefact.

However, the above literatures fail to determine the role of user characteristic on the specific culture of human skills. Although AI scholars have a vast discussion on the relationship between design and user, most of them has placed the user context in the general discussion except Margolin (1997) and Locher et al. (2010). Both emphasize that understanding the user characteristic remains crucial to value the user experience. Therefore, the researcher suggests further studies on the development of behavioural data in the new cultural environment by including the topic of action and bringing it back into relation with experience.

2.11.2 User Eye Behaviour in Perceiving Artefact Design: Eye tracking

Association between behaviour and preference is significant to bridge the knowledge of the user to the artefact. The establishment of design guideline system based on design-user interrelationship should converge between analytical understanding of LA artefact physical and pragmatic assessment of user's behaviour. The convergence depends on the success of the Malay artefact comprehension through the perceiving process on design features and intangible knowledge. The design features are derived

from the outer level as independent variables such as material, colour, form, texture, surface pattern, decoration, and other details that could display symbolic meaning (Fachruddin et al., 1992; Lin, 2007). Ample evidence shows that many physical properties of artwork are detected by the visual system automatically or pre-attentively by genetically determined, hard-wired perceptual mechanisms.

Interestingly, the researcher found that the visual detection on an artwork is a reading process on the creative input vastly discussed for almost 100 years. In the second quarter of the early 20th century, previous researchers began to explore eye-tracking movement associated with still images and interactive motion designs (Wallraven et al., 2009; Shamsul, 2013). There is a wealth of literature dealing with fixation pattern in reading, interactive computer interaction and picture perception (Abel, 2010; Santella, 2005; Schütz et al., 2011; Shamsul, 2013). For instance, Buswell (1935) identified people's eye-movement patterns and perceptions when they look at the coloured pictures (in Shamsul, 2013, p. 41).

Previous study by Glaholt et al. (2009) indicate that fixation times in eye movement test can be used to predict selection in large arrays of design and they might also be employed to estimate preferences for whole stimuli as well as their constituent features. In Glaholt et al.'s study was successfully predict participants' preferences for novel feature combinations in a two-alternative forced choice task by ranking features based on fixation times. Glaholt et al. used fixations time to measure the strength of the association between looking behaviour and preference to obtain a pattern of findings in a very different stimulus domain. Therefore, this study foresees his approach in using fixation times could help in syntactical analysis on the LA artefact designs.

Typically, studies employing eye-tracking evaluate the audience or user toward a static artwork such as painting (Wallraven et al., 2009; Locher, 2006; Massaro et al.,

2012), graphic and photography (Glaholt et al., 2009; Chua et al., 2005) and landscape design (Schütz et al, 2011; Shamsul, 2013; Dupont, 2014). They evoke the point that visual perception could provide valuable information that actively involves user's cognition. In their studies, most of the stimuli used photographic images. Only when the digital era give major influences in information technology in the entire world that websites, interactive graphics, online trade and transaction and social media, eye-tracking studies rise to allow the human-computer interaction design community to learn more about the users' deployment, visual attention and design product interface that more closely fit human requirements.

As many researchers use eye movement test as a method to reveal covert perceptual and cognitive process that trigger the visual perception and aesthetic evaluation, it is worth to look into the development of eye tracking method in AE. Based on the data obtained from keyword search of "eye tracking" in Google Scholar (619 articles on Malaysian design), it was found that eye tracking has been used to understand user behaviours in areas of tourism, e-Commerce, e-Learning, package label and designs, gaming environment and affective interaction design, all of which makes use of fixation and heat maps generated from eye tracker (Sivaji & Soo, 2013). In a recent study, Tzuaan et al. (2014) found that Malaysians are highly attracted to prominent design elements such as using large buttons with good affordance to speed up decision-making process in determining the price of the hotel. By comparison, there is a high tendency for Malaysian users to hold back their feedback during usability testing that could impact the results (Sivaji & Ahmad, 2014). However, the study of Malaysian users seldom involves users who deal with a cultural artefact.

In addition, data on eye behaviour investigation on cultural artefact design is scarce. Most psychological discussion on design is based on qualitative measurement. Instead

of staying on the same parallel paradigm, this research attempts to add empirical studies of aesthetic on a 3D artefact to extract user cognition information through two stages. Firstly, this study anticipated feedbacks of aesthetic judgment from information extraction between user and product based on the past experience specifically on time and duration. Second is through observing how and where the users' eyes fixate while evaluating the LA artefact images. Furthermore, by ranking features based on fixation times, successful participants' preferences for novel feature combinations in particular could be predicted. Particularly, it is to understand the eye gaze behaviour that could provide a certain quality of aesthetic judgment and interrelated communication between user and LA artefact. Therefore, the researcher posits that eye behaviour could reveal vital cultural design information in a form of feed-forward feedback while perceiving the artefact design using eye tracking method.

2.11.3 Information Processing Theory

In line with user-artefact design encoding, Wallraven et al. (2009) and Massaro et al. (2012) highlight one of the most well-known models of attentional processing by Itti & Koch (2001) where several computational features (based on colour, intensities, and orientations of image gradients) are integrated into a so-called 'salience map'. According to Itti & Koch (2001), the model of salience mapping predicts salient regions in an image, regions that are likely to draw attention to them based on their low-level properties. It is common to consider such factors in high-level cognition, but because such factors can influence the allocation of attention, they influence lower-level cognition as well (Chua et al. 2005). This model has been shown to account for a significant proportion of fixations participants made while free-viewing different images (Parkhurst at al., 2002).

For instance, Wallraven's et al. (2009) study shows users have significant preference for certain artistic styles and were based on both low-level and high-level criteria during salience mapping on stimuli. They added eye movement to reveal the time course of the aesthetic dialogue as observers try to interpret and understand the work of art. An eye tracking test was conducted to compare the behavioural results and computational measures of complexity and information content. Wallraven et al. (2009) conclude that low-level saliency measures based on the 'simple method of pixel counting' were surprisingly effective in capturing part of the human AE. Similarly, in recent studies, human subject represented in stimuli images received most gaze attention in content-related top-down processes (Massaro et al., 2012; Shamsul, 2013). On the contrary, bottom-up processes mediated by low-level visual features, affected gazing behaviour when looking at nature-content images. This low-level saliency shows that the information processing in these researches is attributed to the anticipated emotion perception from the observer. Thus, salience mapping is a proposed method to construct the eye movement test.

On the other hand, Locher et al. (2010) elaborate how both artefacts driven and cognitively driven processes (referred to as bottom-up and top-down processes, respectively, in Information Processing Theory) underlie user-product interaction and the resulting AE in their Aesthetic Interaction framework (p.71-77). They are as follows:

i. There is a continuous, dynamic bottom-up/top-down interaction between the properties (form) and functionality of the artefact, the user's sensory-motor-perceptual (i.e., visual, handling or active touch, auditory) processes involved, and the user's cognitive structure;

ii. The "central executive" monitors and directs the user-product interaction, which in the present account is conceptualized as consisting of limited-capacity, effortful control processes that direct voluntary attention to the artefact in a cognitively driven way. An initial impression of an artefact is formed based on information obtained from seeing and handling it. The second stage of processing is to understand the focused attention to its form and functionality and followed by direction of the central executive;

iii. The intertwining of perceptual-motor, cognitive, and emotional elements leads to AE. The two driving forces of the system are the artefact itself and the person context that reflects the user's cognitive structures. The AE is a product of the dynamic, on-going interaction between these two components of the system; and

iv. The top-down and bottom-up component processes underlying thought and action create both meaning and aesthetic quality of the artefact from which the AE with the artefact and the resulting affect emerge.

In turn, the evaluation of data uses the theory of information processing in eye-tracking test that should be gathered from users through their eye movement over an artefact in a sequence of rapid jumps, or saccades, followed by pauses or fixations. The number, location, and duration of fixations used to scrutinize the artefact visually constitute the spatial-temporal aspects of encoding (Locher et al., 2010). From the above studies, none integrates the observer behaviour and feedback nor syntactical features of a 3D object as most of the studies particularly evaluates a 2D artefact. Therefore, the salient map model that closely work with top-down process in information processing theory encourages this research to evaluate the dynamic interaction between user and artefact that could support the understanding of cultural behavioural cognition.

2.12 Variables Components Involvement in Eye Tracking

This section integrates the needs in investigating eye behaviour. In the literature, the researcher attempted to identify the component to include in the test construction for the third objective.

2.12.1 Experts' Experience through Eye Behaviour in Eye Tracking

Many studies have concluded that both experts and novices approach the task of information search from different perspectives particularly as they each contribute varying degrees of existing knowledge to the search process. In turn, these factors reflect both the sources that a user will look for, as well as a searcher's reliance on browsing behaviours (Margolin, 1997). Some studies show that eye movement strategies can be different for expert and novice players. For instance, Land and McLeod (2000) investigated eye movement strategies in cricket players and found that better players used their eye movements more effectively to predict future locations of the ball. Schütz et al. (2011) found that eye movement strategies can be different for expert and novice players, but these groups of people do not necessarily show that the eye movements themselves make the difference.

On the other hand, Sheridan & Reingold (2014) explored the ability of expert and novice chess players to distinguish between regions of a chessboard that were relevant to the best move on the board and regions of the board that were irrelevant. They found that both the experts and novices spent more time fixating the relevant relative to their relevant regions of the board. However, the experts were faster at detecting relevant information than the novices, as the experts were able to distinguish between relevant and irrelevant information in domain-related perceptual processing. Hence, this study finds that experimental paradigm is applicable to manipulate relevancy of experts' knowledge in LA usage under tightly controlled conditions.

However, the studies on Malaysian users seldom involve specific cultural user who deal with a cultural artefact. The previous studies encourages this research to employ the recognition of expertise variable next to experience, training, cultural background and education. Hence, along with experience, training, cultural background, and education, the recognition of one's expertise in LA usage motivates the researcher to define the best respondents to be involved in the eye tracking test.

2.12.2 Syntactical Features of Design Stimuli

With respect to the artefact context, it is shown that the feature of an artefact provides a user with a different type of information (Locher et al., 2010, p. 72). An artefact's appearance can convey its aesthetic and symbolic value as it can communicate functional characteristics and ease of use and draw attention by visual novelty and communicate ease of product categorization. Locher et al. (2010) also highlight the physical properties as an important factor in human-product interaction.

> *'In presenting product properties, interactive artefacts can be designed so that their use contributes to a dynamic aesthetic interaction between their form and functionality and the user. The aesthetics of appearance of an artefact must always be taken into consideration as contributing factors to a user's interaction with it.*
>
> (Locher et al., 2010, p.73)

As Norman (2004) once posited 'attractive things work better', this study is in line with previous studies to research further on human mind by visualising user cognition by employing eye-tracking evaluation to understand how LA design would attract the user's eye fixation. Tractinsky (2012) support Norman's notion that visual aesthetics refers to the beauty or the pleasing appearance of things, which important to be studied

in the field of Human-Computer Interaction (HCI) to suggest directions for future work in human-product interaction field. For instance, artefact appearance (aesthetic and symbolic value) can convey design elements that can draw attention through visual novelty (Jacob & Karn, 2003) "to correspond with functional characteristics, ease of use and product categorization" (Locher et al., 2010, p.72).

Meanwhile, in choosing eye fixation metrics, previous studies (Wallraven et al., 2009; Massaro et al., 2012; Glaholt et al., 2009) highlight well-known models of 'salience map' by Itti & Koch (2001) to predict salient regions in an image or regions that are likely to draw attention from the person based on significant proportion made while free-viewing different images to explore design and syntactic features such as material, colour, form, texture, surface pattern and decoration details (Schwarzfischer, 2011). The mapping uses time, location and duration of fixations to understand if the aesthetic factor could also affect the positive feedback. Wallraven et al. (2009) and Massaro et al. (2012) supports Itti & Koch approach that have proven a strong relation between salience mapping and syntactic dimensioning on stimulus when a user can respond using different types of information on the artefact appearance.

There is a wealth of literature dealing with fixation patterns in reading such as interactive computer stimuli and picture perception on font, logos and also of colour preferences (Shamsul, 2013; Dupont et al, 2014). In these studies, longer viewing time and multiple fixations are caused by occurring memory of specific scenes during the test to result in better data encoding (Koski et al., 2013; Bélanger & Rayner, 2013; Sheridan & Reingold, 2014). However, there is a lack of discussion on what can trigger salience mapping, whereby the specific feature that influences the process of recalling the memory could be discussed further compared to fixating on the area of interest of the stimulus alone. In turn, a rare discussion on eye movement investigation from the

perspective of ease of use encourages this study to understand the syntactic properties of an artefact. Therefore, this study integrates the method of analytical observation on syntactical design features to reveal the eminent criteria of artefact information (artefact classification) and user factor (usage effectiveness and movement).

2.12.3 Perception and Preference

Previous scholars have been relating that the integration of aesthetical communication requires a human-product interaction that is reciprocal. Multiple points of considerations such as behaving and influencing each other are the key points in experiential concept topic. The researcher sees that product experience in human-product interaction massively contributes to the understanding of cognitive response. To look into what one can have in mind while operating LA is a new paradigm in Malaysian artefact study which comprises a degree of aesthetic cognition.

Cognition is about the mental processes of perception, learning, memory, judgment and reasoning both analogic and logic input, as contrasted with emotional processes. Human memory and cognition are defined by Ashcraft (2002, 2nd eds.) as the mental events and knowledge that could be used to recognize an object, remember name, have an idea, understand the sentence or even solve a problem. In one design-research process study, Deckers et al. (2010) posit that the generated design has relevant knowledge for designing perceptive activity in an artefact to allow perceptual-interaction crossing between a person and the artefact. They posit that a person can get the feeling of sharing a common space with the artefact by considering perception as active perceiving process on the perceptive artefact (Lenay et al., 2007; Deckers et al., 2010). This process results from dynamic coupling between a person's action and her/his environment.

On the other hand, preference is considered as the most suitable approach in assessing visitor's perception of particular images of a subject. This approach significantly reduces the ability to interpret or validate any differences between expert and non-expert perceptions of these images (Shamsul, 2013). Regarding the outcome of visual aesthetic whether it influences the user's perception of performance, Norman (2004) claims 'that attractive things works better'.

Scholars suggest human mental activities as the established direction where researchers should start looking for empirical evidence that could provide new solutions in revealing the measurable information on user cognition (Aschraft, 2002; Smedt & Cruz, 2010). The entire elements in cognition contribute to processing information needed. Likewise, the psychomotor is about a response involving both motor (user's movement) and psychology (cognition). It results in an observable activity, a human response to internal and external stimuli which is actually the user's behaviour (Itti & Koch, 2001). The interrelationship between each unit plays a different role in attributing communication to a particular design. Thus, this research considers both cognitive and psychomotor information to understand the unit of analysis (user and LA artefact) to establish the interrelationship between user cognition and the design of an artefact.

The literature shows that application of computational approaches such as eye tracking in product perception and preference could indeed trigger a new chapter of knowledge establishment in Malaysian design industry. The literature shows that the perception and preference factors influence the user's cognitive and psychomotor response. Therefore, the researcher posits that the user's cognitive behaviour is the influencing factor for user perception and preference in a computational eye-movement analysis to reveal dynamic visual interaction.

2.13 Knowledge Inferences of User and Design Interrelationship in Behavioural Ergonomic Study

This section proposes the inferences of knowledge involvement between the experts' experience and the importance of syntactical features of design stimuli from the previous discussions to establish new knowledge on design-user aspect.

2.13.1 Computational Approach to Understanding User Cognitive for LA Artefact

The researcher raises two points of departure from initial literature to enhance the construct validity. The usage of computational test could analyse the user expert preference through salience mapping of tangible syntactic features of LA artefact to bridge the understanding of user preference towards cognitive responses and behavioural ergonomic design.

Based on the literature, the researcher found that trained users (expert) in LA usage play an important role in the eye tracking test based on their related experience, training, cultural background and education. Interestingly, the novices have a more ambiguous expectation of their search needs and goals that they may often spend more time evaluating the abstracts presented to them (Shamsul, 2013). Conversely, some of these studies have evaluated this aspect by examining the amount of time that users take to construct their queries, indicating that experts are often able to conduct faster searches. In short, salience mapping is useful in scrutinizing the artefact using fixation and eye pattern movement in eye tracking test of an expert users familiar with the object they use. Therefore, this study attempts to elicit distinctions in a user's mind on the artefact-user interaction towards the potential stimulus (LA artefact) by making use of pre-existent experience.

In this study of cultural design, the user's knowledge seems like a fertile ground for the application of eye-tracking in artefact usability evaluation. Eye tracking studies show that fixation is a popular metric employed by prior researchers. It is entirely dependent on the intervening saccades of fixation that can be detected and recognized by the researcher. Even though most of the studies have proven the advantage of this computational approach in various fields, there is still a lack of discussion on analysing user eye movement in traditional design, especially a cultural artefact.

In line with the above issue, the researcher agrees with Locher et al. (2010) and Jacob and Karn (2003) that recorded fixations and gaze data from eye-tracking experiments are useful to understand the user's preference through the focused location and dwell time on each composition of stimulus. Moreover, in integrating the analytical observation method on syntactical design features in the eye tracking test, perception on design preference by the expert user could reveal artefact information in the context of ease of use. The result could help validate previous findings of the first research objective. Despite the great works, the researcher argues that previous studies only focused on how the viewer interprets their perception towards the stimuli using current experience.

This research anticipated that computational approach could contribute to understanding the behavioural knowledge by observing the cultural object that requires the user's past experience. Therefore, the computational eye-tracking test could analyse the user's preference towards the behavioural ergonomic design to bridge the understanding between user's cognitive responses and syntactical features of LA artefact using data from eye gaze and fixation metrics.

2.13.2 Summary of Theoretical Proposition Three: Design-User System (DUs)

The notion of interaction design has become an indispensable aspect of any product design development especially for those artefacts with embedded practical concept such as functionality and its physical features. Meanwhile, functionality and physical features in traditional cultural design are more focused on the understanding of intangible influence such as philosophy and user-artefact interaction. This requires different perspectives and approaches for increasing complex yet useful information.

Technologies such as computational approach provide opportunities to develop a new paradigm to understand the interrelationship between a user and the artefact. A combination of many physical artefact data and informational user data could provide a persuasive explanation of product use from more diverse perspectives. This discussion applies not only to physical products but also to other forms of artefact interaction in user's mind. Meanwhile, the user in his/her cultural environment is still able to produce different cognitive feedbacks in artefact interaction. On the other hand, artefacts, through people's interactions with them, influence cultures and can even produce a new product with enriched culture. This special notion would enhance understanding, acceptance, positioning, and use of an artefact by addressing cultural aspects in human-artefact interaction.

In this study, the quality of interactive experience with artefacts is produced in a particular cultural context and only determined or evaluated in the context of use, the so-called design-user interrelationship. Next to analytic study on the artefact and participant observation of user movement, employment of new approach in computational testing could provide more meaningful understanding of user's preference associated with a still image of LA artefact. The review has shed some light

and opened opportunities to establish an appropriate guideline system used from design-user interaction.

To obtain successful data retrieval, rigorous discussion on expert user factor could contribute to data validation (Oyekoya, 2007; Abel, 2010). Therefore, the development of design-user guideline system in cultural product design process with the usage of computational interaction method could support the understanding of users' actual behaviour (perception by eye behaviour) on cultural product to improve the local design product based on behavioural ergonomic data (Figure 2.7).

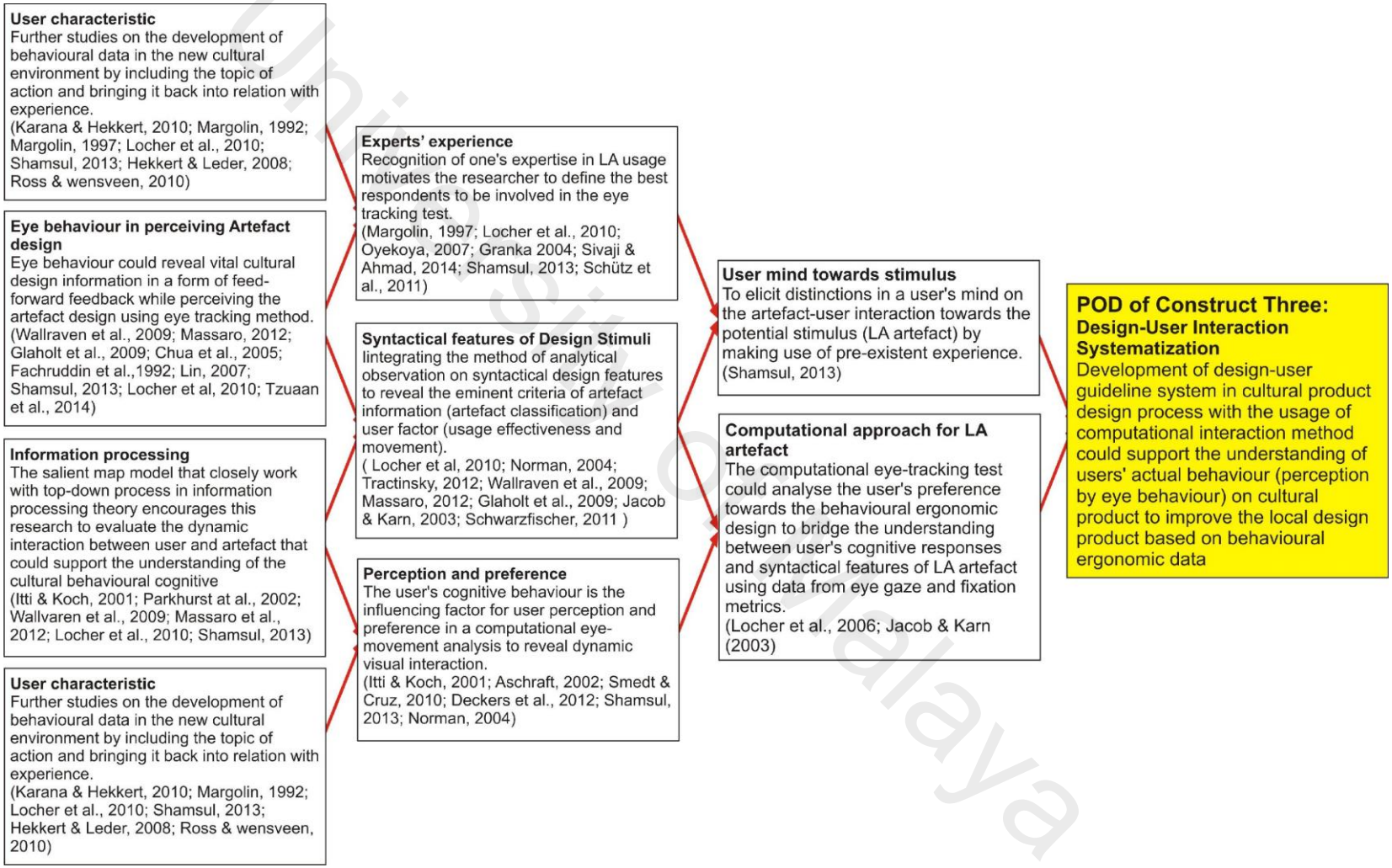


Figure 2.7: Theoretical development of design-user system establishment through amalgamation of artefact syntactic and user pragmatic information in computational interaction. (Graphic: Siti Mastura, 2014)

2.14 Key Conclusion

The literature review covered a wide range of topics to provide coherent understanding regarding the contexts involved in traditional Malay LA artefact study. The identified contexts of LA artefact and the expert user context is a reflection of these research interests. Both contexts provide an interrelating approach for characterizing the AE. The review also provides a theoretical and methodological basis for this research. This research sees the potential of several theories as suitable platform for understanding the involved contexts in different cultural setting such as a traditional invention. These theories are employed and consecutively used to complement the knowledge establishment and the understanding of each topic of the research constructs.

Firstly, the review discussed the documented information of the traditional Malay weapon artefact that is LA. Instead of vast historical research, the review found a major gap of information in LA artefact regarding the artefact design, terminology and the artefact typology. Meanwhile, syntactic dimensions are the vital approach to understanding the design (physical characteristic) in terms of structure, component details, respective materials and functional relationship. This would unveil the ambiguity in artefact context, to fill this knowledge gap in Malay design classification.

Secondly, the AE review captured several important notions that led this research to understand the detail perspectives of pragmatic assessment. As AE is actively discussed in the western world, the researcher found that several approaches could help to elevate the user knowledge in Malaysian context. For instance, specific kind of experience constitutes the user dimensions such as the artefact use functions, user interface features, anthropometric and ergonomics of a particular existing design.

Thus, the two approaches of analytical dimensioning and pragmatic assessment by Petersen et al. (2004) in the Aesthetic Interaction framework were identified to support

the comprehension process of the artefact design investigation. Meanwhile, the specific framework of Aesthetic Interaction by Locher et al. (2010) provides clear direction to understand the information processing of AE between person context and artefact context that expands in wider context in pragmatic assessment. Therefore, this framework of theories is suitable to be the main vehicle for the data acquisition.

Also, the literature on third construct led this research into the understanding of expert factor that plays a major role to provide relevant feedbacks based on appropriate tactical usage of LA artefact. Since LA artefact and the user are the variables, this research found that the eye tracking method is a suitable approach to understand the AI of both contexts and establish them into a design-user interrelationship guideline system. A combination of 'salience map' (Itti & Koch, 2001) and fixation time (Glaholt et al., 2009) in eye-tracking method would give understanding on how an eye gaze could influence the result of behaviour in cognition.

To conclude, findings from the literature have identified operationalize variable that formulated into main theoretical proposition to answer the research gap (Ibrahim, 2012). Therefore, in the inference of these to user and physical properties, the researcher posits that a systematization on design-user knowledge (DUs) could provide more holistic understanding of users' behavioural ergonomic and cognitive perspective in Malay weapon artefact (LA) by implementing the integrated Malay theories (LA artefact classification, LA experts' experience & computational eye behaviour information) for Malay cultural design (MCD) industry (Figure 2.8). The next chapter, methodology, will discuss in detail these three theoretical constructs and the procedures used for data collection in this study.

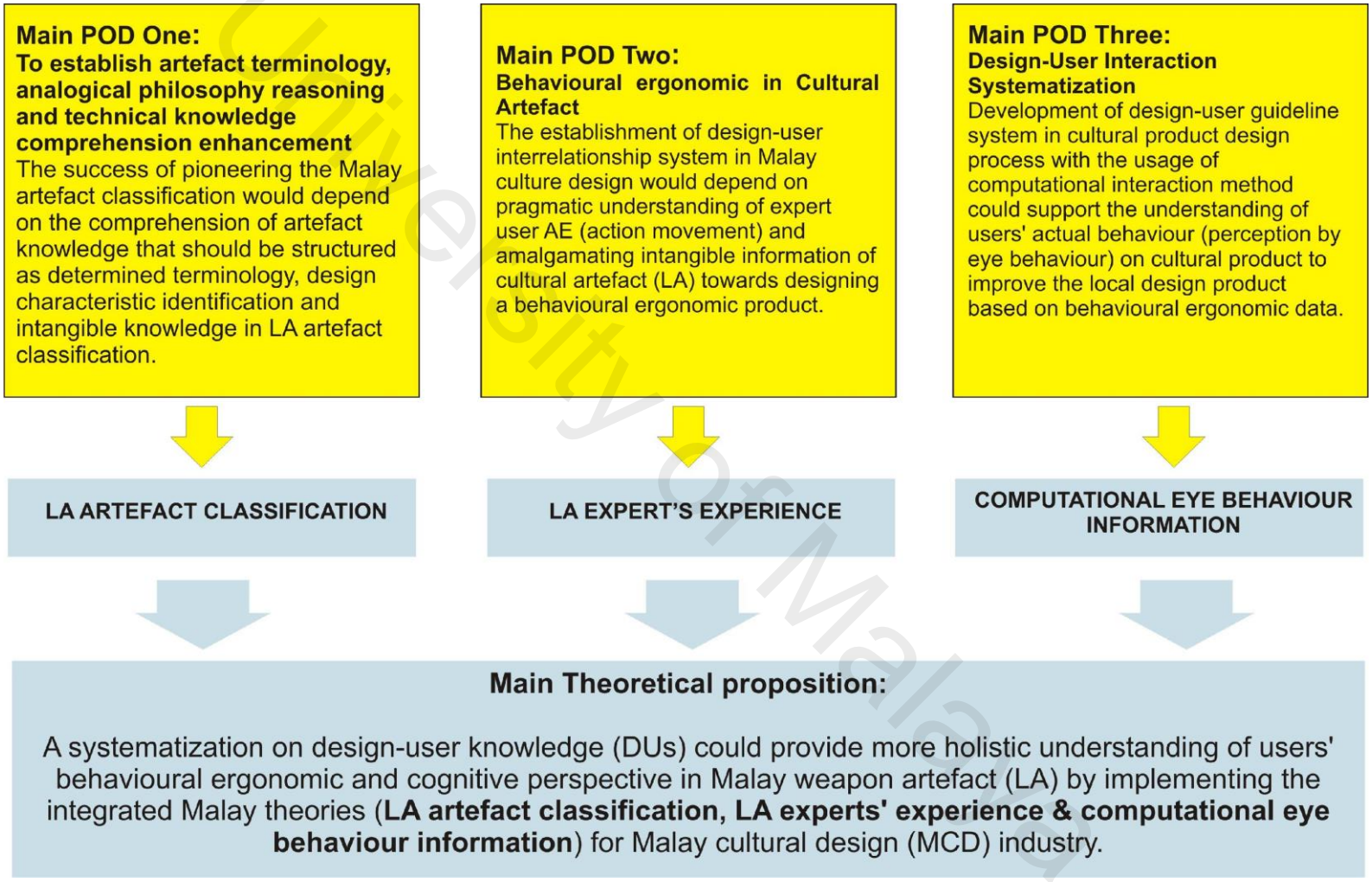


Figure 2.8: Summary of main theoretical proposition through the integration between three theoretical points of departures constructed from literature review. (Graphic: Siti Mastura, 2014)

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

Chapter Three discusses the theoretical framework built from the literature review findings. Potential theories were constructed to guide the following inquiry of research methodology. In detail, identified approach suggested by the previous literatures led to possible methods of conducting this study involving the LA artefact and the user.

Ethnographic case study was selected as the main vehicle to obtain data for this study. This section describes the procedures used to develop the data collection for qualitative research process; artefact observation, participant observation and eye tracking. The study was conducted based on research constructs and theoretical propositions for the purpose of testing the validity and effectiveness of these selected methods.

3.2 Theoretical Framework

Based on previous literature, prior scholars agree that AE is central to Pragmatist Aesthetic (Petersen et al., 2004; Ross & Wensven, 2010; Locher et al., 2010). Staying close with Shusterman's Pragmatist Aesthetic, they used similar theory in assessing a work of art, designing new product, providing new framework and establish the theory of AI into a new paradigm. Therefore, their findings encourage this study to review Shusterman's Pragmatist Aesthetic theory in order to present the overview for initial understanding of the principles in AE.

Through Shusterman's pragmatist perspective, this study assessed AE of Malay traditional artefact to engage a close link between both analytic mind and the bodily experience. Therefore, in order to achieve this study proposition, two consecutive

approaches identified by Petersen et al. (2004) namely analytical observation and pragmatic assessment, guide the data acquisition. In line with analytical observation and pragmatic assessment understanding, this study has identified an appropriate theory to be the main platform to achieve the research propositions. Aesthetic Interaction framework established by Locher et al. (2010) provides a clear direction of structured guideline to understand the information processing of AE coupling both artefact context and person context that expands the context of syntactical analysis (RO1) and pragmatic assessment (RO2) (Figure 3.1).

In this study, both approaches by Petersen et al. are the fundamental procedure for the LA artefact assessment to retrieve information obtained from analytical observation method on syntactical design features for comprehending the artefact context. As LA was the unit of analysis, Boucharenc (2008) suggested using syntactic dimensions in analytical observation on the artefact that aimed to look into several independent variables of LA artefact physical features in terms of design characteristic, component structure details, materials used and functional relationship. His approach is main vehicle in obtaining the LA physical data to support establishing the knowledge for the artefact context in Locher et al.'s Aesthetic Interaction framework.

On the other hand, pragmatic assessment was used to convey the idea of person context and interrelated user knowledge between the typology of LA artefact, usage effectiveness, tactual behaviour (psychomotor skill) and also culture influences (analogical thinking and practices). In detail, Petersen et al.'s pragmatic assessment supports Locher et al.'s framework that along with the behavioural level of processing, central executive corresponded in reflective level too, which is very sensitive to experience, training, culture, and education. In this respect, the researcher agrees that these four factors are the closest characteristics to evaluate the cognitive and

behavioural response of a particular traditional artefact. Also, these variables will be used to provide sufficient information to understand the relation of the cognitive ability within its user eligibility.

In the Aesthetic Interaction framework, Locher et al. integrated an information-processing model of the nature of an AE that describes the coupling of a user's actions (i.e., handling an artefact) and a product's function. The integration formed a theoretical framework for understanding the nature of a user's AI with design artefacts. The framework elaborates how both artefacts driven and cognitively driven processes referred to as bottom-up and top-down processes underlie user-product interaction and the resulting AE respectively.

The scholars highlight the processes in the first stage as follows: 1) the continuous and dynamic bottom-up/top-down interaction between the properties (form) and functionality of the artefact involving the user's sensory-motor-perceptual; and 2) direct voluntary attention to the artefact in a cognitively driven way where the "central executive" is monitored and direct the user-product interaction, which in the present account is conceptualized as consisting of limited-capacity, effortful, control processes. Meanwhile, the second stage of information processing is to understand the focused attention to its form and functionality directed by the central executive; the intertwining interaction of perceptual-motor, cognitive feedback and emotional elements then leads to an AE.

Meanwhile, to result in affect emerge, the two driving forces of the system (artefact and person context) that reflects the user's cognitive structures and the top-down/bottom-up interaction underlying thought and action create both meaning and aesthetic quality for the artefact from, which the AE with the artefact occurs. Throughout the interaction process, Locher et al. also highlight four categories of

human skills; cognitive, perceptual-motor, emotional and social skill. They propose that these human skills dynamically interrelate during interaction between person context and artefact context, which is called information-processing in AE. Moreover, human skills were to be infused during the interaction between design and user context. In the end, the user participation in product interaction could provide insight on design-user relations and their AE.

The researcher foresees that there is a need for a new theoretical model that can help designers to use the power of the collective user experience to create a product milieu. However, the lack of studies on preserving cultural artefacts highlights the need for further studies on the development of behavioural data in a new cultural environment by bringing back the aspect of action into relationship with cultural experience. Therefore, the study agrees with Locher et al. that the constructed information-processing in Aesthetic Interaction framework highlights the importance of human skills and their AE on artefact to understand what is happening when user perceived an artefact.

In the AI framework, Locher et al. also listed at least six ways of artefact appearance that could influence the design evaluation as follows:-

i. Convey its aesthetic and symbolic value to provide a quality impression;
ii. Communicate with functional characteristics and ease of use,
iii. Draw attention by visual novelty,
iv. Communicate with ease of product categorization,
v. Present product properties, and
vi. Contribute a dynamic AI between form and functionality and the user.

At the same time, the researcher finds that components and elements of Malay cultural philosophies obtained from the participant observation during ethnography

provide positive interference for knowledge preservation to AI framework amalgamation. Locher et al. supports that the process of presenting the implicit information is vital to mitigate ambiguity of the user's intangible knowledge that could affect the creativeness of local cultural design state of mind.

Therefore, the researcher uses the Malay philosophies practiced by the artefact experts next to Locher et al.'s framework to elicit the often-ignored role of representational design inspiration and the body movement knowledge during artefact usage in aesthetics experience assessment. The researcher foresees that the establishment of design-user interrelationship information would depend on back-forward interference of Malay cultural knowledge in both analytic (artefact assessment) and pragmatic (user psychomotor behaviour) contexts to produce positive interaction in AE.

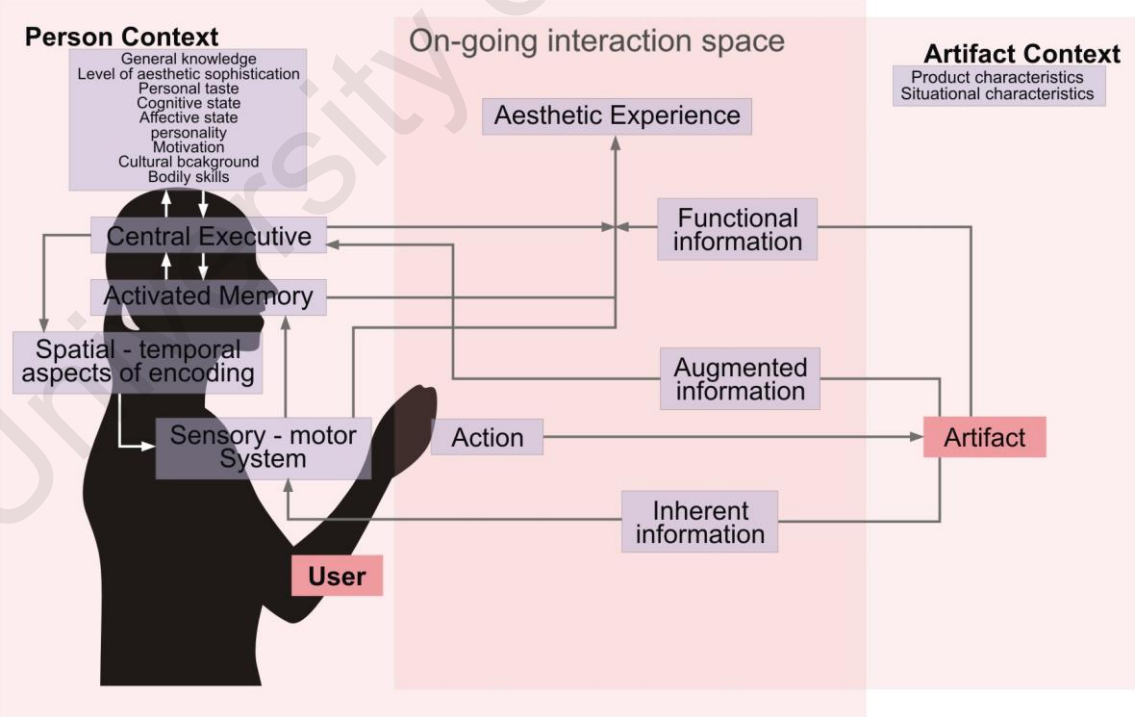


Figure 3.1: Framework of Aesthetic Interaction by Locher et al. (2010)

For the third objective, the established knowledge consisting of three components (user, artefact and usage) is proposed to coordinate cultural cognitive knowledge investigation. Hence, this study found that experiential user knowledge could be used in improvising a human interaction computational approach to understand the perceptual behaviour using user's eye vision. In this study, as LA artefact and LA user are the main sources of data, the eye tracking technology is a suitable approach to understand the AI of those two components simultaneously to establish a design-user system in AE nature of Locher et al.'s framework. Particularly, it is to understand the eye behaviour that could provide a certain quality of aesthetic judgment and interrelated communication between user and LA artefact.

In line with design-user interrelationship encoding, Itti and Koch (2001) highlight one of the most well-known models of attentional integrated processing in several computational features (for example, colours, intensities, and orientations of image gradients) so-called 'salience map'. The salience mapping predicts salient regions in an image or regions that are likely to draw attention to them based on their low-level properties. The model has been shown to account for a significant proportion of fixations participants made while free-viewing different images (Parkhurst, 2002).

Furthermore, the eye movement test will be able to predict successfully participants' preferences for novel feature combinations in particular by ranking features based on fixation times as suggested by Glaholt et al. (2009). Therefore, a combination of 'salience map' and fixation time analysis in eye movement test would give understanding on how an eye movement could influence the result of behaviour in a cognitively driven way. Figure 3.2 summarized theoretical framework that will guide this study in data acquisition.

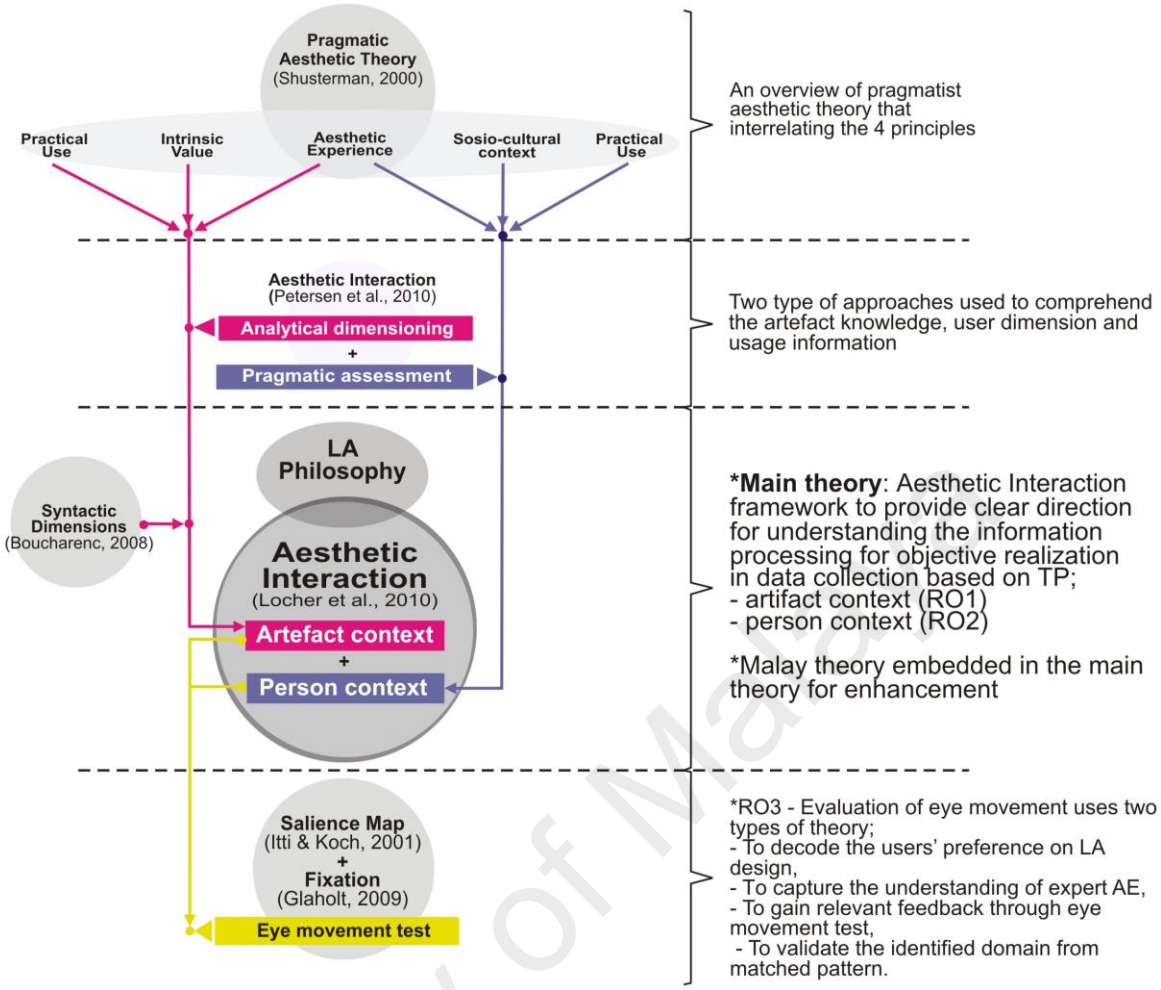


Figure 3.2: Theoretical framework built from several systematic and verified theories. (Graphic: Siti Mastura, 2015)

3.3 Theoretical Proposition

Creswell (2009) defines theoretical proposition as a construction of expected assumption that can be renewed and added by time used in qualitative research. According to Ibrahim (2011), a theoretical proposition is vital in driving a research. These scholars define it as foreseeing construction of theory obtained on concurrent finding. In ethnographic study, the theoretical proposition is gained only during the fieldwork and the literature review must be simple to understand. Also, through the knowledge inferences and amalgamations during literature review, the four levels of sub-point of departures of main RQ constructs were emerged, amalgamated and inferred to form the main point of departures (POD) (see chapter 2).

Then, the integration of the three main points of departures for every research question constructs has established the main theoretical proposition for this study based on the operational constructs (see Figure 2.8, p. 83). As a result, the researcher posits that a systematization of design-user interrelationship guideline (DUs) could provide more holistic understanding of users' behavioural ergonomic and cognitive perspective of Malay weapon artefact (LA) by implementing the integrated Malay theories (LA artefact classification, LA experts' experience & computational eye behaviour information) for Malay cultural design (MCD) industry.

3.4 Strategy of Inquiry: Research Methodology

This qualitative research required a constructivist assumption (Creswell, 2009). This ethnographic case study was selected as the main method to attain the objectives of this study. The method was selected to ensure the success of pioneering the new paradigm for the LA artefact and user knowledge that depends on the comprehension of design characteristic capacities, intangible knowledge such as philosophy of design and philosophy of functional relevance. For sub-RQ1 and sub-RQ2, the researcher has chosen to conduct an artefact analysis as case study to know what is the design features and usage characteristic of Malay LA, where the ethnography was the dominant data procedure that required field observation. The combination of these two methods provides sequel procedure of data collection and analysis for this study.

The six steps of strategies completed the ethnography process (Spradley, 1980). It included the procedure for selecting the sites and indicating types of data to be collected. The researcher decided to use focused observation after identifying the domains from literature review's point of departure. The observation requires structural and in-depth investigation on the unit of analysis to the repertoire of the fieldwork activities.

Meanwhile, the case study method complemented the ethnography for interpreting the findings by fulfilling the five important components (Yin, 2009) such as research questions, theoretical proposition, unit of analysis, linking data to propositions and criteria. The sub-RQ1and sub-RQ2 started with "What", while sub-RQ3 started with a "How". Table 3.1 summarizes the justification of ethnographic case study method.

Table 3.1: The summary of ethnography case study method

ETHNOGRAPHY	**6 steps of ethnographic strategies (Spradley, 1980)**	
	1) Selecting a project	Cultural knowledge of people - To organize a behaviour & to interpret experience – LA user, location & activities
	2) Asking question	Interviews – Gatekeeper & group of informants (LA user & blacksmith)
	3) Collecting data	Participant Observation, collecting artefact & questioning informants = Selangor, Johor, Kelantan & Pulau Pinang
	4) Making records	Various pieces of information. e.g; notes, photographs, videos, diagrams & verbal recording.
	5) Analysing data	Early and continuous – descriptive observation > focused observation = topic > organize into categories.
	6) Writing an ethnography	Include examples and vivid description of the informants' knowledge.
CASE STUDY	**5 Component (Yin, 2009)**	
	1) Asked question	'What' is an explorative question. Pertain to all 5 strategies (Yin, 2009)
	2) Theoretical proposition	TP led to direction of research
	3) unit of analysis	LA artefact
	4) Linking data to propositions	As in Table 3.2
	5) Criteria for interpreting the findings	High anticipation of analytical, pragmatic and cognitive understanding between the interaction of a person and an artefact for new designing environment.
ETHNOGRAPHIC CASE STUDY (6 STEPS STRATEGIES + 5 COMPONENTS)		

Both strategies provide high anticipation of analytical understanding between the interaction of person and an artefact to know how the user (LA user or martial artist) behaves in the context of LA involving actions (how to use the LA) and event (one to one close fight). The strategy combination was supported by the fact that there is a

recurring problem (action-related artefacts still written up in a similar context) even in a long period the work and process are run.

For the final sub-RQ, the researcher conducted an analysis that integrates the result collected from ethnographic case study and controlled lab test. The additional viable strategy in the case study was the computational visual imaging for the quantitative approach such as lab test to demonstrate the ability of a new approach to collect the data from the expert users. The LA was identified as the unit of analysis to bridge all the inquiries. Table 3.2 summarizes the main strategy of inquiry for each sub-RQ.

Table 3.2: Main strategy of inquiry for each sub-RQs

Sub-RQs	Strategy of inquiry	Expected outcome	Expected knowledge Contribution
RQ1	Literature review and ethnographic case study	Documented analytical data of: • **physical characteristic,** • **artefact terminology,** • **artefact philosophies** to establish an artefact classification for user knowledge (RO2)	Knowledge 1: Theories of artefact classification for traditional Malay LA artefact (a determined term and design criteria) elicited from artefact knowledge comprehension, design characteristic capacities and the understanding of design philosophy through syntactic understanding and intangible knowledge.
RQ2	Literature review and ethnographic case study	Evaluated AE in LA psychomotor behaviour understanding through • **pragmatic analysis,** • **artefact usability evaluation in LA user experience** to integrate artefact information (RO1) to support the design-user knowledge (RO3).	Knowledge 2: Theories on Malay AE of weapon artefact through the understanding of product usage typology and user experience knowledge (psychomotor skill) integrated with the LA artefact classification to establish the pragmatic and syntactic analysis for design-user system (DUs).

Table 3.2, continued: Main strategy of inquiry for each sub-RQs

RQ3	Lab test	Recommendation of amalgamation result obtained from ethnography case study in lab test to develop : • **behavioural responses** • **Cognitive knowledge from eye tracking evaluation** to support the understanding of users' actual behaviour on cultural product.	Knowledge 3: Theories of the design-user system (DUs) with implementation of integrated theories; Malay LA artefact classification and LA user's AE using computational approach of eye tracking test to provide more holistic understanding based on users' preference and cognitive response on cultural product for Malay cultural design (MCD).
RQ4	Establishment of the **design-user system (**DUs) as a pioneer approach for Malay cultural design (MCD) knowledge preservation to develop product design in a new cultural environment.		

3.5 Linking data to proposition: Data Collection

Creswell (2009) and Ibrahim (2011) provide a guideline for the researcher to understand the proper strategies of inquiries in collecting data. The scholars state that the importance of identifying the strategies would shape the types of questions asked to form data collection, steps of analysis and final narratives (Spradley, 1979). In this study, the researcher clarified the data collection process engaging several research instruments that were:

i. Ethnography (concurrent approaches)
    a. Artefact observation
    b. Participant observation
    c. Semi-structured Interview
ii. Eye-tracking test

Table 3.3 shows the detailed steps and process involved in completing the data collection driven by TP constructs. Relevant sources of data are carefully identified to link to identified method and expected data finding.

Table 3.3: Summary of the data collection by theoretical proposition

TP constructs	Methods	Source of data	Data to collect
LA Artefact classification	Active Participant observation, artefact observation and semi-structured interview	Literature review, participants (Expert users and blacksmiths) and users' personal artefact collections	<u>Documenting the artefact information</u> To capture the data of artefacts of visual, verbal and descriptive information such as pictures, videos, measurements, verbal information and design notes to understand the physical and non-physical characteristic.
LA user's aesthetic experience	Active Participant observation and semi-structured interview	Expert users & blacksmith (Training session, events, seminars & artefact making)	<u>Documenting the pragmatic information & artifact usability information</u> To record verbal data and practical demonstration in natural setting of artefact culture.
Computational test (eye tracking)	Eye tracking test	Set of stimulus (LA artefact images), Eye tracking equipment (Tobii T60 desktop, Tobii Studio and Mi-UXLab programme & expert users	<u>Documenting the cognitive knowledge</u> To collect users' eye behaviour preference, fixation data and qualitative feedbacks towards stimulus in controlled setting using specific task.

3.5.1 Instrument: What to Measure

Next, data collection must be assisted with identified variables to ensure no information was left out. The details are discussed below.

3.5.1.1 Ethnographic case study

(a) ***Artefact observation***

Systematic examination of the dependent variables of the LA artefact was in order to understand artefact tangible and intangible knowledge (philosophy, and creative analogic thinking), social and cultural context (Lin, 2007). The artefact observation was employed in the study because this data collection was proven efficient by the ethnographic scholars (Lin, 2007; DeWalt & DeWalt, 2002; Fetterman, 2010). Panasonic Lumix 42x High Definition camera was used to capture simultaneously large numbers of photographs during the on-site fieldwork. For the first method, every picture related to LA artefact is captured to build artefact inventory (samples, material and design). A ruler and a comparative item such as one ringgit Malaysian money and a fifty cent coin were used to show the visual scale of the entire artefact.

(b) ***Participant observation***

To collect the user data, the researcher became an active participant-observer during nine months data collection period in two types of environment to gain a pragmatic understanding. Firstly, the researcher participated with the gatekeeper in LA training and practical session in order to understand the independent variables such as LA application addressing the explicit characteristic of operational use (ergonomic design, typology features and body movement). Unstructured questions were asked during the observation and training with the gate keeper. Meanwhile, the user knowledge is the dependent variables since it involved the understanding of the user motor skill and behaviour namely the practical action (how the product works) and tactical technique

(how it is used). Secondly, the researcher became an apprentice to traditional blacksmiths and had access on artefact making, verbal information and blacksmiths' behaviour in creating or designing LA.

The Panasonic Lumix 42x High Definition camera was a vital equipment to capture the pictures of practical activities and to record video evidence such as LA practical usage during training session, LA making process and selected events such as seminars, interviews and lab test.

(c) ***Interview***

The interview was necessary for this study to meet face-to-face with every participant to obtain verbal information regarding their AE with the artefact. It also strengthened the relationship between the researcher and the participants in the study. The participants were given an agreement form to sign. The semi-structured interview had two sections that were; Section A (artefact design) and Section B (user or blacksmith behaviour). The question was designed to excavate the needed information based on the independent (physical artefact features) and dependent variables (intangible knowledge) under the identified domains. A Sony MP3 recorder was used to record all the informal verbal communication and formal interview session. Also, note taking supported the whole processes of interview and observation in the ethnography.

3.5.1.2 Eye-tracking test

Eye movements were recorded with a Tobii T60 Eye Tracker, Tobii Studio and Mi-UXLab, (formerly known as URANUS, (Sivaji & Soo, 2013) in Lab Based Usability Testing (MIMOS Berhad, Malaysia). In the eye-tracking test, two sets of stimulus (six images of LA artefacts for each set) obtained from the findings of ethnographic and artefact observation in Chapter 4 are the important instruments. The artefact was chosen

after the terminology and the physical criteria in classification processes were defined. Figure 3.3 illustrates three main syntactic components of independent variables predicted to be observed; hilt, blade and sheath. The following sub-section discusses the details of the stimuli for each observation instrument.

Figure 3.3: Main syntactic components predicted on stimuli to be the region point of attraction; 1) Hilt, 2) Blade, 3) Sheath. (Graphic: Siti Mastura, 2015)

The following are the instruments that were designed according to the test:-

(a) ***Warm-up session: Stimuli 1 in printed version***

The first type of stimuli in this study consisted of six designs of LA artefact which were superimposed on the white background in individual frames with material indicated. Every design was numbered and displayed according to the holding angle and position (Figure 3.4). The artefact without sheath (curve weapon) was arranged side by side with the one with sheath in the picture. Every page of design was accompanied by a 50 cent coin (Diameter =32mm) to show the consistent scale of every artefact.

Figure 3.4: Sample of LA artefact on the white background in individual frames with material indication (Graphic: Siti Mastura, 2015)

Meanwhile, the questions for the warm-up session are based on the independent variables of the third objective. The questions for warm-up session are as follows:

i. *Di antara enam reka bentuk Lawi Ayam pada gambar, anda diminta untuk mentahapkannya berdasarkan rekaan pilihan paling utama kepada pilihan yang kurang utama. Nombor 1 mewakili pilihan yang paling utama dan nombor 6 adalah paling kurang utama.* (You are required to rank the 6 designs of *Lawi Ayam* artefact based on preference from most preferred to the least preferred. Number 1 represents the most preferred and number 6 is for the least preferred).

ii. *Di antara enam reka bentuk pada gambar, anda diminta untuk mentahapkannya berdasarkan bentuk Lawi Ayam yang paling efektif dalam penggunaan. Nombor satu mewakili pilihan yang paling efektif dan nombor enam adalah paling kurang efektif. Sila terangkan tahapan (ranking) pilihan anda.* (You are required to rank the 6 designs of *Lawi Ayam* artefact based on the usage effectiveness from highest to the lowest. Number 1 represents the most effective and number 6 is for the least effective. Please explain your ranking).

iii. *Di antara enam reka bentuk pada gambar, bahan yang digunakan pada Lawi Ayam mana satu yang paling menjadi pilihan? Tahapkan dari nombor satu*

mewakili pilihan yang paling utama dan nombor enam adalah paling kurang utama. Sila terangkan tahapan (ranking) pilihan anda. (You are required to rank the 6 designs of *Lawi Ayam* artefact based on the material preference from most preferred to the least preferred. Number 1 represents the most preferred and number 6 is for the least preferred. Please explain your ranking).

(b) ***Eye tracking test: Stimuli 2 in Jpeg file format with 300 dpi***

There are two types of image arrangement in the second stimuli. The first is the individual images employed from the first stimuli. However, this time, the material information was removed. The stimuli were a Jpeg file versions displayed in the eye tracker monitor for the participant to observe and give feedbacks (Figure 3.5). The structured question was asked after every Task 1 using generated heat map and gaze plot visualization.

Figure 3.5: Sample of LA artefact on the white background displayed on the eye tracker monitor. (Graphic: Siti Mastura, 2015)

The question for Task 1 is as follows:

i. *Pada setiap reka bentuk artifak Lawi Ayam yang anda akan lihat sebentar nanti, bahagian manakah yang menarik perhatian anda?* (Which design of *Lawi Ayam* artefact presented would attract you?)

The artefact-user interaction was evaluated to measure users' actual behaviour and design perception. In this test, two kinds of data were measured. Specifically, the test is to determine:-

i. Behavioural responses based on design ranking based on three tasks; effective artefact, movement efficiency and material preference, and
ii. Evaluation of syntactical preference based on time of first fixation, heat map images, fixation on AOI, and retrospective think aloud with eye tracking (RTE).

3.5.2 Sampling

Sampling is the crucial aspect to increase the validity and reliability in this study. In qualitative research, a small number of total sample is sufficient. In this study, LA artefact is the unit of analysis for analysing the syntactical artefact design and the artefact usability. Meanwhile, the specific group user was chosen to analyse the pragmatic dimension perspectives.

3.5.2.1 Artefact samples

This study collected a total of seventeen samples of LA artefact. The samples of the artefact were selected from those used or collected by various *kerambit* or LA users (trained user). The artefacts were chosen based on the dimensional sampling by the syntactical characteristic (design features, the component of structures and material) (Chua, 2011). This sampling type could reduce the sample size problem. Then, these samples were analysed and categorized according to physical characteristics and intangible knowledge. Both contexts involved analytical observation on the artefact to segregate the required information. Then, the final classified LA was used as stimuli in the lab test session.

3.5.2.2 Populations samples of respondents and participants in ethnography

The interview session involved nineteen participants during the study. These include blacksmiths (N=9) and users (N=10) who are involved directly with the artefact (Table 3.4). The selected blacksmith were experienced in LA making for more than 5 years, while all the users have experienced more than ten years in *silat* practice and more than 5 years in Malay weapon artefact such as LA, *kerambit*, *tongkat* (wooden stick), *golok* (cleaver), *lembing* (javelin) and *keris*.

Table 3.4: The list of participants in fieldwork

Code		Origin	Years of Experience	Expertise
Black smith / LA maker	**B1**	Pasir Mas, Kelantan	36 years	Blade making and forging
	B2	Bachok, Kelantan.	30 years	Blade, hilt and sheath making
	B3	Pasir Mas, Kelantan.	24 years	Sheath making
	B4	Johor Bahru, Johor	8 years	Blade, hilt and sheath making
	B5	Pasir Mas, Kelantan.	31 years	hilt making & forging
	B6	Pasir Mas, Kelantan.	17 years	hilt and sheath making
	B7	Pasir Mas, Kelantan.	15 years	sheath making
	B8	Pasir Mas, Kelantan.	20 years	Blade carving expert)
	B9	Batu Caves, Selangor	6 years	Blade, hilt and sheath making
Expert user	**U1**	Subang Jaya, Selangor	36 years	*Silat Harimau Berantai*
	U2	Batu Caves, Selangor	36 years	*Silat Harimau Berantai*
	U3	Gurun, kedah	24 years	*Silat Gayung*
	U4	Bangi, Selangor	28 years	*Silat Betawi*
	U5	Cheras, Selangor.	30 years	*Silat Chemandir*
	U6	Kota Bharu, Kelantan	36 years	*Silat Gayung*
	U7	Pasir Puteh, Kelantan.	39 years	*Silat Lintao*
	U8	Kuantan, Pahang	5 years	*Silat Gayung Malaysia*
	U9	Lintang Kampung Rawa 2, Pulau Pinang	30 years	*Silat Kuntao*
	U10	Kuala Lumpur.	18 years	*Silat Gayung Malaysia/Silat Sepelek*

They were familiar with the context of use in terms of body movement and artefact typology of LA artefact used in the training session and the location of training place or *gelanggang*. Although these experienced users may not necessary to complete the context of use forms, it is important to document the information of every participants as useful input to the process of specifying usability requirements and evaluating the prototype with typical end-users (Maguire, 2001).

To note, this study used various experts from Malay *silat* martial art schools and blacksmiths in several states of Peninsula Malaysia (Johor, Kelantan, Penang and Selangor). The justification for selecting the users is based on their background, achievement, recognition and relevant experience with LA (Table 3.5 and 3.6). The limited availability of LA expert user in Malaysia resulted to a limited number of suitable participants. The mean age was 50 years old.

3.5.2.3 Populations samples of respondents and participants for eye tracking test

Meanwhile, users who met the minimum requirement as suitable participants for the qualitative eye-tracking study, which was 8 out of 10 expert users, were recruited. The total number of participants meets the minimum requirement (6 participants) when conducting a qualitative eye tracking study (Nielsen & Pernice, 2009; Rösler, 2012). The selection was justified by four variables that are duration of experience, background, achievement and level of expertise with the artifact usage. All of the participants had normal or corrected-to-normal vision. Neilsen and Pernice (2009) remind that senior participants aged over 65 are not an ideal group for eye tracking studies due to purely logistical reasons such as regression lenses in glasses, bifocals and various eye diseases that come with age conflict with the eye tracker and impact calibration needed to capture the users' gaze. In this study, the participants are coded by sequel acronym. Their details and type of *silat* are as indicated in Table 3.5 and 3.6.

Table 3.5: The list of participant in eye tracking test

Code	Origin	Ethnicity	Type of *silat*
E1	Pasir Puteh, Kelantan	Malay	*Silat Lintao*
E2	Gurun, Kedah	Malay	*Silat Gayung*
E3	Bangi, Selangor	Malay	*Silat Betawi*
E4	Cheras, Selangor	Malay	*Silat Chemandir*
E5	Batu Caves, Selangor	Malay	*Silat Harimau Berantai*
E6	Machang, Kelantan	Malay	*Silat Harimau Berantai*
E7	Lintang Kampung Rawa 2, Pulau Pinang	Malay	*Silat Kuntao*
E8	Cheras, Selangor	Malay	*Silat Gayung Malaysia/ Silat Sepelek*

Table 3.6: The participants were selected according to: 1) age, 2) education, 3) achievement, 4) skill of expertise, and 5) duration of experience

Code	Age	Level of Education	Achievement	Year of Experience	Type of expertise	Level
E1	**54**	Diploma	• Chairman of WARIS, Kelantan. Master of *Silat Lintau*	*silat*: 39 years LA: 10 years	*Kerambit, Keris*	Advanced
E2	**55**	Diploma	• Master of *Gayung Pusaka*	*silat*: 40 years LA: 10 years	*Keris, Kerambit*	Advanced
E3	**46**	Degree in *Silat Betawi*	• Founder of Silam Academy Master/Founder of *Silat Betawi* Malaysia	silat: 36 years LA: 28 years	*Lawi Ayam, Kerambit, Golok,* small axe	expert
E4	**58**	SPM	• Master of *Silat Chemandir* Cheras	*silat*: 40 years LA: 30 years	*Kerambit, keris* and knife	Advanced

Table 3.6, continued: The participants were selected according to: 1) age, 2) education, 3) achievement, 4) skill of expertise, and 5) duration of experience

E5	**51**	SPM	• Warrior of *Silat Harimau Berantai*	*silat*: 18 years LA: 16 years	*Kerambit,* knife, fighting-stick	Advanced
E6	**36**	Diploma	• Warrior of *Silat Harimau Berantai* • Master of *Kerambit*	*silat*: 30 years LA: 20 years	*Kerambit,* knife, fighting-stick, *keris*	expert
E7	**60**	Diploma	• Master of *Silat Kuntao (*Pulau Pinang)	*silat*: 45 years LA: 30 years	*Kerambit,* knife, fighting-stick, *keris,* spear.	expert
E8	**33**	Master	• *silat* instructor of *Silat Gayung Malaysia/Silat Sepelek,* Universiti Malaya	*silat*: 18 years LA: 7 years	*Kerambit, keris, small axe*	Interme-diate

3.5.3 Procedure

After the vital findings were obtained from literature review, the procedures such as artefact observation, participant observation and eye tracking test were properly planned to ensure a comprehensive data acquisition.

3.5.3.1 Ethnographic case study

(a) Artefact observation

In artefact observation, the samples were coded as CK (curvy knife) to give a general indication in the segregation process. The diagram in Figure 3.6 shows the segregation process flow. In preliminary identification, all the artefacts were identified using syntactical factors of material, size, component and shape to define the relevant group. Then, after relevant samples are specified, the CK code was replaced with LA with numbers (LA#) to undergo the second level of segregation for information refinement

based on detailed up physical characteristics such as decoration, finishing and syntactic features.

From the 17 samples, the most artefacts that match with the saturated point of information from literature findings, artefact observation and interview were selected for the next level of information refinement. All samples were categorized according to the structured physical description to identify the actual terminology of LA. Meanwhile, intangible knowledge is a major contribution to analogical thinking knowledge that was presumed in this process for terminology clarification.

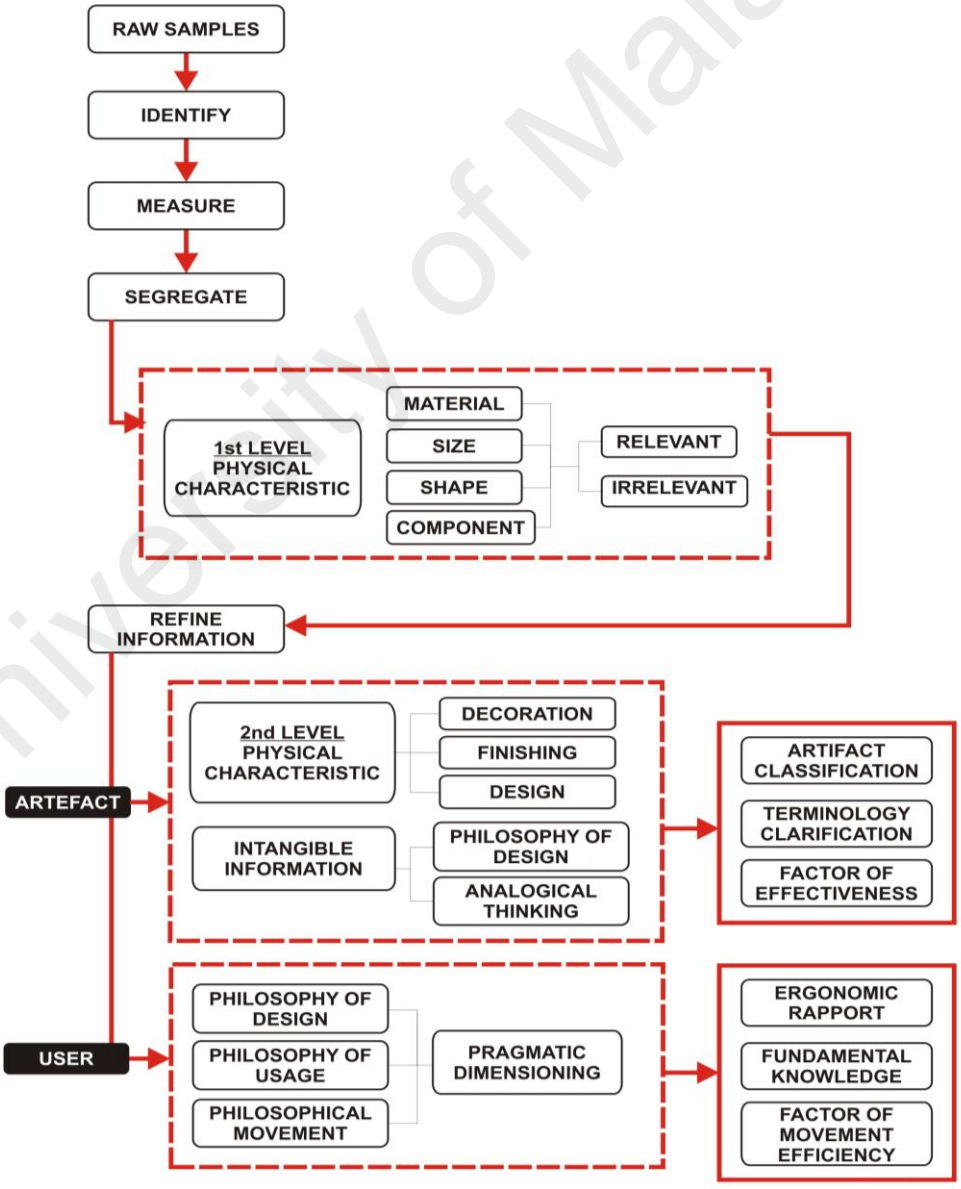


Figure 3.6: The diagram of segregation process. (Graphic: Siti Mastura, 2015)

(b) ***Active participant observation and interview***

Firstly, the scheduled participation was held at the training location (*gelanggang*) and the seminars are conducted by the *kerambit* instructor (the gatekeeper). The participation required the researcher to be in one to one hand combat training using the LA training tool. This process enabled the researcher to understand the user context and usage context during the session.

Secondly, the researcher involvement as a blacksmith apprentice in this study was aimed at approximate active participation in the environment as a natural observer in LA making activity for duration of time (Chua, 2011). Data were collected based on participants' verbal descriptions gathered through the in-depth semi-structured interview to obtain the concept of artefact design, physical structure and material usage. After they signed the agreement form a semi-structured interview, they were asked based on the questions in both Section A (artefact design) and Section B (user or maker behaviour). The interview was conducted continuously until the researcher obtained the saturated point of data based on identified variables.

Thirdly, in-depth semi-structured interviews were also conducted with the identified expert users from different s*ilat* martial art schools. They are selected based on their expertise and experience in Malay s*ilat* and Malay traditional weapon practices. The same interview procedure was conducted. The interview obtained information about types and characteristics, artefact function, artefact philosophy, movement philosophy, responses to artefact design and qualities of experience associated with ergonomic rapport in using LA artefact (Chang & Wu, 2007; Fetterman, 2010; Petersen et al., 2004; Siti Mastura, 2011).

3.5.3.2 Eye-tracking lab test

The test is conducted in two different rooms. The background tests started with warm-up questions. Participants were asked to identify and rank the artefact design based on the printed version of the stimuli (6 designs of LA) by the moderator. The user answered it by filling up the data in Mi-UXLab based on 6-point Likert scale (1 (mostly preferred), 2 (preferred), 3 (somewhat preferred), 4 (somewhat less preferred), 5 (less preferred), 6 (mostly less preferred).

The 6-point scale was chosen to have an even number of ratings on the scale to obtain participants' preference to the stimuli, whether positive or negative. To note, neutral rating (forced response) may not be as necessary compared to a situation where a participant is very familiar with the subject, where it could be argued that the participant could truly have a neutral attitude towards the subject at hand. The verbal feedbacks were recorded using audio recorder. The warm-up session ended within 10 minutes.

Next, the user seated in front of the eye tracker in the second room. The eye tracking procedures occurred into two stages: 1) the calibration procedures; and 2) the experimental procedures. During the calibration process, the participant was required to fixate at various points on the screen. After calibration, the test began with a slide for the participant to view the artefact to evaluate their syntactical preference. The tasks started with a scenario in the first slide.

The participant was allowed to view the image for ten seconds. Then, the moderator extracted the heat map from the eye tracker and displayed it to the user and requested the user to think aloud and explain his action based on the heat map and gaze plot. The participant was also requested to justify his sequence of visual cues verbally based on a gaze plot. The procedure was repeated for the rest of five images, which is known as

Retrospective Think Aloud with Eye Tracking (RTE), and is similar to studies by Rösler (2012) and Goh et al. (2013). The equipment was recalibrated throughout the experiment when necessary.

3.6 Data Analysis

This ethnographic case study used theory generating analysis. The strategy needs a deductive coding (a priori code) based on identified domains to identify sub-theme and themes from interviews, observation, literature review and eye tracking test (Chua, 2011; Chua, 2012). The triangulation was used to provide a matched data pattern to the following theoretical proposition constructs.

The analyses were divided into three main contexts according to the research questions which are: 1) artefact context; 2) person context; and 3) cognitive context. The syntactical and pragmatic analysis (user experience and behaviour information) were used to understand the AI between the user and LA cultural artefact (Locher et al., 2010; Petersen et al., 2004; Boucharenc, 2008; Lin, 2007).

3.6.1 Artefact Classification of LA

Syntactical analysis on the specified LA artefacts describes the physical characteristic, terminology definition, design inspiration and artefact philosophy. To extract information, the level of analysis was based on the relevant artefact to avoid discrepancies between measurable variables. The triangulation method helped the analysis process in terminology clarification, physical characteristic identification and understanding the intangible knowledge of artefact (analogical thinking in philosophies) (Figure 3.7).

Towards the end, layouts of the syntactical analysis of matched artefacts were displayed in visual drawing and technical drawings (Boucharenc, 2008; Lin, 2007). The

physical design evidence also provided information on artefact effectiveness based on the design characteristic.

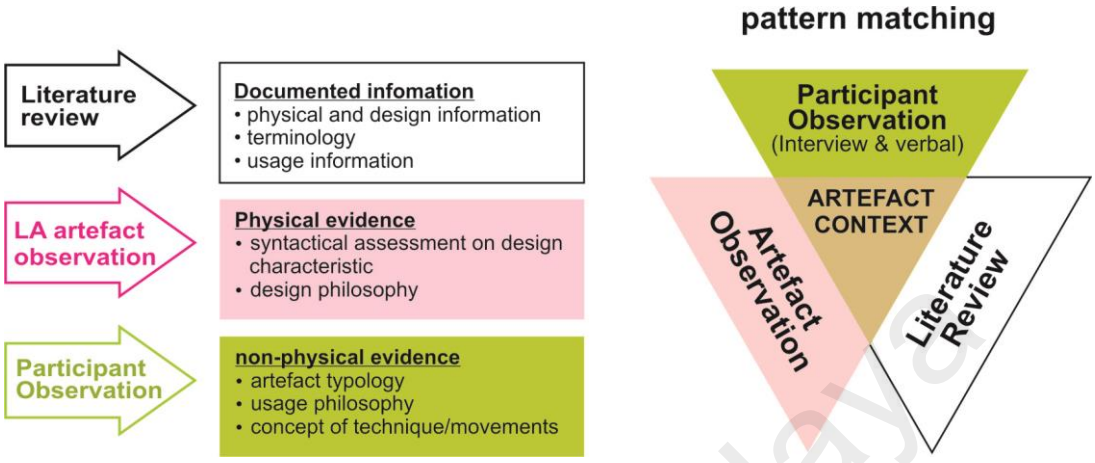


Figure 3.7: Data triangulation for RO1**.** (Graphic: Siti Mastura, 2015)

3.6.2 LA User Experience

In order to identify characteristics of user context that affect user interaction knowledge (experience and behaviour), Boucharenc (2008) strongly suggest to conduct a pragmatic analysis. The descriptive statistical analysis (Chua, 2011; Spradley , 1980) was based on RO2 domain which covers the themes of user motor skill and ergonomic rapport towards the artefact design, artefact design effectiveness, usage functions and user body movement (Locher et al., 2010; Petersen et al., 2004). The analysis used visual and video evidence to understand user movement dimension when participants used the LA artefact. Additionally, verbal statement regarding their pragmatic and pre-existent experience supported the descriptive analysis.

The results of the participants' description were an important part of the triangulation process as well as the understanding of user experience context. User cognition and ergonomic analysis have to be explained in the context of psychology behaviour and anthropometric automation (Bridger, 1995). This factor helped to understand the

interactive qualities (characters of operational use and behaviour biometric profiling) defined to be the efficiency of user movements in person context (Figure 3.8).

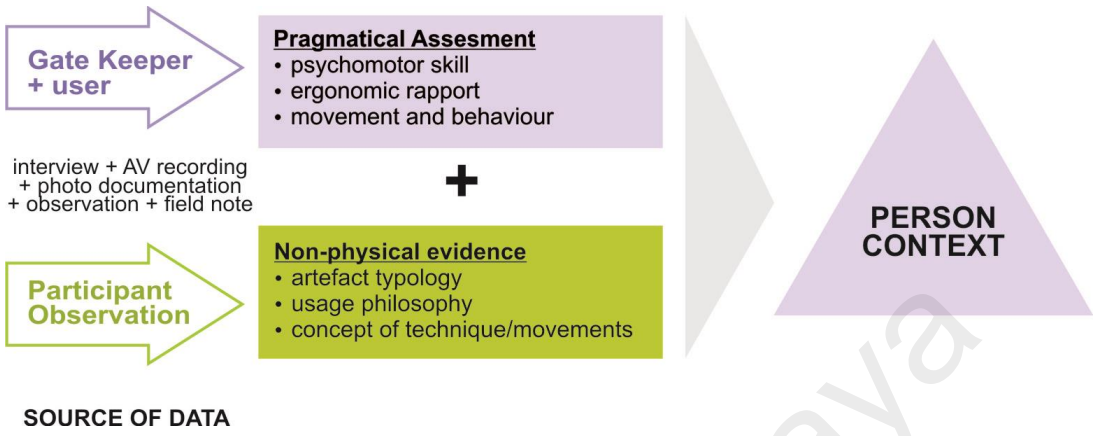


Figure 3.8: Data analysis for RO2. (Graphic: Siti Mastura, 2015)

3.6.3 Computational Behaviour Information: Eye-tracking

In eye tracking study, the qualitative result can be used to see the discrepancies of users' feedback in RTE, frequency of agreement or even interrelationship of cognitive evaluation between eye behaviour (fixation on heat map and gaze plot) and empirical data using standard deviation (mean score and percentage). This study presents the descriptive statistical analyses of eye behavioural data of the participants towards LA artefact. Meanwhile, the recorded RTE data are used to understand the every viewer's preference on the each design of LA artefact in the stimuli presented.

Also, the results from the eye tracking were used to validate some of the earlier findings (from previous method to achieve RO1 and RO2) to increase the reliability of the data analysis. Towards the end, the matched pattern increased the result validity of the first and second section results in the triangulation process. In this study, the content analyses conducted for this section are threefold to answer the identified theoretical propositions.

3.6.3.1 Analysis of warm-up session: Behavioural response data

First, the behavioural responses data recorded in the MI-UXLab used mean score analysis to understand the viewer's eye preference through ranking the artefacts shown by the printed images. This provides a frequency score. Responses to the ranking task were collected and the design that received the most responses was chosen as the winning category based on the frequency analysis and percentage analysis. The participants' responses were analysed descriptively. Meanwhile, the ranking results were based on three tasks which are effective artefact, movement efficiency and material preference, presented using standard deviation (mean score and percentage).

3.6.3.2 Syntactical analysis of eye tracking data: time to first fixation score, RTE and heat maps

Studies by Dupont et al. (2014) and Duchowski (2007) indicate significant finding that a larger amount of fixations in the same observation time will increase the observer's capacity to identify, recognise and memorise what is represented on the image.

The syntactical analysis of the LA artefact involved the component, the design structure and the material. The empirical result of time of first fixation anticipated which provided informative design evaluation of particular section of the artefact through the area of interest (AOI) identification. The fastest and slowest time of fixation result led the researcher to capture the participants' attention on the artefact. At the same time, the RTE feedbacks were transcribed to obtain the information from the participants who were used to explain the empirical finding. Meanwhile, the heat map visualization is interesting evidence used to justify the finding in both the results of time of fixation and RTE.

The heat map visualization analysis (hotspot) represents the viewer's visual attention to understand the eye preference and behaviour on design properties of LA artefact images (stimuli). The heat map result supports the time of first fixation data and RTE feedbacks. However, if there is an error in generating some of the data of time of first fixation from the participant, the rest of the complete data is sufficient for analysis as long as the total data of participants is more than five. Errors are due to several factors such as habit and physical attitude of the particular user during the test or the eye is rather small.

Meanwhile, the analysis on RTE feedback was conducted using eye tracking replays on most preferred design to identify significant viewing patterns that could be associated with participants' image preference. For instance, the explanation on vast amount of gaze plot and fixations on specific images presented in the scan path pattern and heat map visualization also helped to understand the eye behaviour influenced by the cognitive information processing of the pre-existent experience in current time. The process in the eye tracking test was anticipated to help in understanding the underlying reasons for participants' verbal responses.

3.7 Validation

Scholars coined that participant observation in ethnographic research is a way to increase the construct validity, external and internal validity of the study (DeWALT & DeWALT, 2002; Fetterman, 2010; Spradley, 1980). The construct validity was tested through literature finding and expert qualitative judgement. Meanwhile, other than documental literature analysis, external validation was established using active participant observation with the expert (gatekeeper) in LA application to check every definition of terms used to identify the research gap. Meanwhile, external validation was established using full participation by the expert users (participants) of LA

application in several different stages. Any agreement or approval of data (pattern matching) with the same gatekeeper, theoretical proposition and key informants increases the internal validity. The role of the gatekeeper is to help the research process have extensive access to the needed sources. Table 3.6, summarizes the four test validity emerging both context of ethnographic case study suggested by Yin (2009) to support this study.

Table 3.7: Four validity test for ethnographic case study

Test	Tactics		Phase
Construct validity	Literature review	Documenting the artefact information from published work	Data Collection
	Participant observation	Involvement with the gate keeper and informants to collect oral data of culture and pattern	
Internal validity	Pattern matching (agreement or approval of data)	The gatekeeper:- • to access key informants • to link with TP and eye movement test (data from selected expert users)	Data Analysis
External validity	Participant observation	Data obtained from selected informant (gatekeeper – expert in LA application) • to check every definition of terms used • to identify the research gap	Research Design
	artefact analysis	Existence of artefacts	
Reliability	Triangulation (increasing the internal and external validity)	To obtain matching pattern from Informant interviews + artefact collections + field observation to increase internal and external validity	Data Collection
	Recorder equipment	As an evidence of research (material documentation): • to record both tangible and intangible information • to understand the informant to give reliable and quality information • to understand the identified perspective	
	computational test	vision test to validate some of the findings	

To increase the reliability validation, a triangulation technique was employed to compare the collected information from different locations, time and sources (informant and respondent) (Chua, 2011; Fettermen, 2010; Spradley, 2010). The technique was to test the quality of the information, to understand more on the part an informant plays in the social setting and ultimately to put the whole understanding into perspective (Fetterman, 2010).

According to Figure 3.7 (p.111), the triangulated results to attain the RO1 consist primary information from LA expert, LA artefact collection, and fieldwork observation of physical and tacit knowledge. Meanwhile, all participant observation data result from interviews and internal participation in different events, locations and time was systemically captured and stored using audio and video recorder, and compiled photographs as a vital evidence to increase the reliability validation for the RO2 (refer Figure 3.8, p.112). Therefore, in this study, gathered data were triangulated forming two established knowledge which are 1) artefact context and 2) person context, to contribute relevant information for the eye tracking test (RO3).

The result of eye tracking are made through inferences and comparing the result within behavioural response analysis and syntactical analysis. The four test validity was also tested in the eye tracking test. Through the inference process, descriptive explanation was used to determine the significant finding on the artefact effectiveness (RO1) and user movement efficiency (RO2) and eventually to increase the eye tracking result validity qualitatively (Neilsen & Pernice, 2009). As the eye tracking method is important for RO3 to have further understanding on the interrelationship between the person context and the artefact context in HCI, any related agreement or approval of data (pattern matching) with the participants to link with the theoretical proposition

increases the internal validity. Table 3.8 summarizes the construct validation that led to expected outcome.

Table 3.8: Summary of construct validation to expected outcome

Construct	Definition	Source Of Evidence	Result
LA artefact classification	Categorized analytical information from physical and non-physical characteristic to help object identification.	Artefact Observation	Identification of explicit and tacit properties to preserve the knowledge in Malay worldview consisting of functional application.
LA user's aesthetic experience	A person's interaction (stands out for consciousness) and response to a piece of work (LA), including its visual, literal and expressive qualities.	Participant observation and interview	Identification of psychological & usability experience to understand users' actual behaviour on cultural product (psychomotor skill – action and reaction).
Computational test (eye tracking)	A technological or cognitive approach of engaging the user in a fun and beautiful experience on the creative form of object.	Eye tracking test	Establishment of explicit interaction knowledge between artefact & user through computational evaluation (qualitative analysis and empirical data) to understand cognitive response.

At the same time, this eye tracking method is to validate (RO3) some of the findings in RO1 and RO2. Therefore, as the objective is to find the cognitive data from eye tracking test for the third component to support the triangulation process, the result was used to complete the cycle of data mining. Then, the identified data from previous domains of constructs (artefact context and person context) are brought in to complete the final triangulation process and also to increase the research LA artefact validity as shown in Figure 3.9. Finally, the finalized data was used to achieve the theoretical propositions.

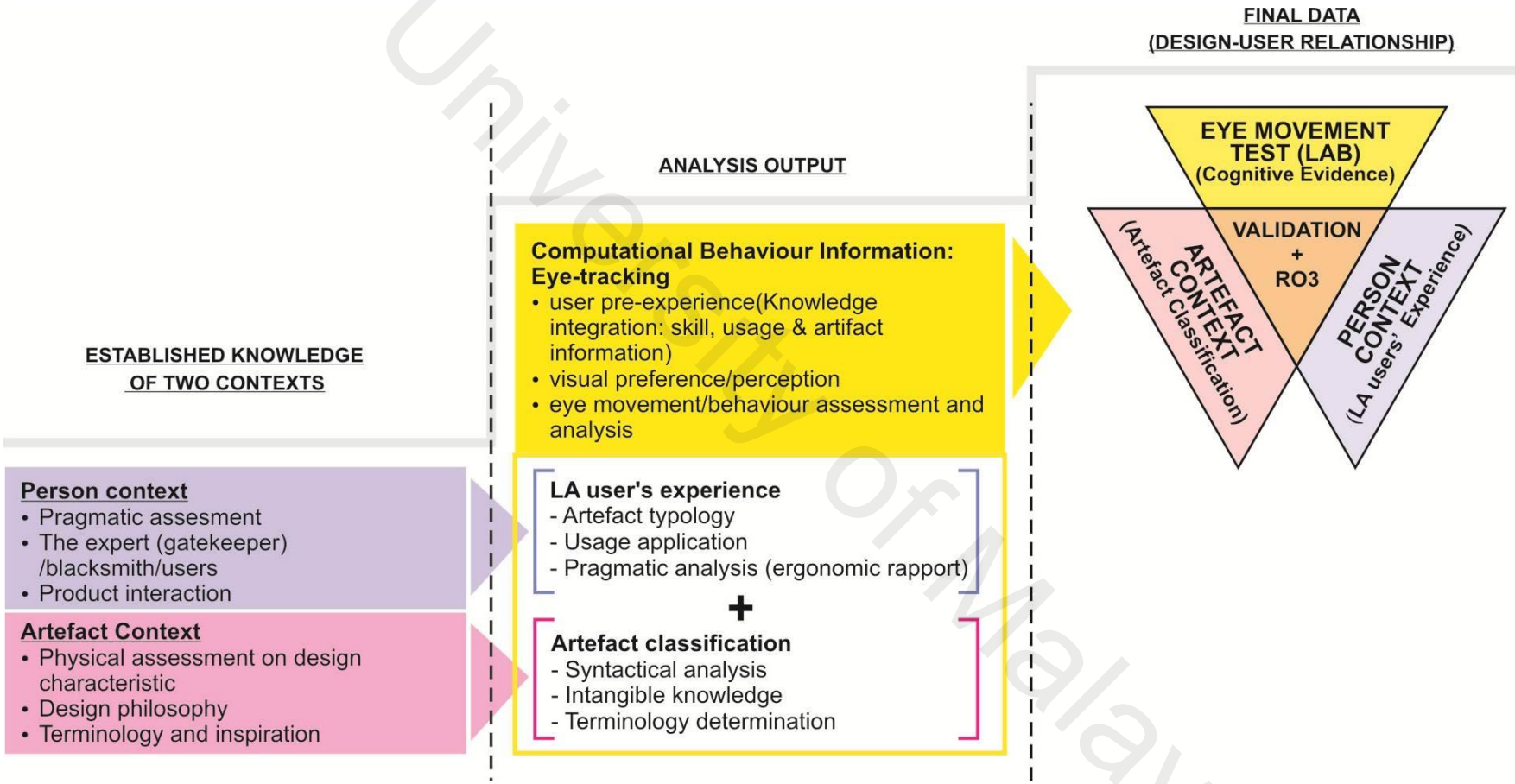


Figure 3.9: Data analysis for RO3 and validation strategy to achieve data pattern matching for theoretical propositions to attain the research objectives. (Graphic: Siti Mastura, 2015)

3.8 Key Conclusion

The research methods and procedures presented in this chapter shows how research questions posed in this study were answered. In conjunction with AI, the research methodology emphasized the use of ethnographic case study using artefact observation, participant observation, semi-structured interview and eye tracking test as the most appropriate methods of assessing the AE of Malay traditional artefact (LA) in terms of physical design and user pragmatic dimensioning. These research AI theory and methods were appropriate to investigate which creative cognition in cultural artefact was utilized by the user. The Malay LA from user collections; and Malay weapon expert users (*silat* practitioner) are the key components in this study. Finally, these findings could then be related to the future research of cultural product and local wisdom. The researcher believes that the computational eye tracking technology is a new approach in pioneering future research of cultural artefact. This potential technology could provide holistic understanding of effectiveness in design, users' behavioural and cognitive ability for better understanding of Malay knowledge in different perspective. Chapter 4 will cover the results of each of these analyses.

CHAPTER 4: ANALYSIS OF ARTEFACT CLASSIFICATION OF MALAY LAWI AYAM

4.1 Introduction

This chapter discusses the results of ethnographic observation on documented text, artefact and interview survey as the core of the first research objective to answer the sub-RQ1. The first section presents the descriptive report on visualizing design data to provide understanding of artefact characterization. The second section presents the information refinement to cover the analytical assessment of design characteristic for LA artefact through syntactic analysis. The final section discusses the findings related to intangible information toward LA cultural thinking. The intangible information is to provide further understanding of artefact philosophies, terminology and design inspiration from the participants' perspective. The answer to this section contributes to vital understanding of how AE is involved while the user perceived the LA design. To achieve valid and reliable results, all analyses involved triangulation by three sources of data that work within all setting and on any level in the ethnography (fieldwork) to find matching pattern and link it to the theoretical propositions.

4.2 Analyses of LA Artefact Characteristic Identification

In artefact context, the appearance of LA artefact provides the viewer to communicate with different types of visual information. Prior to that, general information about LA artefact obtained from the literature review, interview and artefact observations are evaluated to provide fundamental understanding of LA characteristics. Therefore, the initial result of the document analysis, observation and in-depth interview conducted during the ethnographic observation could help during the segregation process.

4.2.1 Analysis of Documents

A total of 14 documents from literature review were investigated in order to find significant information on LA artefact information at the initial level (number of documents are shown as 'n' value) (refer Appendix B, p. 280). These documents are identified to be the valid source of LA artefact information. According to the documents, the researcher found that LA is a curvy shape knife or weapon artefact, which was categorized in the third type of hidden Malay weapon. 13 out of 14 text documents defined LA as comprising three main components that are the blade, hilt and sheath. Each component has different criteria for cutting effectiveness, typology and aesthetic value. The graph in Figure 4.1 summarizes the information availability in total text documents based on the three main components (blade, hilt and sheath).

Previous scholars defined LA as associated with curvy two-edged or single-edged sharp blade. Majority of the documents (n=8) show identical information that the LA blade is two-edged curvy weapon, where the inner and the outer blade are sharpened to ensure optimum cutting impact. Only six documents highlight that LA has a sharp single-edged blade.

Secondly, this study found that the ring hole is a prominent identification marker for LA. The majority of the documents (n=11) agree that the hilt with ring hole is a unique component that explains ease of use and ergonomic design factor. Also, the documents show that the ring hole on the LA hilt has a relative function to artefact effectiveness. To support this statement, the documents explained that the hole in the hilt is used to insert forefinger, index finger or little finger to ensure the grip. Although n=3 documents mention that the ring is an unnecessary component because certain LAs were designed to conceal, the researcher found that majority of documents emphasize that the hilt design with a ring hole is a vital identity of LA to have firmer grip and to ensure the

best cutting sphere. Moreover, the use of different fingers depends on how the user moves his hand upward, downward, left or right. Surprisingly, some LA lack ring hole.

Meanwhile, 9 out of 14 documents have illustrated the sheath as the third main component. In the documents, the researcher found that decoration or ornamentation is always associated with the sheath. The result shows that sheath with ornamentation attracted the attention of majority of scholars in describing the LA sheath (n=9). The result showed that sheath have significant roles of purposes, too which are: 1) to hide the LA in cloth folding (hidden) or in pocket; 2) to protect the owner from accidental injury by the shape blade; 3) to withdraw LA easily from loose sheath,; 4) to be an optional 'blunt' weapon before the sharp blade is used; and 5) to be as aesthetical element (for instance, to represent the status of the user). Interestingly, some of the documents provide a visual illustration of the sheath (Shahrum 1967, p.105-106; Gardner 2009, p.52; Razak 2000, p.62; Ku Ahmad & Wong, 1978, p.65; Ismail 2009, p.80; Mubin 2011, p.154).

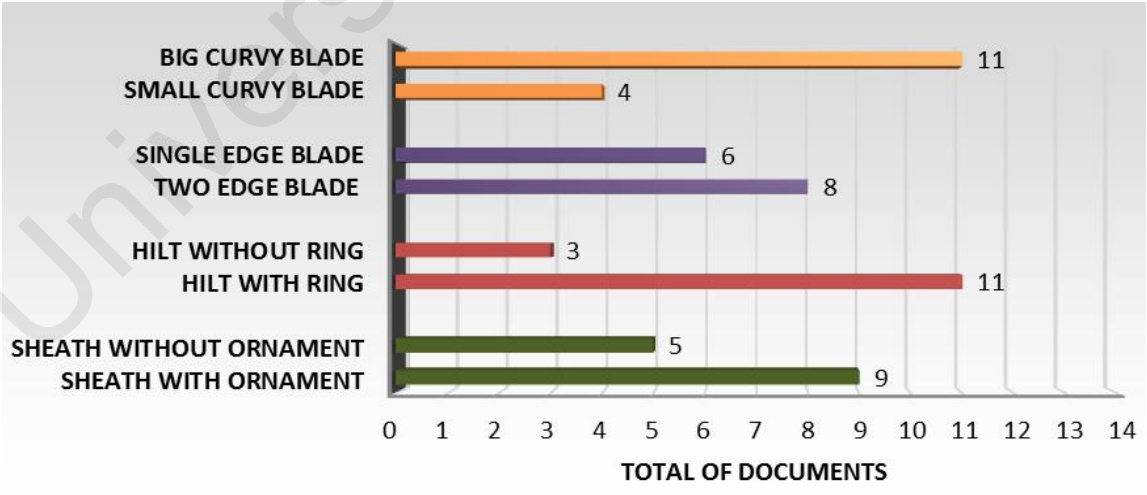


Figure 4.1: Total of text documents based on the 3 main artefact components. (Source: Siti Mastura, 2015)

In terms of size, the specific sizes of LA are mentioned in two versions, big and small. Interestingly, the data shows that majority of the documents (n=11) indicate the

specific size to justify the appropriate size of LA. Although small size appears in the text (n=4), the scholars seem to agree that LA is a big version of a curvy weapon that is measured according to the blade length. For instance, this information found in Shahrum (1967), Mohd Zainuddin and Mohd Syahrim (2007), Zakaria (2007) and Mubin (2011) describes several LA blade size as within 4¾ (11.5cm) inches to 12 inches (30.5 cm), while the width of the blade varies from 15/16 inches to 1 1/16 inches.

These results show that LA's definition as big curvy weapon with blade length between 4½ inches to 12 inches is a vital guide for this study to identify the proper size of LA during the artefact segregation process. The notable findings from the document analysis show that the sharp two-edged blade, the hilt with ring hole and the ornamented sheath are the major criteria of LA. However, even if an LA lacks ring hole, has a single-edged sharp blade and plain sheath design, the artefact can still be considered as optional criteria in defining the LA as long as the length of blade meets the requirement.

On the other hand, the above findings suggest that it is not appropriate to place smaller curvy weapon to be placed under the same category. This is because smaller curvy weapons have different characteristics, artefact terminology, usage and design inspiration. In addition, this study notes what Mohd Zainuddin and Mohd Syahrim (2007) have suggested which is to consider the philosophical dimension of the user anatomic measurement. For instance, LA blade length and curvature are measured by the distance from one side of the owner's ear to the eye, and the width of blade is based on his forefinger or the width of an eye.

4.2.2 Analysis of Interviews

Identified users (n=10) and blacksmiths (n=8) were interviewed to obtain the intangible knowledge and experiences regarding artefact evaluation and behaviour responses towards the LA design. Generally, the users and the blacksmith (n=18)

agreed that LA is a big curvy weapon. This result is anticipated because the participants are likely familiar with the artefact as part of their Malay weapon training tool and artefact fabrication.

They defined LA as a curvy weapon comprising three main components such as the blade, hilt and sheath. Therefore, descriptive analysis based on interview results will be the domain of syntactic properties in relation to three componential details (component, design and shape) and measurement (Table 4.1, p. 128-130). The result of descriptive analysis from 18 participants' feedbacks yielded into a graph in Figure 4.2, which showed similar finding with the document text finding.

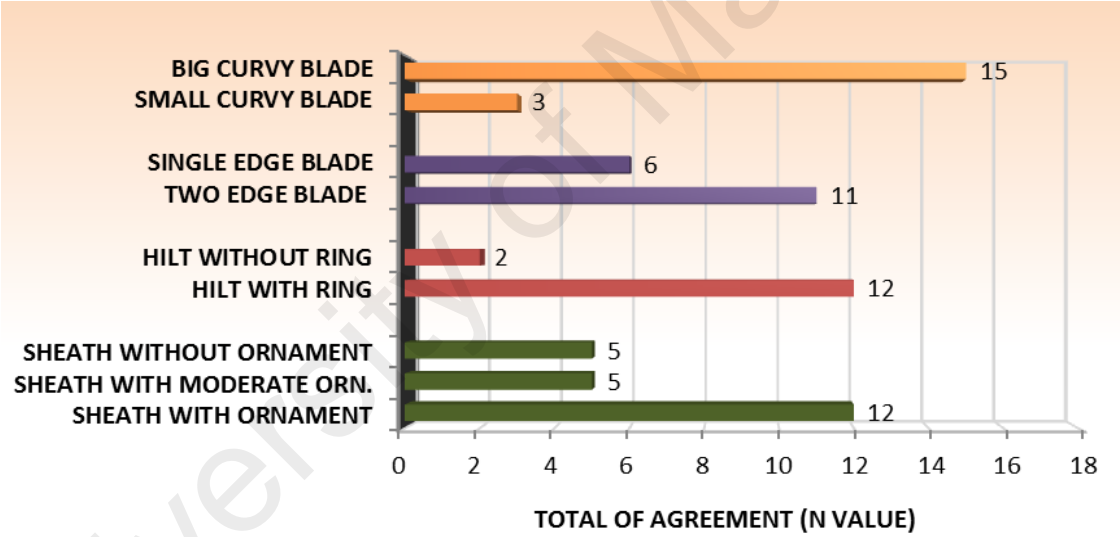


Figure 4.2: Total of users and blacksmiths agreement on the 3 main artefact components. (Source: Siti Mastura, 2015)

Based on three main components, majority of the participants (n=11) (user, n=6 and blacksmiths, n=5) highly agreed that LA has the sharp two-edged blade as its criteria. They emphasized that LA weapon has sharp two-edged blade. However, 6 of them mentioned that LA also has sharp single-edged blade. Some of the participants explained that there are samples of LA blade which are sharpened only on the tip. Therefore, based on the agreement found between the interview and the text document,

the researcher concludes that the common sharpness of LA blade is on three areas: 1) outer edge; 2) inner edge; and 3) blade tip. The blade component has at least 80% along the blade edge (Figure 4.3). Also, the researcher found that LA blade sharpness is different compared to the smaller version of the curvy weapon.

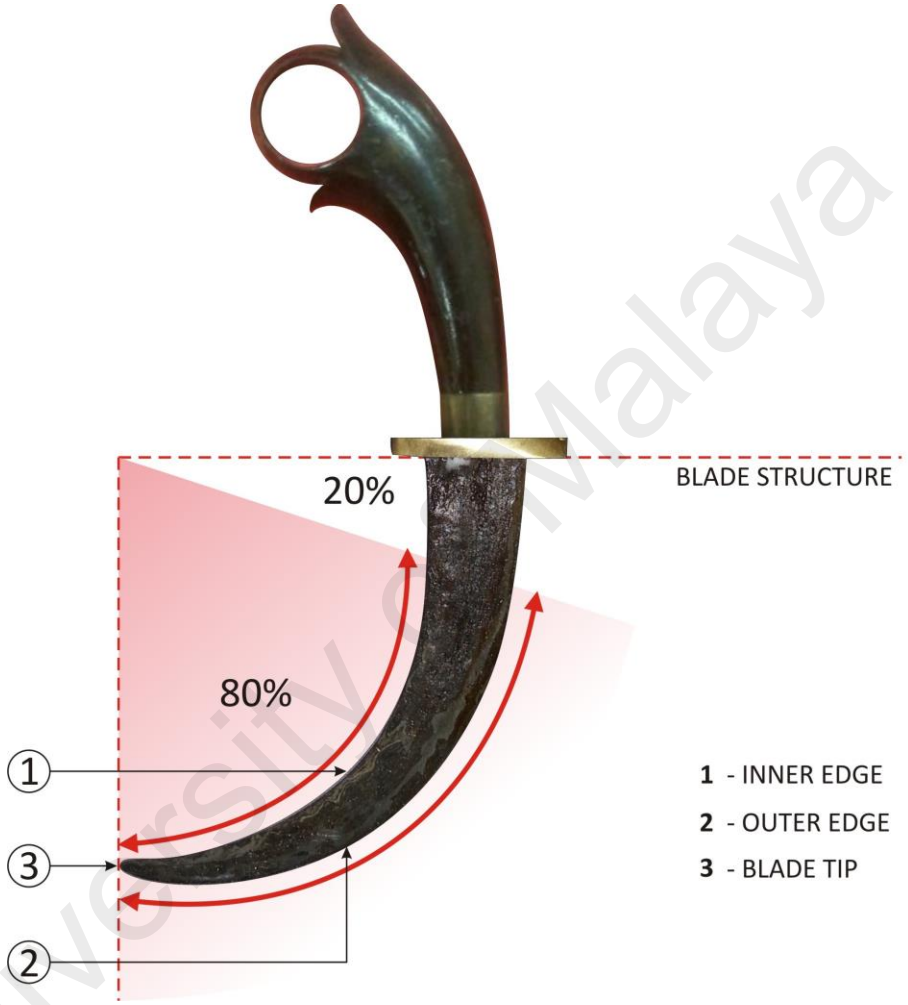


Figure 4.3: The sharp edge area on LA blade. (Graphic: Siti Mastura, 2015)

This study also found that some of the LA sample used *pamor* (damascene)[1] iron as the blade for aesthetic and functional purposes. The macro lifted irons were added on *pamor* blade to keep poison. One type of poison applied on the blade is venomous substances either from natural rusting or animal venom. Several participants agree with

[1] In the damascening process, layers of iron lifted during the process of '*sepuh*' (Gardner, 1936).

previous scholars (Hill, 1956; Khamis et al., 2013) that chemical reaction during *sepuh*[2] process forms arsenic substances from natural rusting (B3, ln. 83; B4, ln. 83).

On the other hand, from interview, some of the participants provided an exact measurement to differentiate the LA with other curvy weapons. The participants agreed that the size of LA blade is between 5 inches to 6 inches for the normally found or created samples. However, there is also a bigger and longer size versions that exceeds to 12 inches as per mentioned by Shahrum (1967) and Mubin (2011). Majority of the participants agreed that those smaller curvy weapons with less than 4½ inches length must be categorised under different weapon name. For example, 3 inches to 4 inches is *kerambit* and 2 inches to 3 inches is *taji ayam* (cockspur) or *kuku rimau* (tiger claw*)*. Meanwhile, the artefacts with less than 2 inches length should be defined according to design concept using several suitable terms such as *kuku helang* (eagle claw), *kuku beruang* (bear claw), and etcetera.

In comparison, most of the users and blacksmiths (n=12) stated that LA must have a ring hole on the hilt. As the user has closest contact to the artefact usage during training, 7 out of 10 of them agreed that ring on hilt is a 'locking' component in LA typology to ensure a firm and strong grip and to ease the hand flow movement. The hilt with ring enables the user to have more versatile techniques and different form of body movement in LA usages such as manoeuvring, flipping and LA transition. Conversely, the hilt without a ring hole is normally designed depending on personal preference and specific uses of the technique which might be limited to certain movement only.

The users and blacksmiths also highlighted a unique criterion of hilt design that is sub-component of 'horn' shape alike (*balung* or *tajung*)[3] (n=4). The horn is

[2] *Sepuh* is a traditional technique that makes use of acidic solution such lime juice, banana tree substance, snake or blow fish venom or even, acid hydrochloric (new method) (Hill, 1956; B3, ln.83; B4, ln.83).

commonly designed as a jutted out component at the very end of the hilt area. This sub-component is functioned to hit targeted area on an opponent such as the head area like eye, under the chin, jaw and neck which represents a 'warning' before blades were used during LA initiation.

Meanwhile, the sheath is a component that complements the LA design. Since the LA blade is sharp at both edges, curvy and sometimes has poison, the sheath is important component to prevent the blade to cause unexpected injuries to the owner (*makan tuan*). And, as the LA is known to be a hidden weapon, the sheath is very useful to keep the blade safe in owner's cloth fold, head gear (*tanjak*) or pocket.

In terms of decoration, the popular notions given by the participants (n=12) on the sheath include that the beauty or intricacy of the ornamentation is an aesthetic appreciation to nature such as the motif carving of flower or animal, silver capping, half-precious stone setting and sometimes brass, leather or silver ring. They highly preferred the sheath design that used a variant material, which believed to strengthen the artefact structure, to serve as an aesthetical presentation and also as a medicinal element. Hence, the researcher summed that the usage of a good quality material could ensure the value of LA artefact, the durability level and the medicinal properties. However, they also highlighted that plain sheath (n=5) or minor decoration (n=5) is sufficient as the participants emphasized that LAs are short weapon used in close fight. Some participants mentioned that motif carving should not be too excessive to avoid *mabuk ukiran* (cluttered motif carving) to LA artefact (B1, ln.37; B4, ln.134; B6, ln.27).

[3] Component indication is depending on state or location of LA origin and use.

Table 4.1: Samples of feedbacks from users and blacksmiths regarding the syntactic properties

	Interview Responses	Statements
Syntactic Properties: Component detail	Three main components (n=18)	• Blade: tempered iron, *pamor* (damascus), sharp edge and tip, awestricken, curvy shape, sometime has carved pattern. • Hilt: with/without ring hole, decorated with motif carving or silver ring or cap, simple form, in original wood grain pattern or black colour, durable and strong material. • Sheath: blade protector, represent status, decorated with motif carving or ornaments, medicinal wood.
	Curvy blade of shape (n=18)	'*Lawi ayam* shape cannot be changed. If it does, it won't fit the identity and function…'. (B1, ln.30) 'I would say to keep its traditional look because the shape is itself already causing effective usage..'. (B2, ln.24) 'The sheath may vary, but the blade cannot be changed…'. (B3, ln.22; B8, ln.11) 'Yes.. LA shape is better in original shape (curvy) ...'. (B4, ln.123; B8, ln.13) 'The LA blade shape is curvy like sickle..'. (B5, ln.2; B6, ln.4B7, ln.4) 'In terms of shape, it is based on the back tail of cock's feather. Normally, the best LA design is smooth and does not contradict with the feather shape. There is no crooked/bent LA..'. (B2, ln.8)
	Two edged blade (n=11)	'..by means, the character of LA is double edged blade..'. (B4, ln.42) 'Both edges of blade is able to cut flesh to the bone..'. (U1, ln.58; U6, ln.14) 'The blade is very sharp on the tip and both inner and outer edges..'. (U3, ln.14; U7, ln.39) 'LA blade has one side sharpen, but there is also the same criteria at both sides..' (U5, ln.2; U7, ln.39)
	Single edged blade (n=6)	'LA blade has one side sharpen, but there is also at both sides..' (U5, ln.2; U7, ln.39) 'From what I understand, LA blade is a single blade weapon..' (U4, ln.59) *During participant observation in artefact making, the researcher has found 3 participants stateing that LA also has a single-edged blade.

Table 4.1, continued: Samples of feedbacks from users and blacksmiths regarding the syntactic properties

Syntactic Properties: Component detail	Hilt with ring hole (n=12)	'The LA won't easily slip out of the hand because the hilt has a ring as lock..' (B1, ln.10; B4, ln.22; U8,ln.52) 'Ring hole on the LA hilt is compulsory..' (B3, ln.4) 'The hole is not for rotating the LA but it is for a better grip..' (B4, ln.46; U6, ln.20) 'The Malayness of LA artefact is on the round shape of ring hole to fit the philosophy..'. (B4, ln.109) 'The hilt where you can insert can a finger..'. (B8, ln.27) 'Like mine, I have LA with ring hole on the hilt..'. (U5, ln.42) 'The ring will lock to ensure the gripping quality…'. (U8, ln.71) 'LA without a ring hole cannot be called as LA..'. (U8, ln.72)
	Hilt without ring (n=3)	'Whether it has ring or not, it depends on the owner…as for me, I use the LA without ring…'. (B2, ln.8) 'There is no ring.. only a plain hilt..'. (U4, ln.59) *Participant observation has found one user stated that LA also has the single-edged blade.
	Sheath with High Ornamentation (n=10)	'The hilt is better and beautiful if the motif carving is fine and intricate..'. (B3, ln.34) 'For the decoration on sheath, we can use carving of gold, brass or silver. ..'. (B5, ln.10) 'I love the sheath, hilt and ring hole to have new form of design (decoration) ..'. (B6, ln.10) 'The sheath is more beautiful if decoration is added..'. (B7, ln.20) '*Temin* (ring cap) on the hilt can be decorated. Like hilt, it can be incorporated with silver..'. (B8, ln.11) 'I want a tiger motif carving on my LA as I use tiger style in my silat technique…'. (U4, ln.25) 'There is an LA that has a motif carving, which means it has better added value…'. (U4, ln.45) 'The users always like to have a fine (beautiful) weapon..'. (U5, ln.52) 'It must have motif decoration….if LA, it needs to refer animals pattern..'. (U6, ln.24) 'If we look at LA hilt and sheath, there should have a fine ornamentation as it worn at waist. Perhaps, a motif carving…'. (U9, ln.41)

Table 4.1, continued: Samples of feedbacks from users and blacksmiths regarding the syntactic properties

Syntactic Properties: Component detail	Sheath with Moderate ornamentation (n= 4)	'Moderate decoration and mix media..' (B8, ln.5) 'Too much motif carving will make the hilt decoration look cluttered (*mabuk ukiran*)..'. (B6, ln.27) 'The sheath…plain. If it needs a decoration, should not be so excessive..'. (B1, ln.37) 'It depends on the wood. If the wood itself is very nice, then the ornamentation should be less. Because, the wood itself is already beautiful..'. (B4, ln.134) 'Too much carving won't be nice. It should be simple. This particular size of weapon is not suitable for massive motif carving. Flower motif should be placed appropriately on the carving…'. (B5, ln.8)
	Sheath with no ornamentation (n=3)	'No ornamentation, because I want the wood grain to be highlighted..'. (B6, ln.25) 'Sheath without ornamentation is nicer, original and looks authentic…..'. (B7, ln.25) 'If it's used for fighting, it doesn't need to be outstanding. It is better with no ornamentation at all..'. (B2, ln.30)
Measurement	Big (more than four inches) (n=15) Small (less than 4 inches) (n=3)	• Big size (n= 15) • LA size is different from *kerambit* (n= 3) • Anatomical dimension (n=6) 'The size of user's hand..'. (B4, ln.134; U5, ln.24) 'The appropriate LA size is measured from the eye to the ear of the user…from the centre of the pupil to the ear hole.. not the ear lobe.. it is very precise to hand size and to have very good curvature according to bursa line..'. (B1(observation); B4, ln.14) 'Shape and size of LA is between 5 inches to 6 inches, *Kuku rimau* is 3 inches – 4 inches, *taji ayam* is 2 inches – 3 inches..'. (B7, ln.29)

In summary, the interview results supported the text document finding based on relevant physical syntactic character such as size, component and shape of Malay LA artefact as follows:

i. The blade length size between 4½ inches to 12 inches;

ii. Two-edge sharp blade;

iii. The hilt with ring hole; and

iv. Ornamented or decorated sheath

However, the researcher found critical opinion on the size of LA and that it cannot be made similar with other smaller curvy weapon. Nevertheless, if the blade meets the length size requirement, even if it lacks ring hole, is single-edged blade and with plain sheath design, the samples are still are considered to be a relevant identification for LA physical character.

4.2.3 Artefact Analysis

In this analysis, a total of 17 collected samples are coded and numbered as 'curvy knife' (CK1 to CK17). Firstly, the samples were observed and identified based on the general characteristics of physical features, artefact name and measurement. Then, in segregation process, the Figure 4.4 shows the blade length as the main factor to define the matched artefact with matched pattern in the previous results of document analysis and interview. Based on the result of text document and interview, the researcher found that 6 out of 17 samples of the artefact (CK1 to CK6) were strongly relevant with identified physical characteristic of size, component, shape and material. Therefore, these 6 relevant samples were examined during syntactic analysis for further detail information refinement on structure characteristic (decoration, finishing and design) and intangible information.

Meanwhile, the remaining artefacts with smaller size (CK7- CK17) are irrelevant for further examination. Although the rest of artefacts have the same shape and material, this study suggests further investigation is needed for categorizing them into proper class groups such as *kerambit*, *kuku ayam* (cockspur), *kuku rimau* (tiger claw), *lawi itik* (duck's feather), *kuku helang* (eagle claw) and *kuku beruang* (bear claw).

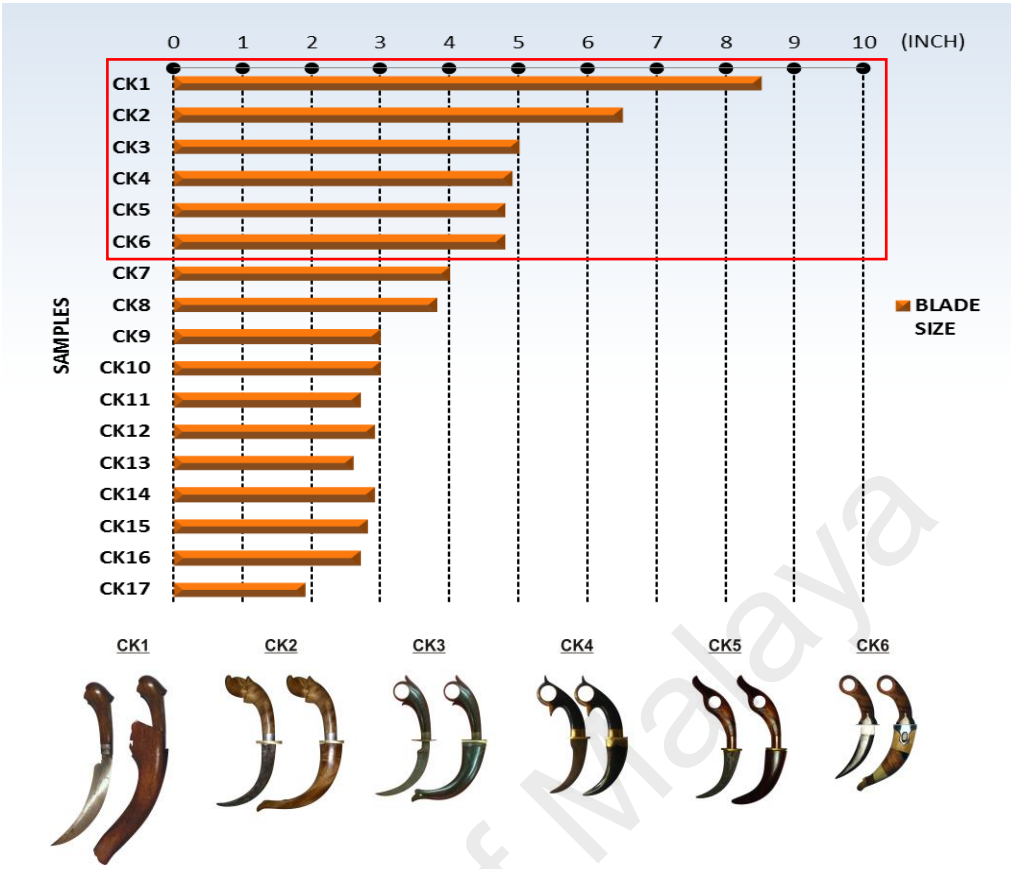


Figure 4.4: Selected six relevant samples in preliminary segregation by size characteristic. (Source: Siti Mastura, 2015)

4.2.3.1 Syntactic analysis of LA artefacts

In this syntactic analysis, further detail description on every syntactic property including the artefact structure and the uses of the material were presented. Information refinement covers the physical characteristic based on the three main components. Six identified samples were recoded as LA with a number (LA#). Description on design structure characteristic (design, finishing, material and ornamentation) for every sample was detailed up. The visual drawing is to show the technical details of the artefact structure and indication.

(a) LA1 artefact

In this section the researcher presents descriptive analysis and visual presentation results of the LA1 artefact (Table 4.2). In terms of the blade size, LA1 has the most prominent length amongst the other six samples that were 8.5 inches. The sharp single-

edge blade has two radiuses of curvature and sharp on the inner side. The analysis has found the curvature rather bigger compared to the other six LA artefacts. Overall, the design is big and bold. According to the owner, although the physical appearance is different from the other five samples, LA1 design is what is commonly used in his *silat* practice.

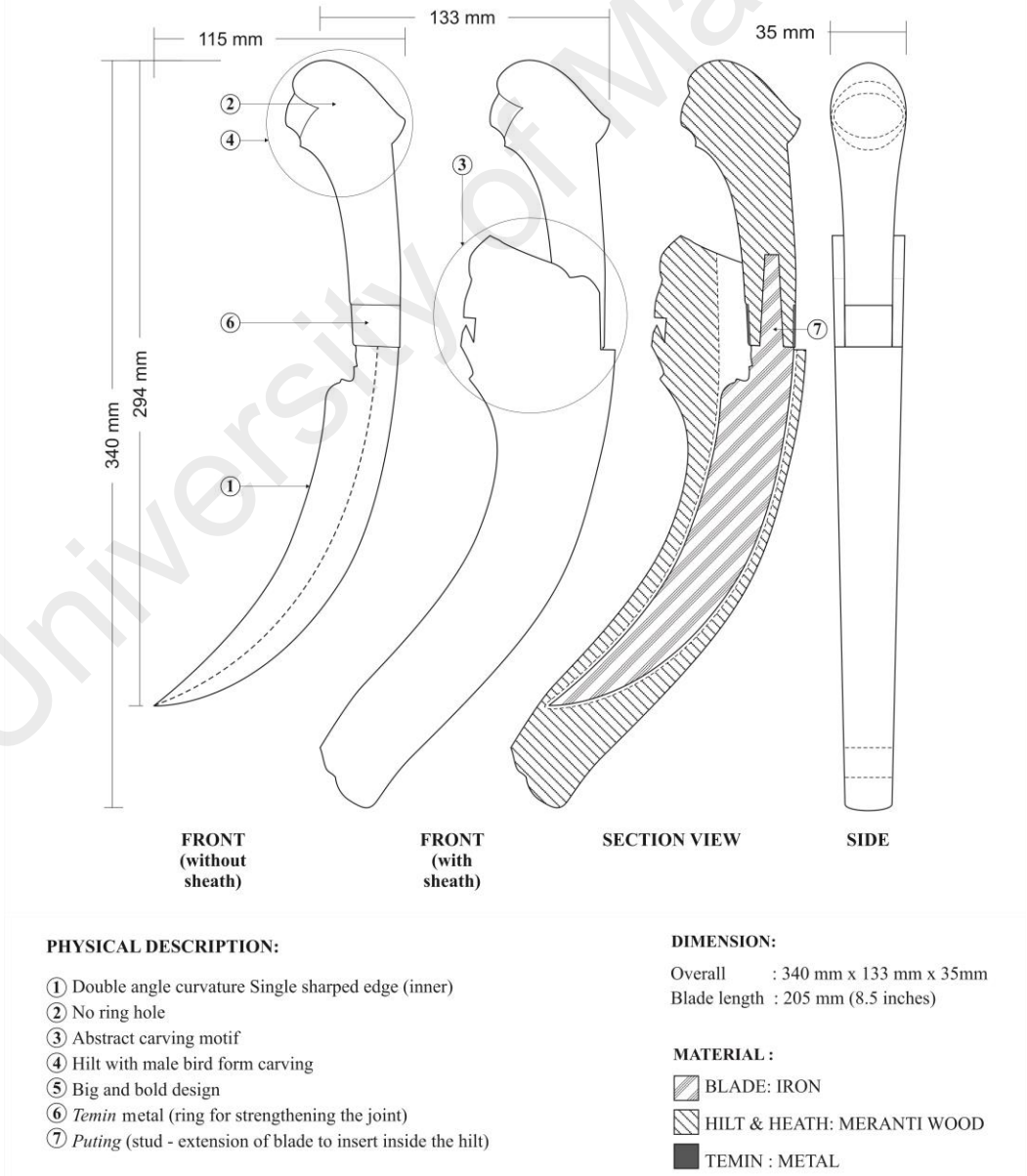
Meanwhile, the hilt lacks ring hole and it has lumpy form. The character of motif carving on LA1 hilt is an animal (fauna) motif. The motif looks like a male bird or cockerel comprised of *paruh* (beak) and *balung* (cockerel fleshy comb). Although the design is abstract, Locher et al. (2010) remind that different interpretations by the viewer depends on how they convey its aesthetic and symbolic value to provide a quality impression. Here, the researcher sees how interpretation is important to build up pre-existent aesthetic experience (AE) for the user to justify the shape of hilt design.

In terms of the material, the blade used tempered iron to withstand stroke impact. For the hilt and the sheath, the component was made from *Meranti* wood that is strong and durable. Metal ring (*temin)* was used to tighten blade to the hilt. Meanwhile, unrefined finish is applied at all three main components. The unrefined finishing suggests the artefact was probably designed for daily usage and rough usage purposes. Only a thin layer of lacquer was applied to highlight the natural colour and the grain of wood.

The disadvantages of the limited features of the LA1 in design are: it lacks ring hole; over wide radius blade; and single sharp-edged blade which suggests only specific gripping style could be used by the user. This finding shows that the versatile technique of flipping, transitioning or manoeuvring cannot be used. Despite the design issues, the criterion of the LA1 blade (8.5 inches length) is suitable to be categorized under the

same group of LA. To note, the above findings suggest that LA1 artefact probably was designed for specific s*ilat* style that requires certain movement.

Table 4.2: Details of syntactic analysis for LA1

Sample LA1	Description
	• Design and size: Long blade and no ring hole. • Finishing: Unrefined form. Natural colour for hilt and sheath. • Material: The blade uses tempered iron. Hilt and sheath use *Meranti* wood. metal ring (*temin)*. • Ornamentation: Motif carving of male bird or cockerel design with '*paruh*' (beak) and '*balung*' (fowl's fleshy comb).
VISUAL DRAWING	
	

(b) LA2 artefact

The results, as shown in Table 4.3 present that LA2 has significant blade characteristics such as moderate length of blade (6.5 inches), two sharp edges (inner and outer) and two numbers of radius curvature. Similar with LA1, the hilt of this artefact was designed without a ring hole. However, flora motif carving was applied on the LA2. In similar function like *tajung* or 'horn' sub-component, the flora motif carving is the abstraction of *biji gajus* (cashew seed) motif. The angle of the jutted *biji gajus* motif was designed and properly positioned without obstructing the handling grip (Figure 4.5). Interestingly, the advantage of this sub-component is that it also serves as a puncher to hit without using the blade.

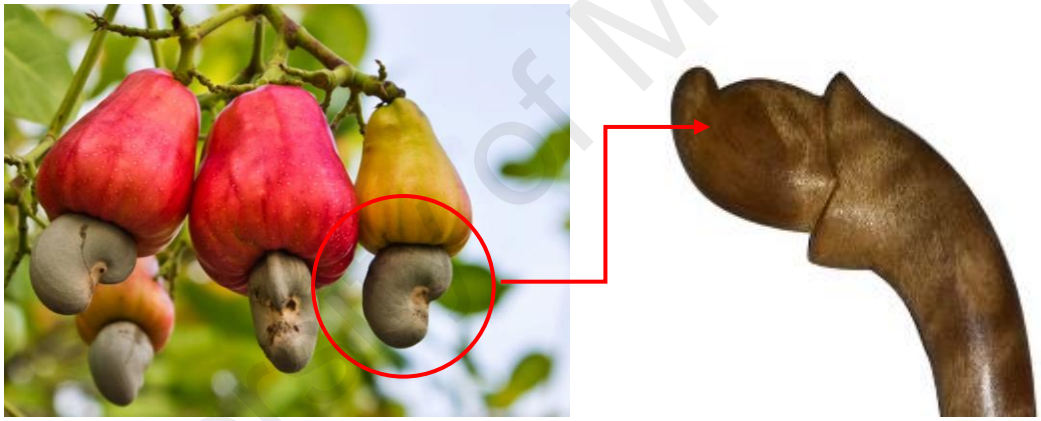


Figure 4.5: Motif abstraction of *biji gajus* (cashew seed). (Graphic: Siti Mastura, 2015)

Visually, the design of LA2 sample provides direct interpretation to the viewer that it was designed in such a way to draw attention by visual novelty (Locher et al., 2010). Similarly, as the tip of sheath was also carved with floral motif of *sulur* (tendril), the researcher believes that these applications of motifs are to visualize the creative imagination in the maker's mind while appreciating his AE towards nature. Therefore, although this artefact lacks ring hole and cooperated with carving decoration, the LA2 design has fulfilled the concept of a functional aesthetic as a whole.

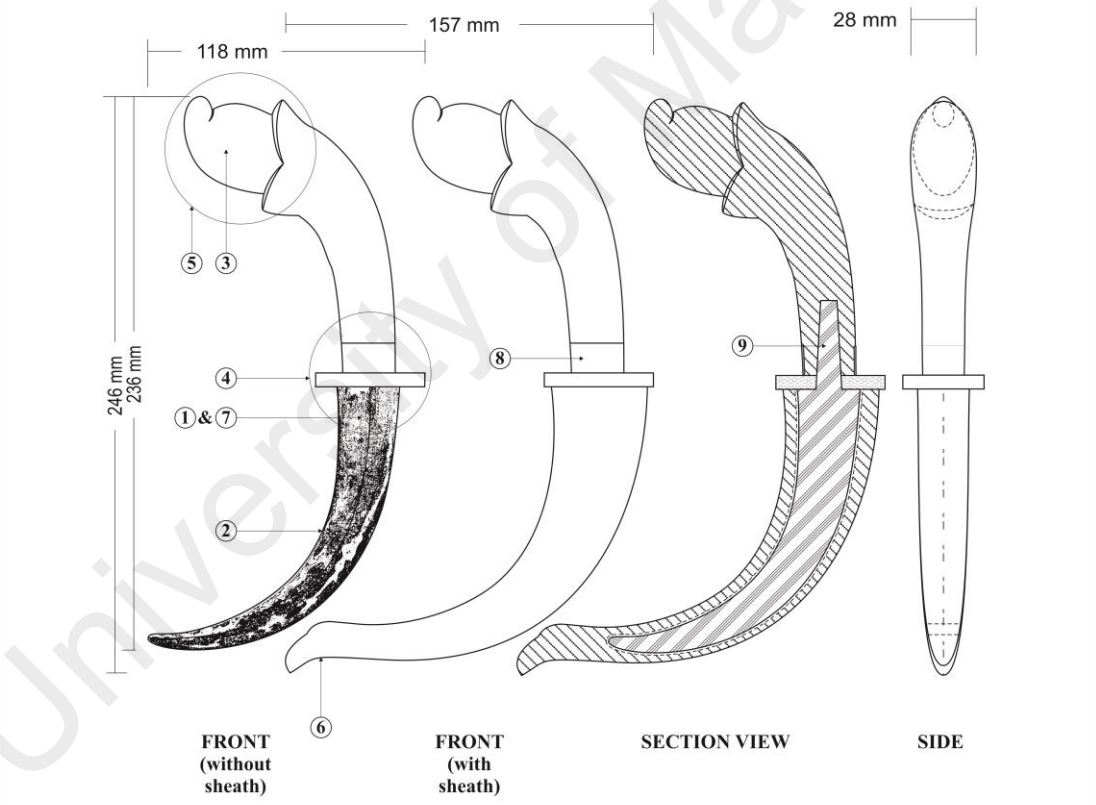
However, the brass guard sub-component between the hilt and blade was associated with safety to avoid a slippery grip as this particular artefact has no ring hole. Some users added that the guard is to protect the hand grip from any liquid substance that might flow towards the hilt. Therefore, the position of the hand must be perfectly fit in between these sub-components (jutted hilt and guard). However, the researcher finds that the guard gives disadvantage for the LA2 sample as the additional sub-component would obstruct the gripping position and it might not be suitable for different user. This measurement factor is important to provide greater fit with the owner's hand.

In terms of material, the hilt and the sheath used a *Kemuning Kuning* wood (*Murraya paniculata*), which is popular in Malay weapon artefact making. This material has physical and visual attraction as the shiny natural colour from the wood grain stands out. Meanwhile, the blade was made from forged iron highlighting the natural damascene (*pamor*) pattern, which is also popular amongst blacksmiths in Malaysia. Also, the silver colour of the metal *temin* ring used to tighten the joint of the blade to the hilt brings contrast to the wood.

In order to present good impression of LA2, the fine surface of artefact finishing was designed to highlight the wood pattern, the brownish natural colour and the shiny wood characteristic. The refined finishing emphasizes the beauty of craftsmanship and quality of workmanship. This research suggests that the craftsmen created LA2 as an aesthetical artefact to draw attention by visual novelty. Locher et al. stated that this is one of the ways the AE of LA viewers' could establish by the artefact appearance.

Table 4.3: Details of syntactic analysis for LA2

Sample LA2	Description
	• Design and Size: blade is moderate in size. No ring hole. • Finishing: Refined surface. Natural colour. Hairline finishing brass and metal part. • Material: The blade used forged iron. The hilt and sheath used Yellow *Kemuning* wood. metal *temin*. Brass guard. • Ornamentation: Motif carving of *biji gajus* (cashew seed) motif. The sheath tip with a *sulu*r (tendril) design.
VISUAL DRAWING	



DESCRIPTION:

① Double angle curvature
② Double sharped edge
③ No ring hole
④ Fitted with a 'temin' (tighter) and a guard
⑤ *Biji gajus* (cashew seed) motif
⑥ curvy motif carved tip.
⑦ Pamur (damascene) blade.
⑧ Metal *temin*
⑨ Puting (stud)

DIMENSION:

Overall : 246 mm x 157 mm x 28mm
Blade length : 166mm (6.5 inches)

MATERIAL:

BLADE: FORGED IRON
HILT & SHEATH: KEMUNING WOOD
TEMIN : METAL
GUARD: BRASS

(c) LA3 artefact

The analysis result in Table 4.4 shows that LA3 artefact blade was designed with 5 inches length blade, one radius curvature and single sharp edge (inner). The blade was made from forged iron rod. For the hilt, LA3 has a ring hole to insert a finger (the forefinger, middle finger or small finger). The cylindrical 'neck' hilt gives the user to have a very comfortable hand grip compared to the flat form. This criterion suggests that LA3 is the simplest design yet it fulfilled the main LA criteria.

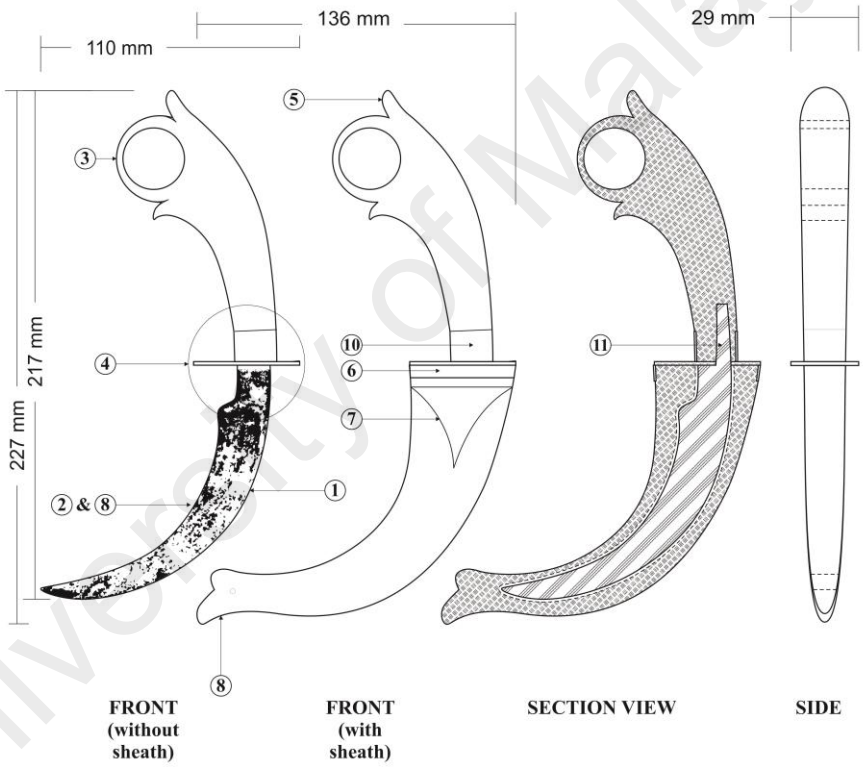
As the hilt and sheath use buffalo horn material, the polished surface emphasizes the beauty of natural colour and fine quality of material. The hilt is incorporated with small horn-like motif carving to add aesthetic value to the ring hole. However, the moderate decoration in LA3 shows that the maker thought practically to avoid any obstruction during the usage like flipping and transitioning. Meanwhile, the sheath has a little *sulur* (tendril) design and a simple sleek 'V' groove line. There is no exaggerated motif on this particular sample. For the brass *temin* ring and guard, hairline finish was applied.

The advantage of LA3 is the curve angle of the blade and hilt. The criteria for these components show how the user could use versatile hand technique. Conversely, the disadvantage of LA3 is the incorporation of a guard on the hilt. Similar with LA2, this particular sample might not be suitable for another user due to different hand measurement, where the guard would obstruct the hand grip position. But, if the hilt was designed without it, then other user whose hands are bigger can grip perfectly and his movement will be more dynamic. Based on the above evaluation, the physical appearance of LA3 design could influence the viewer to contribute a dynamic AI between the form and functionality upon observing it visually. This finding agrees with what has been suggested by Locher, et al (2010) in evaluating an artefact.

Table 4.4: Details of syntactic analysis for LA3

Sample LA3	Description
	• Design and Size: The blade size is moderate and with single curvature. The hilt has ring hole. • Finishing: the Polished surface is from horn material. Hairline finishing for brass. • Material: Forged iron rod (blade). Buffalo horn (hilt and sheath). Brass (*temin* and guard). • Ornamentation: The hilt has small horn-like motif carving. The sheath has a *sulur* (tendril) design and a simple sleek groove line.

VISUAL DRAWING



DESCRIPTION:

① Double angle curvature
② Single sharped edge
③ Hilt with ring hole
④ Fitted with a 'temin' (tighter) and a guard
⑤ Small horn motif carving
⑥ Brass crowning
⑦ Simple groove line added
⑧ curvy motif carved tip.
⑨ Pamur (damascene) blade
⑩ Brass *temin*
⑪ *Puting* (stud)

DIMENSION:

Overall : 227 mm x 136 mm x 29mm
Blade length : 125.5mm (5 inches)

MATERIAL :

BLADE: FORGED IRON
HILT & SHEATH: HORN
GUARD & TEMIN : BRASS

(d) LA4 artefact

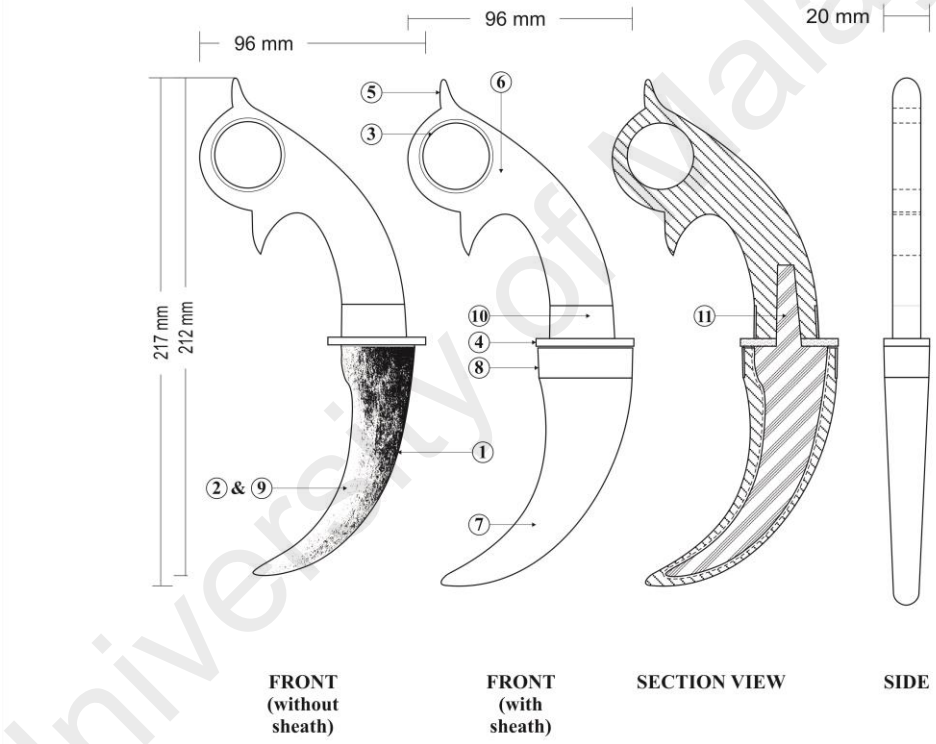
In contrast with LA3 that has a 'neck' on the blade, LA4 was incorporated with a 'chin'. Some blacksmith informed that this particular difference stands to signify the artefact gender whether it's a male or a female LA. The LA4 blade length is within the range of 4.9 inches. The blade was designed with two curvature radiuses and two sharp edges (inner and outer). Interestingly, the hilt was designed with simple yet elegant design. The hilt shape resembles a bird comprised of the 'beak' and small 'horn'. The artefact was made with minimal decoration yet looks elegant. In addition, the LA4 has a ring hole for better grip.

For the material context, the blade was made from forged iron with a natural damascene (*pamor*) pattern to preserve the classic look. The hilt was made using a high quality *Kemuning Hitam* (*Hunteria zeylanica)* for medicinal (poison antidote) and aesthetic purposes. Interestingly, the high gloss finish for both components was intended to emphasize the beauty of natural colour and sleek surface even though the whole design is simple. However, the thick layer of lacquer on *Kemuning Hitam* material suggests that this LA4 was created to expand the beauty of the material compared to its medicinal function. High polished finishing was also applied to the brass *temin* ring and guard complementing the quality of finishing.

The advantages of LA4 were the blade and ring hole. These enable the user to have a firm grip. However, the position 'beak' design in the inner LA4 hilt curve seems to obstruct a perfect grip. This suggests that LA4 was designed based on the specific finger position and hand movement style of the owner. On the other hand, fine finishing and the high quality material usage suggest that this artefact is favoured as a piece of workmanship by the viewer in both physical and visual context. Table 4.5 shows the detail of LA4 visualization.

Table 4.5: Details of syntactic analysis for LA4

Sample LA4	Description
	• Design and Size: The blade has a 'chin' (*dagu*) shape, sufficient length, two curvature angles and two sharp edges. The hilt has ring hole. • Finishing: High gloss surface for the components of; hilt, sheath, *temin* and guard (brass). • Material: The blade uses forged iron. The hilt and sheath were made from Black *Kemuning* wood. Brass *temin* and guard are used. • Ornamentation: The hilt shape resembles a bird with 'beak' and small 'horn'. Minimal decoration. Elegant.
VISUAL DRAWING	



DESCRIPTION

① Double angle curvature
② Double sharped edge
③ Hilt with ring hole
④ Fitted with a 'Temin' (tighter) and a guard
⑤ Small horn motif carving.
⑥ Hilt design is bird alike.
⑦ Simple yet elegant sheath design
⑧ High polished brass crowning
⑨ Pamur (damascene) blade
⑩ High polished brass *temin*
⑪ *Puting* (stud)

DIMENSION:

Overall : 217 mm x 96 mm x 20mm
Blade length : 125mm (4.9 inches)

MATERIAL :

BLADE: IRON
HILT & SHEATH: BLACK KEMUNING WOOD
GUARD &TEMIN : BRASS

(e) LA5 artefact

Table 4.6 shows the LA5 blade length as 4.8 inches with two radius curvature and two sharp edges. Aesthetically, a forged handmade damascene (*pamor*) iron was used for the blade to have *gigi ikan Yu* (Jaw teeth) pattern on it. However, this artefact was not featured with any poison although the *pamor* pattern seems obvious. This suggests how the blacksmith makes use of his skill to manipulate and present the material in such a beautiful manner to appreciate the properties of the material. The curvy angle was implemented ergonomically on the blade that makes LA4 have appropriate space and angle in both gripping and usage.

Meanwhile, similar to LA2, the hilt was designed with ring hole and prominent jutted 'horn' or *tajung* design. The hilt shape resembles a bird. However, the researcher found that the horn rather is too big for the user whose hand is small. Due to the big horn size, flipping and transitioning might not be suitable to be used for this particular sample. In sum, the researcher found that the grip comfort is debatable.

On the other hand, the cylindrical criterion on the lowest area of the hilt is rather comfortable to grip. However, the unsmooth edges of the circumferences inside the ring hole should be improved by rounding it to about 5mm diameter. The researcher believes this is because of the blacksmith hand condition which is coarse due to the nature of his work resulting in having no issues with the ring hole that lacks smooth radius.

In terms of material, the hilt and sheath of LA5 was made of *Setar* wood *(bouea macrophylla)* or *Kundang* wood that has a blackish brown colour. The natural finishing applied on LA5 emphasized the beauty of the natural wood colour and grain. Nevertheless, although this wood has very elegant grain pattern, it also has several disadvantages as it is brittle, easily cracked and difficult to carve. That is why LA5 was

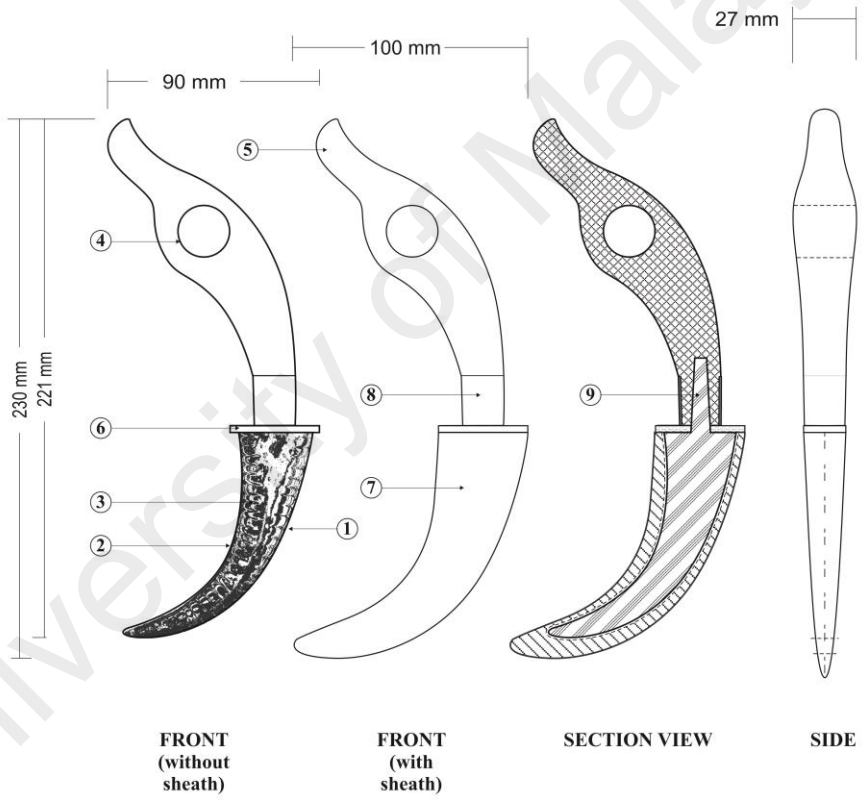
designed with minor carving. The blacksmith advised to use the core of *Setar* wood as it is stronger and has solid grain composition. In addition, hairline finish is applied for the brass guard and copper *temin*, which matches with dark coloured wood hilt. Again, the researcher found that this artefact was designed emphasizing the blade quality and material without fancy decoration.

Similar with LA2, the guard sub-component on LA5 has the same limited ergonomic gripping. To add, the 'horn' and the guard affect the dynamic movement, where the sub-component disables certain technique use. However, the researcher finds that this sample was successfully made if one considers the user's anatomical measurement as the sample was compared to the physical attribute of the owner (head circumference and distance from an ear to an eye).

Table 4.6: Details of syntactic analysis for LA5

Sample LA5	Description
	• Design and Size: The blade has two curvature angles and two sharp edges. The hilt is comprised of ring hole and jutted 'horn' (*tajung)*. • Finishing: Natural finishing for the wood. Hairline finish for the copper *temin* and brass guard. • Material: The blade uses forged iron with *gigi ikan Yu* (Jaw teeth) pattern. The hilt and sheath using *Setar* wood. • Ornamentation: Plain and minimal decoration.

VISUAL DRAWING



DESCRIPTION

① Double angle curvature
② Double sharped edge
③ The blade using *Gigi Yu* (Jaw's teeth) pattern
④ Hilt with ring hole
⑤ Hilt with *balung* (cock's comb) or horn-like design
⑥ Guard.
⑦ Plain design sheath
⑧ *Temin*
⑨ *Puting* (stud)

DIMENSION:

Overall : 230 mm x 100 mm x 27mm
Blade length : 124 (4.8 inches)

MATERIAL :

BLADE: FORGED IRON
HILT: STA WOOD
SHEATH: STA WOOD
TEMIN : COPPER
GUARD: BRASS

(f) LA6 artefact

LA6 has two-edged blade and one curvature angle with a length of 4.8 inches. Furthermore, the hilt was designed with a ring hole and specific for ergonomic grip without any additional sub-component like 'horn' or exaggerated motif carving, which is simple yet beautiful. This could provide an advantage to LA6 as it can be used with versatile technique application to form a dynamic hand movement. Therefore, the researcher found that if the hilt is designed appropriately with ergonomic consideration, the artefact can be highly effective to cause needed impact.

Compared to the previous samples, LA6 blade has different criteria in design and material. Tungsten steel was made for the blade to ensure the cutting quality and durability. This kind of material normally could be found in newer range of LA artefact as it undergone design innovation. Relatively, the hilt and the sheath were made from hard *Meranti* wood (*Shorea spp*.) to withstand stroke impact due to the interlocked grain properties) and beige colour rubber wood (*Hevea brasiliensis*). Interestingly, the sheath was designed with both materials glued together in certain arrangement to create alternate colours. Application of natural finish was to emphasize the beauty of different natural wood colours and to highlight the dark wood grain due to the small amount of silica present in the wood that gives unique decoration effect.

Meanwhile, the hairline finishes on the *temin* ring and the guard is made of pewter. Pewter material was also used as a crowning on the sheath that was designed with a floral pattern. Interestingly, this particular sample was ornamented with highly polished semi-precious stone (tiger eye). Meanwhile, the tip of the sheath has a *sulur* (tendril) motif carving. According to these ornamentations, the finding suggests that LA6 represent the status of the owner, and this explains how the design helps the viewer

communicate with ease of categorization as per suggested by Locher et al. (2010) in evaluating an artefact.

Overall, the artefact was designed for practical use as the hilt and the blade was made of strong and durable material (*Meranti* wood and tungsten). However, the researcher found a possible issue in the context of fabrication. Traditionally, a combination of two types of woods or components in an artefact fabrication was uses *damar*[4] as the adhesive substance (Figure 4.6). In comparison, LA6 design required stronger bonding agent to fabricate the sheath. In LA6 sheath itself, the researcher has observed the joint part of two woods glued together and found that the craftsman used rapid-dry araldite adhesive. Perhaps, further discussion is needed on the level of strength of *damar* application compared to araldite in future research.

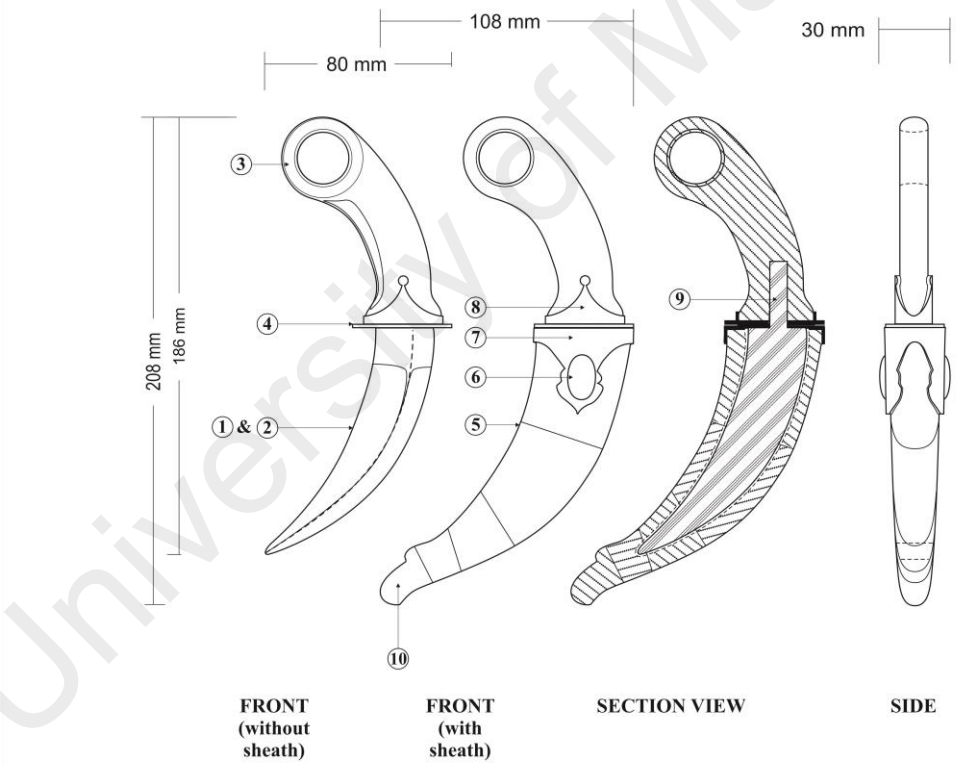
Figure 4.6: Natural glue of *damar* from a tree resin (Photo: https://www.emaze.com (Left), and http://zulbahrihussin.blogspot.my (Right**))**

In addition, the disadvantages of guard sub-component also occur in this sample as found in previous artefacts (LA2, LA3 and LA4). However, although the guard seems to obstruct the handling, the size of it complemented the design of the lowest part of the hilt. Table 4.7 summarised the above finding.

[4] *Damar* is a natural resin, sticky and adhesive substances produced from various type of tree. This material is very useful to the Malay locals as an option in using engineered material as bonding agent.

Table 4.7: Details of syntactic analysis for LA6

Sample LA6	Description
	• Design and size: Two-edged blade and one radius. The hilt has ring. • Finishing: Natural finishing for the wood surface. Hairline finishing for pewter *temin*, guard and crowning. High polished semi-precious stone. • Material: Tungsten steel (blade). Hard *Meranti* wood and rubber wood (hilt and sheath). Pewter (*temin*, crowning and guard). • Ornamentation: simple yet beautiful. The pewter crowning complemented with a semi-precious stone. The sheath has a *sulur* (tendril) motif carving. A difference colour of wood.
VISUAL DRAWING	



DESCRIPTION:

① Single angle curvature
② Double sharped edge
③ Hilt with ring hole
④ Fitted with a pewter *temin* (tighter) and guard
⑤ Combination of two different wood type
⑥ Tiger stone fixed at both side
⑦ Pewter crowning
⑧ Pewter *temin*
⑨ *Puting* (stud)
⑩ Curvy motif carved tip.

DIMENSION:

Overall : 208 mm x 108 mm x 30mm
Blade length : 122.5 (4.8 inches)

MATERIAL :

BLADE: TUNGSTEN STEEL
HILT & SHEATH: MERANTI WOOD & RUBBER WOOD
TEMIN & CROWNING: PEWTER

In summary, the aesthetic judgment conducted fulfilled the first stage of analytical observation on artefact. The syntactic analysis suggested by Boucharenc (2008) and Locher et al. (2010) shows that the physical criteria of LA design affected the function of the artefact usage. Most of the findings confirmed the dynamic interaction between the form and functionality of LA artefacts involving the user sensory-motor perception during evaluation process. The analysis on every sample indicates that LA is a curvy weapon categorized as a big type of curvy weapon in its range. The finding fails to support that curvy weapons that are smaller in size are the same with LA because it does not match with the design typology. These findings have added new information for artefact classification to enrich what is lacking in previous statements.

4.3 Analysis of Intangible Knowledge

This study has revealed several intangible connotations that are closely related to the context of LA tacit knowledge. The results of interview with users and blacksmiths are presented within an interface to examine the way they communicate across cultures as well as to look at the interwoven experience of designing and application process. Figure 4.7 presents the graph of total agreement of the LA design concept in text document.

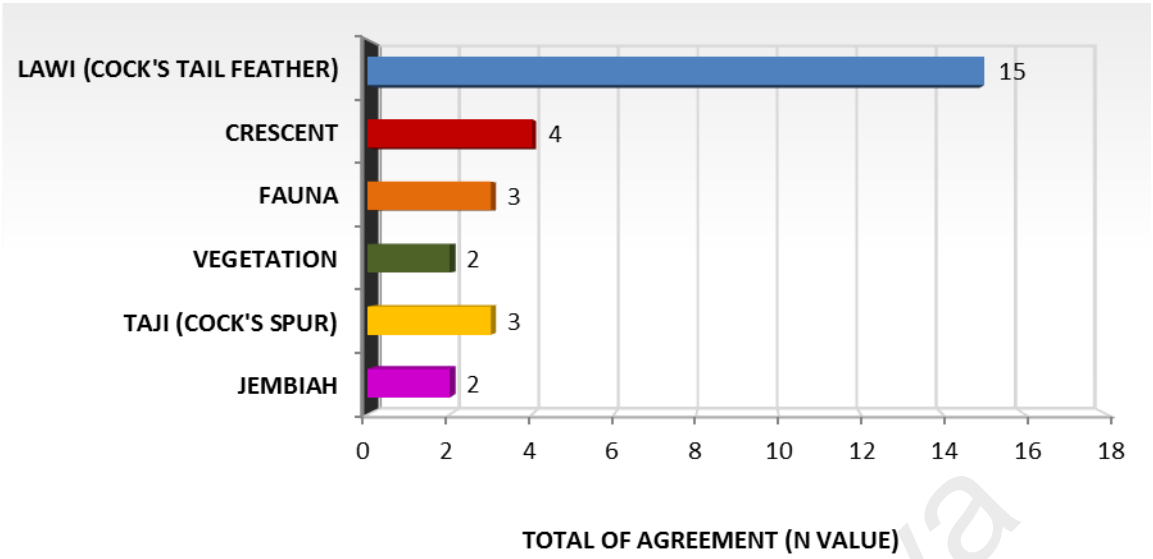
4.3.1 Design Inspiration

The documents (n=14) state that LA design was inspired by the cock's tail feather. From the interview results, Figure 4.7a shows that the majority of the users (n=8) and blacksmiths (n=7) agreed on LA design concept which was also based on the idea of *Lawi* (cock's tail feather). The participants emphasized the curvy shape as the characteristic of '…long curvy cock's back tail feather known as *Lawi Ayam*…' (U6, ln.2; U3, ln.2; B2, ln.8; B3,ln.16; U2, ln.25; U9, ln.2).

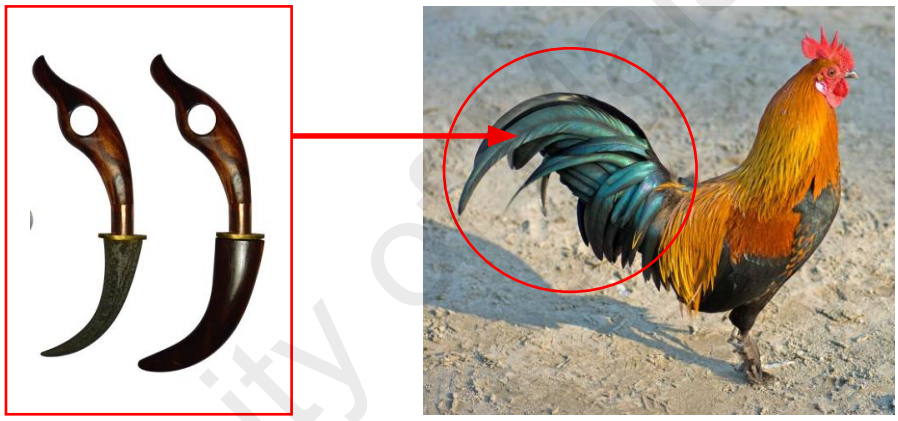
They also emphasized how the Malays found the cockerel as a strong, brave, fast and agile animal (U2, U9, U5). Simultaneously, U2, U5 and U9 suggested that the observant Malays who were involved in cock fighting finds that the cock's wing inspires the light swing and pouncing movement (swing) to represent wind element. Meanwhile, the syntactic analysis has found that the blade length, physical shape and decoration were closely related to the same idea.

These important notions of LA as a cock's tail feather show how the inventor specifically imitates the physical features of the cock's prominent part, beautifully exposed while it is in action (fighting) (Figure 4.7b). Creatively, they transformed this '*Lawi*' which signifies beauty and pride (n=18) into the design. In comparison, the least agreed upon notion was that LA was inspired by the cock's spur as the users and blacksmith sated that the spur was of different design structure and characteristic (Wan Yusmar, personal communication, January 13, 2013).

Thus, the participants strongly supported the contention that the derived name of '*Lawi Ayam*' itself justifies the terminology of the LA artefact. Therefore, these results from interview and artefact observation have proven that LA artefact was inspired by the Malays from the concept of the 'beautiful *Lawi* that is exposed when a cockerel fights bravely'. This result mitigated the steep ambiguity in previous contention of LA artefact in terms of terminology origin. Also, the result showed that the stakeholders of artefact enabled their aesthetic interaction during presentation of the persuasive analogy by conveying the aesthetic and symbolic value and functional characteristic of LA to provide authentic definition.



(a)



(b)

Figure 4.7: (a) The graph shows the total agreement of the LA design concept in interviews, (b) Prominent cock's tail feather (*lawi*) inspires the LA design. (Graphic: Siti Mastura, 2015)

4.3.2 Artefact Philosophy

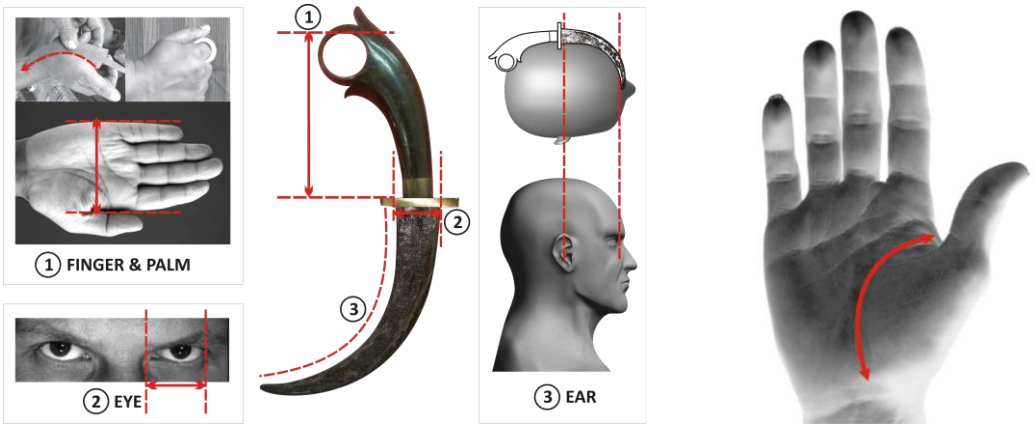
In the context of artefact philosophy, this study found that the user's understanding of the aesthetic experience of LA knowledge plays an important role in obtaining technical information. This study found that the analytic concept of human anatomy is adapted as the basis for the LA design philosophy in the making process and the artefact usage. The users and blacksmiths (n=6) emphasized that this philosophy could

influence the artefact effectiveness. The following result showed two types of philosophies in the artefact design.

4.3.2.1 User anatomic dimension and scale

In the fabrication processes and usage of LA, the blacksmiths have stated that the LA philosophy is comprised of a unique analogical explanation based on human anatomy. Like the document texts which posit the philosophy of LA as a hidden weapon with intrinsic values, the researcher found from the interview with the users and observation on artefact that the blade signifies the eye that sees and observes. Meanwhile, the finger that holds LA signifies fast reactions and precise responses. For example, Mohd Zainuddin and Mohd Syahrim (2007) statement matched with what was explained by U5 (ln.46) & B4 (ln.12), that 'the eye sees and the ear hears' (p. 305). At the same time, they demonstrated how to measure an LA by placing the blade end on his ear and the sharp blade tip at the centre of his eye. The blade width is based on the width of the owner's eye size and forefinger (Figure 4.8a).

Meanwhile, B1 explains that the length and curvature of the blade must match with the radial bursa of owner's hand (Figure 4.8b). They strictly mentioned that if these traditions are disobeyed, the weapon can cause self-inflicted wounds. This usage of human anatomy concept used by the local blacksmiths and LA users has demonstrated how they interconnect the logic factor of safety and ergonomic design.



(a) **(b)**

Figure 4.8: (a) Anatomical methods of measuring a suitable length of blade based on user body part dimensions (a) The curve angle of LA blade and hilt refers to the owner's radial bursa. (Graphic: Siti Mastura, 2015)

4.4 Knowledge Synthesizing towards Artefact Context

In this section, information from both physical characteristic and intangible knowledge were synthesized to summarize the answer for the first research objective of artefact context. Clarification on artefact classification and artefact terminology elaborated the functional factor for artefact effectiveness.

4.4.1 Artefact Classification

This section summarizes the findings yielded from the triangulation from various levels of analyses affecting the artefact context. The analyses results from document review, interview and artefact observation suggest that the syntactic properties can significantly influence how to identify the proper criteria of LA artefact. The physical variables including the three main components that are the blade, hilt and sheath were identified, while the intangible knowledge including design inspiration and philosophy was also found as significant factor that influence the artefact classification.

In general, the results show that syntactic properties have prominent characteristic for artefact identification. The features of blade length size between 4½ inches to 12 inches (big curvy knife) with a sharp two-edged blade, the hilt with ring hole and

ornamented sheath received the most agreement in defining a LA characteristic. In contrast, the smaller versions of the curvy blade knives fall into several different categories that cannot be generalized as the same weapon. A significant amount of agreement (n value) from three different sources indicates these results as a validated finding.

4.4.2 Artefact Terminology

The important notion of LA as a cock's tail feather showed how the inventor specifically imitated the physical features of the cock's prominent part of tail feather (*ekor Lawi*) that was creatively transformed into functional, effective and ergonomic weapon. The inspiration offers a significant concept of beauty and pride for the design. Practically, they used basic yet very reasonable technical knowledge in realizing the idea of LA designs as they consider all the ergonomic matters.

The analysis of participant observation on the intangible knowledge of LA has revealed that the LA expert user notions in practical and functional philosophies need to be understood to result in artefact effectiveness. In turn, the participants strongly supported the contention of the derived name '*Lawi Ayam*' (cock's tail feather) itself to justify the terminology of LA artefact. Thus, this finding could clarify the current arguments. This supports Gentner's (1983) theory of how culture in human activity develops mentally to capture the psychological processes that carry out the analogical mapping. Therefore, the researcher posits that analogic thinking in LA usage enhances artefact effectiveness.

4.4.3 Artefact Effectiveness

From the interview result, all the users and blacksmiths (n=18) agreed that LA's sharp blade and curvy design contribute to artefact effectiveness. They highlight 2 out of 3 main components (blade and hilt) contribute to increase the level of artefact

effectiveness. Moreover, the sharp tip and sharp two-edged blade design facilitate the use of effective techniques even with minimal movement (n=11) of upward-stab, rip, hook and swing-slash. For instance, the angle and sharpness of the LA plays a vital role to ensure the most impact for the slice and slash effect, cutting sphere, stroke precision and blade penetration.

The shape helps the user to direct the hand towards the target point or even to the most vital vein in slender areas like armpit, limb and joint fold, neck or crotch, abdomen and back of body (U5, ln.28; U7, ln.7; U6, ln.8; U6, ln.10; B4, ln.50). As eyes and mouth are also attack points, neck injury is more severe as the larynx, windpipe, jugular notch and crucial jugular veins are in the neck area as shown in Figure 4.9. Also, although the jutted horn or *tajung* on the LA hilt functions as a blunt puncher, this sub-component is sufficient to hurt the opponent on vital attack point (B4, ln.52) especially when it is targeted to opponent's eye, under the chin, temple and jaw.

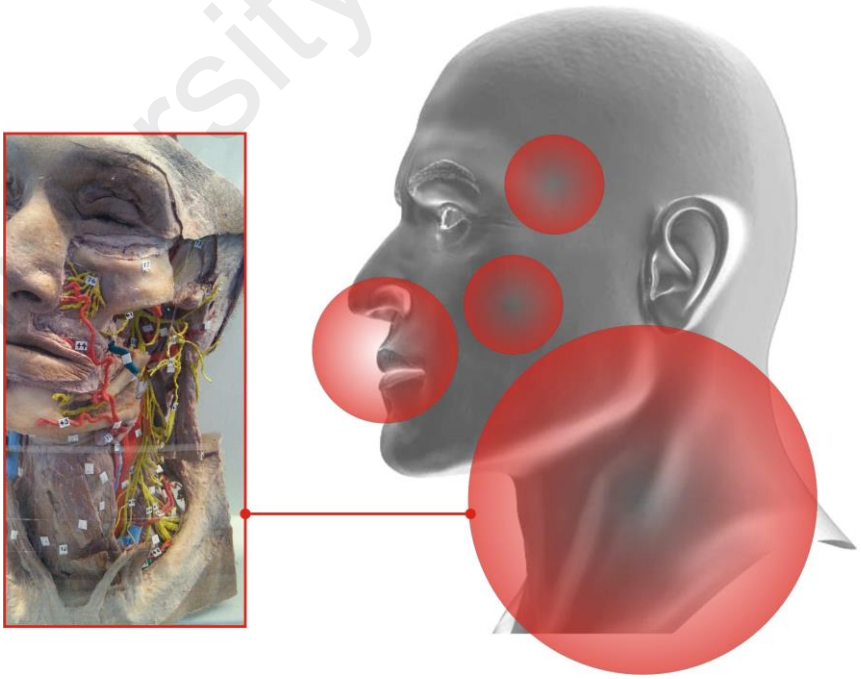


Figure 4.9: The vital part of neck exposes potential target point
(Left picture: Muzium Kuala Terengganu, Terengganu.
(Graphic: Siti Mastura, 2015)

In addition, the angle of the blade must be within 45 angle degree to ensure the effective flow movement of the blade at certain position and angle. For example, 'you will comfortably hold the LA and able to move your hand efficiently due to the weapon design itself to target the hand joints, tendon, armpit, neck and his back.….it's like having an extra harmful body part rather than just an empty hand to attack or deflect….' (Wan Yusmar, personal communication, January 1, 2013). Moreover, the users and blacksmiths (n=13) unanimously agreed that shorter LA is better to disguise (hidden) and deceive the opponent which makes the artefact more effective in unpredicted initiation (U6, ln. 10; U10, ln.42; U6, ln.10; U6, ln.10; B4, ln.123; B4, ln.50; U6, ln.30; B4, ln.46).

Simultaneously, the hilt with ring hole is also favoured by most users (n=13) as the component secures firm grip and enable the user to use the LA with various techniques to counter the attack and to do deflect-attack (U7, ln.7; U6, ln.10; U6, ln.8; U5, ln.28; B8, ln.17; B4, ln.50; B6, ln.6; U4, ln.39). In comparison, the hilt without ring hole has an aesthetic function such as impersonation from naked eyes when it is used as adornment by the user. However, some of the respondents believe that using the ringless LA is in accordance with users' personal preference and specific use of technique and body movement. Table 4.8 shows the relevant statements that support the result.

Table 4.8: Samples of participant statement on LA artefact effectiveness

Main component	Statements
Blade	'The traditional curvy shape is effective…'. (B2, ln.24; U9, ln.6) 'The user will target the veins, knee and hand joints.. and when the opponent is down, the counter attack is persistent. The weapon is fast and agile yet hidden..'. (B4, ln.50) 'P*amur* is to hold poison..'. (B4, ln.83) 'Yes LA was designed to meet the actual function (to wound and immobilize the opponent)..'. (B6, ln.6; U3, ln.13; U4, ln.39) 'Yes, the LA could be deadly..'. (B7, ln.8) 'From the shape itself, we know how to use it..'. (B8, ln.17) 'I am awestruck by LA! Because it could result in deadly injuries compared to other small weapons. The blade can rip widely open the bowel and decapitate the head..'. (U6, ln.8) 'The shorter LA is hidden from the opponent's view. If he kicks, his leg will open up widely and could be hooked by the LA without his knowing. The curvy shape is horrifying and it could cause very severe injuries..'. (U6, ln.10) The longer version of LA is able to decapitate the head…if the opponent kicks but the LA is ready to counter back, the weapon could also decapitate the leg…'. (U7, ln.7) 'LA can be used effectively to cut-off the opponent's Adam's apple and genital part..and it is practical for trained user...'. (U5, ln.28; U9, ln.10). 'LA is effective in all sorts of condition, a swing slash movement by a novice user..'. (U8, ln.43)
Hilt	'Yes, LA is a practical weapon..if we use this weapon by inserting the finger through the ring hole of the hilt, the grip is secured…'. (B1, ln.10; B3, ln.8) 'If the *tajung* (horn of hilt) is used for punching, it could still harm the opponent..punch him hard with it..'. (B4, ln.52 and ln.123) 'If LA is compared to the knife, I can hold the LA better and firmly. The ring hole is to lock the hand grip. The LA won't slip out easily even though the opponent knocks hard. If the LA is redesigned, the ring hole must be retained..'. (U8, ln.70; U2, personal communication January 2013) 'If we look at it (the hilt) we know that LA is effective..'. (U9, ln.6)

Surprisingly, the sheath is less mentioned by the users and blacksmiths. However, in terms of material, the sheath was found very effective as an emergency support if the medicinal wood is used. Also, this third component of sheath complements LA usage

due to the blade-friendly feature for the user to easily withdraw the weapon and protect him from self-injury.

To note, the participants highlighted that trained users are appropriate LA user as they understand the necessity of the physical (syntactic) criteria and intangible knowledge (artefact and usage philosophy). However, the result fails to support that LA is only used by the women user.

The results show that majority of the users and blacksmiths emphasized several notions as follows:

i. The LA hilt has a ring hole to insert finger for practicality and effectiveness, to firmly grip, to secure the efficient movement, to effectively slice, stab or penetrate and also provides flexibility for the hand to use different unique techniques such as manoeuvring, flipping and transition.
ii. The curvy blade has sufficient angle curvature, length and shape is very effective to cause both severe and mortal injuries. Thus, Malay LA is an effective short weapon used in close fight.
iii. The sheath contributes less to the artefact effectiveness yet the component is still important for safety purposes.

4.5 Key Conclusion

This study provides reliable matched evidence suggesting that syntactic understanding is useful to excavate the proper identification of Malay LA design characteristic. Also, the result has identified proper artefact classification of design features, material usage, component fabrication and design structure through viable interrelated methods to construct the artefact context. The researcher suggests these results to be used as crucial content in constructing other artefact classification to

preserve the knowledge in the Malay-world. These results also provide crucial understanding on how intangible knowledge can be customized based on the philosophy of nature of human physiology by positioning Malay analogic reasoning as an intrinsic feature. In fact, results from this chapter could provide a transferable artefact evidence for artefact interaction investigation that underlies the design guideline system on the basis of cultural ideas. Towards the end, this chapter has captured and synthesized the artefact knowledge comprised of information of physical characteristic, design philosophies and ideas for inspiration to contribute to the knowledge of artefact effectiveness.

CHAPTER 5: ANALYSIS OF USER MOVEMENT AND BEHAVIOR IN LAWI AYAM USAGE

5.1 Introduction

The first section deals with the descriptive reporting of how LA artefact works to provide further understanding on aesthetic experience and physical behaviour[1] of the results. The second section examines the ergonomic rapport between the user and LA artefact which constitutes analysis of pragmatic dimensions of how the artefact is to be used. Both results highlight the successive phases of the application of technical knowledge, usage philosophy and movement philosophy in the context of LA use to answer the sub-RQ2. The active participant anticipated obtaining the user responses and psychomotor skill experience while using the artefact including the artefact usability, the artefact usage effectiveness and the movement efficiency. Then this information is used in eye movement test with controlled setting (lab test) to identify the participants' artefact design preference and syntactical evaluation in Chapter 6.

5.2 Functional Information of LA Typology

Functional information relates directly to the function of the artefact. Therefore, typology understanding is a way of describing the feed forward information for the context of use. Description of the artefact typology will be based on the accumulative pre-existent experience about the functionalities of the LA artefact. The visible functional part or physical design in a mechanical object like LA provided anticipated information. When the user understands the concept of usage and movement of LA, it is clear that the functions and movements are successful.

[1] Way of acting or functioning (action or reaction). (Kamus Dewan Bahasa dan Pustaka, 2008-2015)

5.2.1 LA Usage Philosophy

This study revealed several intangible connotations that have close relation to the tacit knowledge of artefact usage. The researcher conducted an interview and participated in a training session with Malaysian LA expert and *kerambit* master, Wan Yusmar Wan Yusof to elucidate the applied design through philosophical thinking. In LA usage context, he stated that one must understand the concept human body to ensure the usage effectiveness, other than knowing the target points. The same agreement on the related documented information in the text documents (n=14) and expert users (n=8) in Chapter 4 were corresponded during training. Figure 5.1 shows the representation of the concept of nature to the human body.

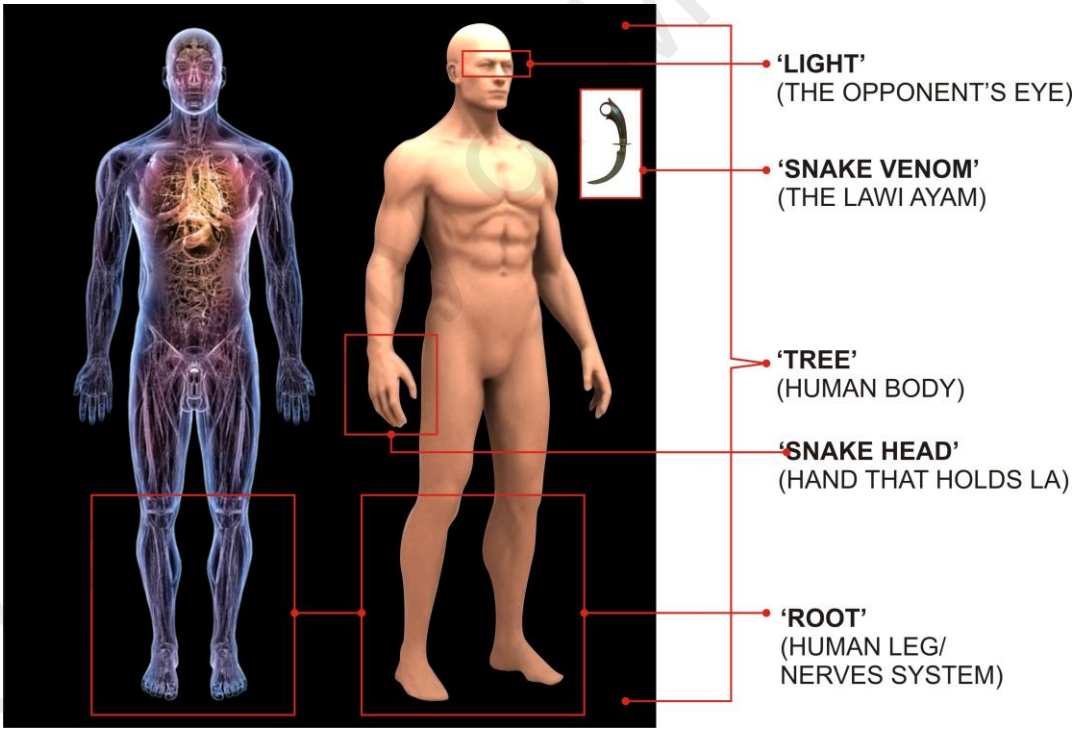


Figure 5.1: Representation of human anatomy in LA usage context
(Graphic: Siti Mastura, 2015)

The usage philosophy defines the worldview of expert user like Wan Yusmar by involving a context comparison and similarity of viciousness in two types of LA usage philosophy that were representational and methodical. He stated that the users must

understand both types of philosophies towards the artefact use in the early stage. For example, disarming and immobilizing the opponent through the analogy of defanging the snake using continuous strikes is how the user understands the efficacious representations. Such persuasive analogies are meant to explain new inferences of behavioural ergonomic and cognitive response knowledge.

Table 5.1 indicates every definition that brings meaning to the philosophy of LA usage. For example, *cabut bisa ular, cincang sampai lumat* mean to immobilize the opponent's ability to result in a total damage. During the recorded training session, He added, '..precise attack to the opponent's leg to injure it and immobilize him is how to use the philosophy of *potong akar*…..and, as we deflect the attack at standing position after we use the LA to wound the attacker, our body automatically reflects efficiently using more techniques to disarm him…' (vid1, t.00:02; vid5, t.00:48).

Through the observation on the training session and LA seminars, the researcher found that the majority of user participants gave positive feedback when their LA application was practical and effective as they understood where to target (*potong akar*, n=10) on the opponent's body. At the same time, they successfully disabled the opponent's vision (*padam lampu*, n=7).

Table 5.1: LA usage philosophy

	Philosophical	**Code**	**Definition**	**Usage of Artefact**
Representational	*'Cabut bisa ular cencang lumat'* (Take out the snake venom, chop it dead)	CBU	Defanging the snake by chopping off the body with several attacks	• To disarm the attacker • To immobilize the attacker • Several attacks to vital body points.
	'Potong akar' (Cut off the root)	PA	• Tree stands by roots, human stands by leg. • 'Paralyzing' the tree by cutting off the roots	• To immobilize the attacker (targeting on the nerves system, joints and tendon on opponent's leg) while he is in standing position

Table 5.1, continued: LA usage philosophy

	Philosophical	Code	Definition	Usage of Artefact
Methodical	*'Padam lampu'* (Switch off the light)	PL	Once cannot see, one cannot fight	• An attack to the eye to disable the view or visibility of the attacker. Next, initiate the LA on target point.
	'Potong nafas' (cut-off the breath)	PN	To disable the opponent's breathing ability.	• To attack at opponent's throat and Adam's apple.
	'Potong sendi' (Cut-off the joint)	PS	Cut sectional body part into 2 or 3 parts	• To attack at every joints of neck, arm, hand and leg.
	'Itu diberi, itulah diambil' (Take what is given)	ID	To trap-combat the opponent first attack	• To demoralize the opponent by quick cut first attack
	Silang- satu di atas satu di bawah (cross – one each on upper and lower)	SLab	Hand form – arm crossed for deflection and attacking	• Hand movement must be alternately up and down in position. • Blocking method
	'Serang atas bawah' (high and low attack)	SAB	• Attack at both upper and lower body	
	Susun lawan' (line-up opponent)	SL	• Fights on opponent one at a time at certain position.	
	Pukul dan lari' (hit and run)	PLr	• Flight or/and fight (Must have skill) • Fighting technique • Complement to SL • Hit the nearest opponent and run. • To decrease amount of opponent during large scale attack • To slow down the attack movement • Diversion	
Additional	*'Pantang undur'* (no setback)	Pu	• Stand still and move forward	
	'Orang-orang' (scarecrow)	O2	Self-sacrifices for the sake of others	• To protect the person and not be harmed

Previously, in the interview result in chapter 4, U9 (ln. 30 and ln. 41) also mentioned the similar context of the applicability of the notion of LA male user because of the physical character and philosophical function rapport. He explained that the LA user (male user) must be brave and strong in using the LA as it is a hidden and short range weapon and he could get injured if he does not understand the concept of it. His notion of the cock's *Lawi* that is exposed during cock fighting represents how a cock fights bravely without a setback. He added that the way a cock's fight was by a swing-fly and upward stab using *taji* (spur) on his leg.

If this representation of usage philosophy was understood, the LA user would effectively use the weapon with efficient technique and movement. Thus, in turn, the result suggests that the use of analogical representation in Malay creative thinking contributes an important role for the LA effectiveness. The findings were consistently agreed across participants and Wan Yusmar. Interestingly, these findings show the ignorance of previous scholars to document the important notions of potential tacit knowledge of cultural artefacts such as in traditional weaponry system.

5.2.2 Analysis of Points of Attack

In LA usage, one must know which point of the target gives optimum effect to result in an effective initiation of LA usage. Previously, as mentioned in chapter 4, artefact effectiveness vitally depends on the understanding of the representation of the human anatomy in LA usage context. Likewise, the human anatomy is closely related to the points of attack. This study has divided the target points on the opponent body into several sections. Figure 5.2 shows that the target points are grouped into four.

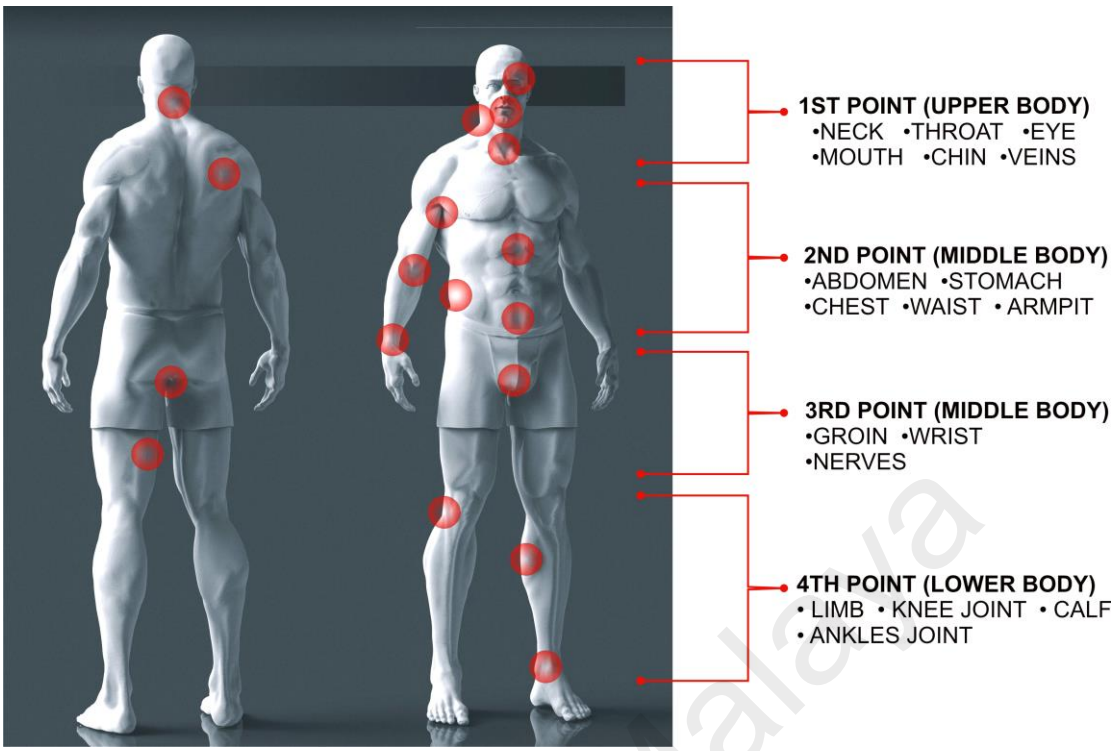


Figure 5.2: Target points on the opponent body for the context of LA usage (Graphic: Siti Mastura (2015) & www.cgtrader.com)

The first group of attack point known as upper body consists of neck, throat, eyes, mouth, jaw and jugular veins. These points, if wounded or severely cut, can be life threatening. For example, the eye that sees should be important for one to make moves and steps. Therefore, PL (switch off the light) philosophy is perfectly applied on the opponent even at the first attack by covering his eyes.

Meanwhile, the body part that is more devastating is the neck area, which could lead to fatal injury. Fatal injuries could occur if some of the important body parts such as jugular veins, oesophagus and neck muscle is cut off even with one swing slash movement. Hence, the philosophies of CBU (defanging the snake by chopping to pieces) and PN (cut-off the breath) are very efficacious.

Similarly, the CBU philosophy also applies to second and third group of target points. The second group (middle body) of attack point is associated with abdomen, stomach, waist and armpit that also related to deadly injuries as the LA is very effective

in swing slash cut and upward stab technique in all type of user body positions. The expert emphasized that fatal injuries caused by LA attack were on the abdomen that contains all of the structures between the chest and the pelvis whether it is slashed through or stabbed.

The abdomen is separated anatomically from the chest by a powerful muscle spanning the body cavity below the lungs (diaphragm). The abdomen is hosting the vital organs including the stomach, small intestine, colon, rectum, liver, spleen, pancreas, kidney, appendix, gallbladder and bladder. The expert added, 'imagine if the opponent's LA slashes any part of our abdomen…it's fatal!.... because the entire stomach component is placed in one cavity'.

In the third group of attack point, the groin is the vital body part to be one of the main targets of LA attack. A user could efficiently move with an economic technique (one body movement) by targeting the opponent's groin. Also, another interesting finding from the observations, the philosophies of the CBU, the PA (cut off the root) and the PS (cut-off the joint) were effectively used to attack the third (middle body) and fourth (lower body) points of attack. This area mostly contains the veins, nerves system and muscle and meniscus[2] system of the knee, elbow and wrist including limb, tendon and joints. As the human body representation were adapted in the system, all the above three philosophies such as 'root' (veins and nerves) and 'snake venom' (hand that holds LA), the main objective is to immobilize the opponent by attacking the wrist, armpit, knee joint and all the systems in third and fourth points.

These results showed that one can effectively use the LA weapon if the philosophy of usage and knowledge of human anatomy for target points are understood well during

[2] Thin fibrous cartilage between the surfaces of some joints such as the knee.

LA usage application. In fact, it takes only a short period for one user to understand the uses of philosophy as the LA design itself contributes to the effectiveness and functional usage (the sharp edge curvy blade and firm grip on hilt).

5.2.3 Analysis of Ergonomic Rapport with LA Techniques

This section shows the pragmatic analysis of functional typology of LA artefact. The result from document analysis showed that more than half (n=8) of the 14 text documents provide general information about the function of LA. These documents explained the way to initiate LA. Most of the documents mentioned the firm hand grip factors in LA function. The following are the types of function when finger is inserted into the ring hole of hilt resulting from certain artefact techniques:

i. Index finger in the ring hole and the hilt was held with the blade in outward position for upward movement.
ii. Little finger in the ring hole and the rest of fingers grip the outside of hilt with the blade in extending downward position for hook movement.
iii. Index finger in the ring hole and the hilt was held with the blade in outward position for swing slash movement to the right side or left.

Meanwhile, in the interview with the LA users and blacksmiths, most of them agreed that ergonomics is one of the important factors in LA function and technique (n=9). Majority of the respondents (n=11) responded with positive feedback on the 5 types of handling typology and movement such as *sauk* (upward stab), *cangkuk* (hook), *rodok* (front forward) and *libas* (swing slash) as also per documented by previous researchers. The hidden concept of LA received less agreement (n=4) as the rest of expert users indicated that the LA is not as small as *kerambit* or *kuku helang* (eagle claw) or *beruang* (bear claw).

This result showed that the definition of hidden weapon is subject to the LA size and how the later user intellectually manipulated the design to hide it from the opponent's knowledge. In addition, close range and deflection with cutting sphere was also mentioned to explain how they use the LA effectively and efficiently. Table 5.2 indicates the agreed upon statements of the influential factor of LA techniques by the users and blacksmiths.

Table 5.2: Sample of respondents agreements of influential factor in la techniques

Factor	Total	Statements
Ergonomic	n=9	'Ring on LA hilt could result in a proper grip..' (B1, ln.10; B4, ln.22)….. 'The hilt component plays important role in stronger and neat grip if you hold the LA.. .' (U5, ln.26; U6, ln.20) 'The LA without a ring and a 'horn' could cause uncontrolled hand movement, like an empty hand. Therefore, the horn was designed to fit with the user thumb for comfort and firm grip.. .' (B4, ln.128) 'Effective LA design is evaluated by the quality of material, how it's used and ergonomic factor..' (B6, ln. 29) 'The LA should be held like wolverine claw between fingers.. .' (U1, ln.27) 'The LA hilt is surely ergonomic. This curvy weapon is very effective using *sauk* & *layang* handling style because the tradition of LA design making is always suited with comfortable handling..' (U2, ln.46) 'You will notice the weaknesses and strength while you used LA artefact, so you know how to move or react.' (U3, ln.74)
Movement • *Sauk & rodok* (upward stab) • *Libas* (swing slash)	n=11	'Some of the users prefer the hooking technique. But, it is not so practical in fast movement. If so, the design of LA must taper (bigger curvature). Unfortunately, hook technique sometimes can be entangled.. but still, the cut is severe.. .' (B2, ln.14) 'If the horn is used in simple punching move, it still harmful to the opponent...' (B4, ln. 123) 'Because the blade is curvy on the inner side when it holds, that's why the holding style looks like stabbing, when the hand moves either upward or downward.. .' (U4, ln.67) 'Some of the users used it by swing slash movement… (U4, ln 29) that is the first impression when they looked at the artefact.. '(U3, ln.142) The wound is wider if hooked by *rodok*. For example, the LA could rip open the bowel with severe injury by the curvy blade..'. (U6, ln.10) '*Layang* (swing slash), *sauk layang* (upward stab) could be dangerous if targeted on neck and abdomen area.' (U6, ln.47; U7,ln.73)

Table 5.2, continued: Sample of respondents agreements of influential factor in la techniques

		'Some people call it *sauk...Sauk* is a stabbing technique using LA. *Sauk* can be combined with swing slash.' (U7, ln.77) 'LA is effective and useful weapon in any situation.. even by untrained user…they can automatically know how to do the swing slash technique... .' (U8, ln.43) 'In certain position, one can use swing slash technique. Let's say from right to left…and from that position, he can do either hook or upward stab, the movement is like dancing although it is to kill effectively.' (U8, ln.54) 'Movement of cock's feather tail in LA concept has element of wind. Thus, the way the LA artefact is supposedly used is by a swing slash.' (U9, ln.30)
Hidden weapon	n=4	'The LA is hidden at the side or back waist.' (U6, ln.30; B4, ln.46) 'The LA weapon could be hidden. Without the opponent's knowing, he gets injured while he kicks you…rips open.' (U6, ln.10) 'The user moves front and back.. he keeps his LA in cloth fold either on the arm or the waist. He used it when the intimidation is initiated.' (U6, ln.14 and ln.46) 'As for me, LA is a true weapon for war that is effective yet still can be hidden...' (U10, ln.42)
Close range	n=3	'As LA is a short range weapon for a close fight, one won't let off his LA when facing an opponent.' (U4, ln.5) 'We aim the LA closer to the opponent.. then, initiate it with a swing slash attack from back because it is easier and efficient..' (U6,ln. 30) 'Perhaps, as the LA is big, rough movement is used..'. (U8,ln.78)
Deflection and cutting	n=2	'Deflect and cut with only *one slash per one time blow.'* (U3, ln.143) 'We also use LA for deflection and cutting.. .' (U9, ln.41)

To add, although the result of document analysis and participant observation have highlighted the importance of finger position and handling typology, they barely provided verbal evidence which particular finger should be used throughout the interview. Instead, they practically showed the finger placing and grip position while explaining the artefact design.

Meanwhile, based on the participant observation to LA technique application with the LA expert, the analysis was more detailed using the Malay terms to justify how the expert's hand moves the LA. Interestingly, the finding obtained from the expert user proves that the types of hand grip and hand movement are vital mechanical knowledge for LA usage. For instance, Figure 5.3 show both functions of *sauk* (upward stab) technique and *layang* (swing slash) technique. Both techniques involve an identical finger position, direction of blade (the tip of curvy blade pointing outside) and ergonomic gripping style, which the blade expose more than the gripping line by at least 50%.

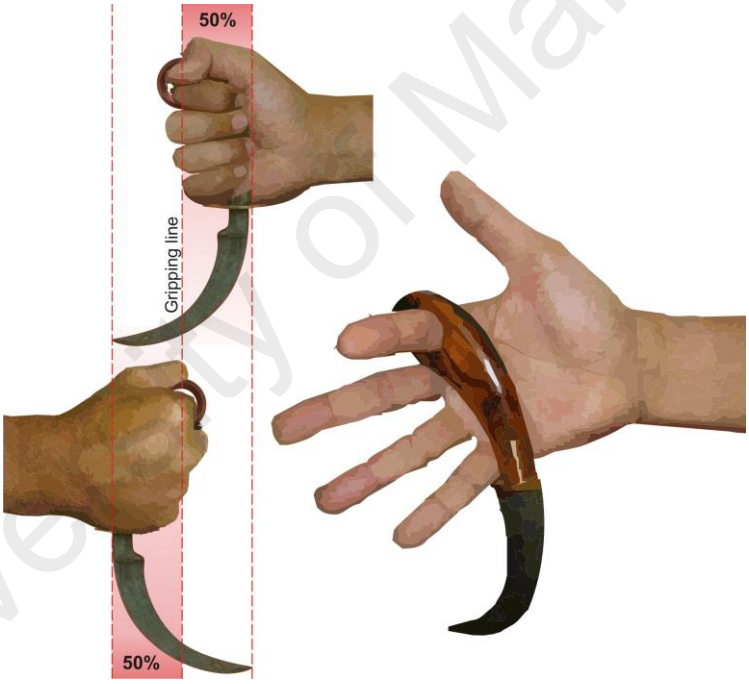


Figure 5.3: LA Position for the techniques of *sauk* (upward stab), *layang* (swing slash) and *hentak* (back strike)
(Graphic: Siti Mastura, 2015)

In terms of function, different types of hand movement were used in these three techniques, but still using the same gripping style. Figure 5.4 shows the hand movement of *layang* (swing slash) technique moving horizontally like 'a wing that flies' (U2, U9) either from right to left or vice versa. On the other hand, Figure 5.5a shows the *sauk* (upward stab) technique which functions to stab upright at the targeted points, also

known as a vertical upward movement. These techniques received the most agreement across the previous text documents, informant interviews and participant observation as it is the most dangerous technique.

Figure 5.4: Hand movement of *layang* (swing slash) technique (Graphic: Siti Mastura, 2015)

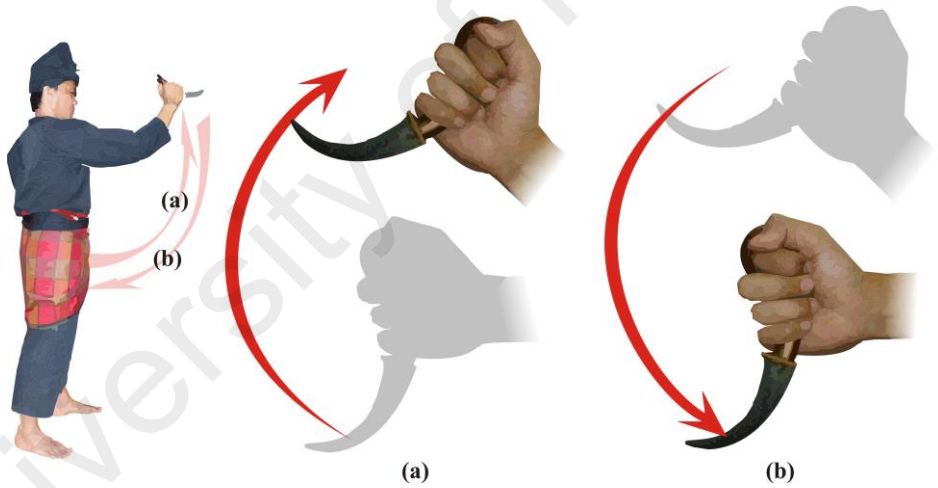


Figure 5.5: Hand movement of (a) *sauk* (upward stab), (b) *hentak* (back strike) technique. (Graphic: Siti Mastura, 2015)

Meanwhile, the *hentak* (back strike) technique in Figure 5.5b is a manipulation of the LA design by using the outer sharp edge of the blade to make the cut. The researcher found that the *hentak* technique is a reaction movement of downward strike after the *sauk* (upward strike) move was made. Even though the technique of slashing uses the concave sharp edge, the result observed from video recording showed dangerous impact even with just one stroke.

All these three movements were the mostly used as the momentum of movement made is linear and efficient to cause severe and fatal injuries to all four group points of attack especially the abdomen. Physically, the researcher found that the grip style in this technique is comfortable and flexible yet useful in the various strike angles and wrist movement. However, these three techniques are too technical to be used by normal users.

In comparison, *cangkuk* or hook is the next prominent technique of LA function. Figure 5.6 show that little finger inserted through the ring hole ensures ergonomic grip. The expert showed the comparison between two styles of finger placing for a hook technique. The first style (Figure 5.6a) is a complete grip. However, the researcher has observed that the expert is likely to place his thumb finger on the convex curve of LA in between the blade and hilt with the blade facing the opposite way from him (Figure 5.6b). This indicates that the second style provide a better pressure during the hooking and could guide the hand movement to intended direction compared to the complete firm grip.

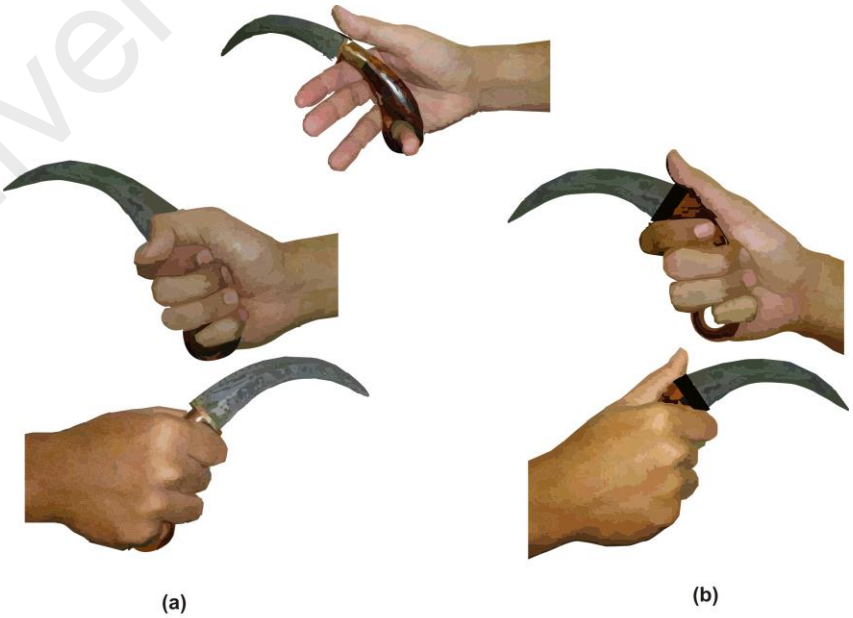


Figure 5.6: Two types of grip style of *cangkuk* (hook) technique, (a) Complete firm grip, (b) A grip with thumbs-up position.
(Graphic: Siti Mastura, 2015)

Also, the hand movement of a *cangkuk* (hook) technique is particularly downward vertical, linear or slanted. Or, crosswise from either upper left or right side to the lower sides, vice versa (Figure 5.7). However, the researcher found that both holding styles have an identical effect on penetration and cutting effect as long as the LA is still in the user's hand and used with certain speed and precision.

Figure 5.7: Hand movement of *cangkuk* (hook) technique.
(Graphic: Siti Mastura, 2015)

Then, the expert demonstrated the following deadly function that is *tumbuk* (punch) technique with LA artefact. The researcher found that there were two options to use this technique during the LA application. If the style (Figure 5.8a) is used, the user opts to punch, and if needed, the stab or slash follows. Meanwhile, if the user intended to 'warn' the opponent before initiating any further vicious attack, he could use style (Figure 5.8b) to punch the target point such as the face using the ring of tilted hilt.

Figure 5.9 shows the hand movement of *tumbuk* (punch) technique which uses upward direction with full force like normal punching moves. Here, both hand positions can result in two significant effects of different injuries, either to penetrate the skin or to break the bone. The researcher also found how a user could involve an emotion factor in the attack using the LA, but it still depends on the situation. Punching attack using the hilt for warning purposes is one of the findings presented.

Figure 5.8: Two types of grip style of *tumbuk* (punch) technique, (a) Using the blade to injure, (b) Using ring on the hilt to punch.
(Graphic: Siti Mastura, 2014)

Figure 5.9: Hand movement of *tumbuk* (punch) technique.
(Graphic: Siti Mastura, 2015)

Lastly, the optional technique in LA function is *ketuk* or knock. Figure 5.10 shows how the inserted forefinger through the ring hole plays a role for the *ketuk* movement. This particular technique is the extended version of *sauk* (upward stab) technique. The movement of *ketuk* technique involves a reverse flip from *sauk* hand grip position to front outward for the outer sharp edge of the LA blade to cause a minor injury (Figure 5.11). The advantage of using this *ketuk* technique is to give variety and flexibility if the user intends to use two techniques at one time on the same target. On the contrary, the impact of *ketuk* technique is less effective (minor injury) if the manoeuvring force is weak. Thus, the user must put an extra momentum in hand movement by manipulating the LA weight.

Figure 5.10: LA position for *ketuk* (knock) technique using the forefinger.
(Graphic: Siti Mastura, 2015)

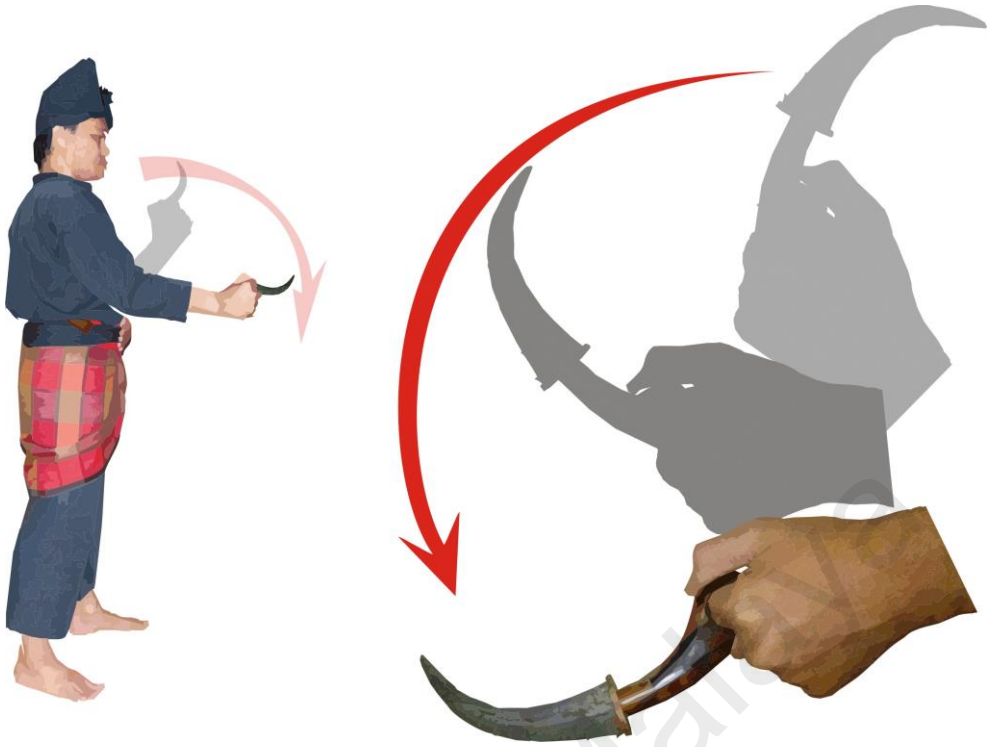


Figure 5.11: Hand movement of *ketuk* (knock) technique.
(Graphic: Siti Mastura, 2015)

Interestingly, the observation result showed that LA users' grip styles vary and free manoeuvring from one position to the next depends on the functionality, the force of movement and the criteria of the design itself. The result indicates that the artefact function could rely on handling techniques by altering the LA positions. For instance, the technique of *cangkuk* and *ketuk* had a different hand grip compared to *sauk* and *layang*, where a shifting orientation technique is needed. Three main shifting orientation techniques were found:-

i. Spinning - In tactical situations, being able to maintain control of the LA throughout the entire spin in any direction (horizontal, vertical, forwards and backwards) is vital in order to perform this transition without injury. For instance, one can spin from the extended grip position and then simply pull the blade back into a reverse grip.

ii. Flipping – This technique is to change the direction from extended outward (*sauk* or *layang*) to *cangkuk* position blade.

iii. Transitioning – The additional access to targets due to the blade's curve and the ability to move the LA without dropping it are two of the most significant. However, this particular technique remains undocumented as per requested by the expert.

In summary, based on these results, LA handling style has a lot of advantages and disadvantages with regards to artefact function that must be mastered with certain training regimes to discover the truth about balance, weight, momentum and hand/forearm conditioning by precision and control. For instance, hand conditioning is a vital phase for a user to familiarize the LA design and ability, because automaticity in their muscle memory results in a better artefact usage application.

Significantly, during the participant observation, the researcher found that 72% of respondents in training session agreed that trained users are able to use LA effectively because they understood the relation of perceptual-motor skill between usage philosophy, artefact typology and ergonomic rapport. Thus, these results proved that perceptual-motor skill and skill of artefact used lead to dynamic technique use. According to the above findings, this research coded the technic typology as functional information to support the ergonomic rapport in the following analysis shown in Table 5.3.

Table 5.3: Codes of technique typology components

FUNCTIONAL INFORMATION			CODE
	Malay Term	**Definition**	
Technique Typology	*sauk*	upward stab	S-us
	hentak	back strike	H-bs
	layang	swing slash	L-ss
	cangkuk	hook	C-h
	tumbuk	punch	T-p
	ketuk	knock	K-k
	potong belakang	back slash	PB-bs
	pusing	spinning	Sp
	-	flipping	Fp
	-	transitioning	Tr

5.3 Inherent Information: User Body Movements in LA Artefact Application

Inherent information is provided by the natural consequences of taking an action by touching an object while simultaneously observing it visually (Locher et al., 2010). In LA context, this research found that the perceptual-motor skill of user is tied together with the action possibilities of the product, where user and product communicates with the possible physical actions to reactions when handling and moving the LA. The analyses on ergonomic rapport of the LA to the user body movement are described in the following section. The expert user provided this research with the terms and concept of fundamental knowledge to assist the ergonomic rapport analysis.

5.3.1 The Philosophy in Tactical Movement

In this study, we found that the movement philosophy for LA traditional artefact is related to observation skill and logical thinking. The nature entity used in this philosophy showed how movement efficiency can be obtained through their ability and skill to submerge into the logical representation. In the interview, most of the expert

users (n=9) agreed that the analogical reasoning using the component from surrounding nature is to replicate the knowledge of human body mechanics, which contributed to the efficiency of user movement. For instance, the analogy in assuming the self as a tiger is how the user implements the tacit knowledge to gain the understanding of how the LA should be used in a proper way. Table 5.4 summarised the philosophy movement accompanied by the representation meaning, definition and support statement.

Table 5.4: Analogical reasoning for philosophical movement.

Analogy	Representation	Definition	Statement
'Permainan Harimau' (Tiger play)  (http://www.taringa.net/posts/imagenes/5732007/Fotos-National-Geographic-HD--parte-2.html)	The user's movement imitates the tactical moves of how the tiger plays.	Ability to obtain body and muscle memory	'.. Once I had the *Lawi Ayam* design on my hand, automatically I know what to do.. my body and muscle memory seems to know how to position by philosophical concept gained before I initiate the *Lawi Ayam* …' (n=4)
'*Gerakan Harimau*' (Tiger movement)	The user's vision replicates the awareness and alerts towards the attacker's movement	Ability to see and evaluate the situation using tunnel view and peripheral view	I can see where they stand and what they hold upon the intimidation situation…thus I am able to plan my moves to deflect the attack or make my *Lawi Ayam* initiation...'. User (n=4).
'*Mata Harimau*' (Tiger eye)  (http://www.amazingwallpaperz.com/tag/tiger-3d/page/2/)	The user's action is based on their movement planning to intuition	Ability to deflect the attack or to counter the *Lawi Ayam* initiation.	'I feel as I'm able to see everybody around me even though I only have a limited range to see them (tunnel view and peripheral view)…. '. User (n=6).

5.3.2 Analysis of LA Application Concepts

Table 5.5 shows the geometrical concept used as fundamental of LA application. This concept is applied in fundamental knowledge of LA application and movements such as footwork, *pelampas* (hand drill), the direction of attack and deflections. As such, the basic geometrical concept defines the applicable foundation of nurturing the user's cognitive structure ensuring LA effectiveness.

Table 5.5: Geometrical concept of LA applications and user movements

GEOMETRIC SHAPE	MOVEMENT	APPLICATION
	Peripheral vision Range & distance Point of Attack Direction of movement Footwork and hand drill	Identification Attack Defence Deflection Clearing
	Attack movement Direction of movement Footwork and hand drill	Attack Defence Deflection Clearing
	Direction of movement - Footwork - Hand drills	Attack Defence

5.3.2.1 Peripheral vision

In self-defence, the victim must be able to do peripheral viewing through the concept of triangle shape using the philosophy of *mata harimau* (tiger eye). The viewing is a wide angle in the front area of his body to analyse the intimidation and to estimate his moves to do a counter attack or self-clearing or even to identify any possible chances to withdraw the LA for protection purposes (Figure 5.12). In terms of self-clearing, *kelek* is effective body movement in LA attack. The *kelek* is a type of deflection by twisting the hip to divert the LA attack to outer body area with hands. Meanwhile, *sikat* movement is the other hand positioned like combing the hair. As veins in neck and

wrist are the crucial part that should be protected, *sikat* hand form is a practical defensive. Thus, both *kelek* and *sikat* should be understood by LA user.

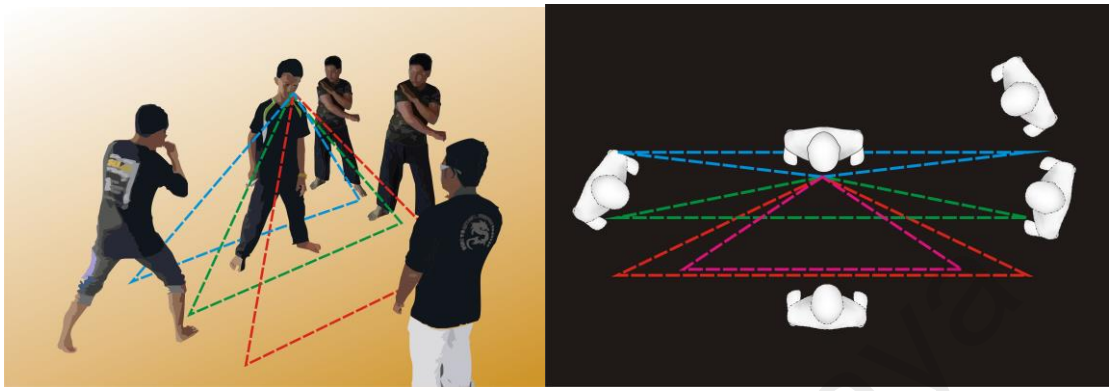


Figure 5.12: Peripheral viewing using the concept of triangle shape.
(Graphic: Siti Mastura, 2015)

In this analysis, the researcher found that the major contributing component to an aesthetic interaction is the user's cognitive structure, which contains several types of information such as strategy and methodology in experiencing a functional object. Therefore, the factor of movement, body language, muscle memory and automaticity in movement influences the cognitive structure of LA user. Also, the precision of manipulation, speed and repetition demands, required stability and kinetics that all need to be understood and expressed.

5.3.2.2 Range

In the participant observation during the training session, the researcher found that the expert user demonstrated the triangle shape as the basis for justifying the range and distance between the user and the opponents. Based on Figure 5.13, the range of clearance is measured according to the hand length of the user himself. Both hands held together shaping a triangle is important to justify the safest distance and space. Because LA is classified as a short range weapon for close fight in Chapter 4 (p.157, Section 4.4.3, ii), perfect timing for movement reaction and body agility are required to support

the bodily muscle memory ensuring effective and efficient in usage. Thus, finding shows that the essence of geometrical user concept influences LA application to be integrated with the movement form.

Figure 5.13: Appropriate range of distance for la application.
(Graphic: Siti Mastura, 2015)

5.3.2.3 *Lapan arah mata angin* (eight cardinal directions)

Figure 5.14 shows the eight cardinal directions or points are the direction of north, east, south and west, commonly denoted as N, E, S and W. Similarly, the intermediate points or inter cardinals are also known by initials such northeast (NE), northwest (NW), southeast (SE), and southwest (SW). In LA application and movement, these eight cardinal directions are vital to ensure the artefact effectiveness and movement efficiency. The expert user explained that if a user practices the stepping and footwork repeatedly with these cardinal directions, he would be able to deflect intuitively

depending on which way the opponent approaches. The SL (line-up opponents) philosophy supported his statement.

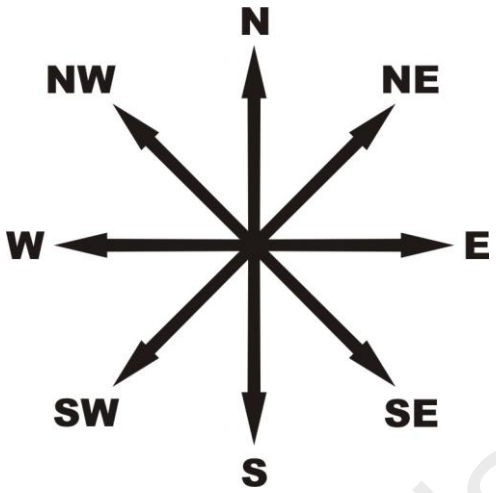


Figure 5.14: Eight cardinal directions

5.3.3 Analysis of the Fundamental of Body Movements in LA Application

In terms of LA application, this research has found a series of relevant approaches to user-centred practices as it focused on the relationship between the user, his/her skill or abilities and the artefact itself. The fundamental movements in LA application recorded based in the sequence of LA usage knowledge are 1) hand drill and 2) footwork.

5.3.3.1 Hand drill

Hand drill is a disciplined form of hand movement in LA application using appropriate speed and timing. The direction of attacking and deflection comprised of two geometrical motions (triangle and round). There are two types of hand drill known as *pelampas* and *belebat*[3]. *Pelampas* is a series of parrying and empty hand stroke with the open hand for offensive n defensive at the same time. Meanwhile, *belebat* is a combination of hand and footwork movement using the LA.

[3] Definition *belebat* may vary from different *silat* system.

Particularly, the basic movement in LA application is a combination of repeated S-us (*sauk*) technique and deflect stroke movement. The user needs to move both hands in opposite round direction movement. The empty hand (left) moves in clockwise direction and the hand that holds LA (right) is anticlockwise. The direction is also interchangeable with the other way around (Figure 5.15). The researcher was given this training regime to master for three months because it is the essence of body automaticity and muscle memory in LA application. The expert user has proven this notion by demonstrating it with unexpected attacks by his trainees with the speed of eight seconds with five to seven blows, compared to a novice user with two to three blows only.

Figure 5.15: Hand movement of *belebat* (combination of hand and footwork movement) using geometric concept. (Graphic: Siti Mastura, 2015)

5.3.3.2 Footwork

Figure 5.16 shows two types of footwork that is (a) *langkah segi tiga* (triangle stepping and (b) *tapak tiga* (triangle step). Both types indicate the use of triangle geometric concept application in the foot movement. This stepping is based on the eight cardinal directions for precision. Series of movements involve the forward and backward stepping. *Langkah segi tiga* was applied during *tapak melilit* (entwine step) to obtain LA effectiveness by 1½ feet distance.

On the other hand, *tapak tiga* is used for defensive and offensive purposes by a zig zag movement. Similarly, another type of movement is *tapak empat* (4 points stepping in a square shape) also observed during the training session (Figure 5.16c). If one mastered these four types of footwork, the body automaticity ensures the movement efficiency such as attacking, defending, deflecting and self-clearing.

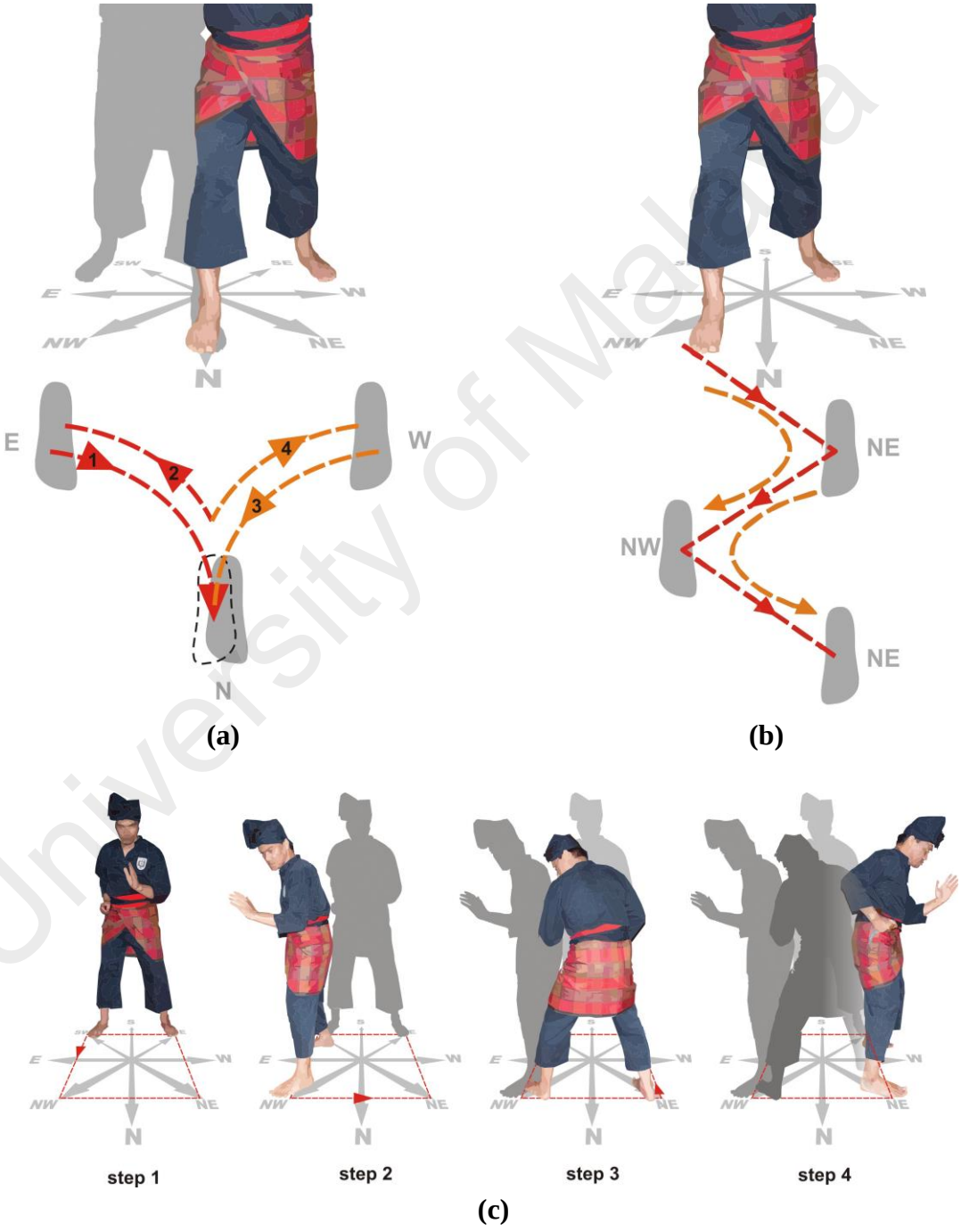


Figure 5.16: Three types of footwork (a) *Langkah segi tiga* (triangle stepping), (b) T*apak tiga* (triangle step), (c) *Tapak empat* (square step)
(Graphic: Siti Mastura, 2015)

Physiologically, the researcher found that all four types of footwork consider 1) the body weight distribution on both legs while moving, 2) shuffling as a key of stability to ensure the agility for deflecting and counter attacking, and 3) crouching position to stabilize the standing position on any terrain. Interestingly, the expert user emphasized that this footwork required the user to use their range of body size to estimate the distance of every step and movement.

Therefore, the analysis covers the inferences between the user knowledge and the LA design. Although LA design is simple, yet the usage effectiveness is undeniable. As the expert mastered the hand drill and footwork conditioning through PT, Bt and other type of steps, the transition technique would be successfully applied to dynamic body mechanics involving automaticity and muscle memory. The training regime also positively affects the expert user movement with high level of agility, speed and precision. Therefore, the application of usage philosophy complements both person context and artefact context.

For instance, if the user tends to use wider range, they are suggested to combine several techniques such as footwork and the suitable philosophy. As figure 5.17 shows the combination of various techniques in 360 degree attack using footwork, *layang* (swing slash) and *sauk* (upward stab), the user wisely manipulated the peripheral view, deflection and the eight cardinal directions that ended with the LA withdrawal. Thus, this movement has proven the concept of hidden weapon, ergonomic and vicious short range weapon for close fight.

Figure 5.17: Combination of various techniques and movement with philosophies application of PS, PA and SAB.
(Graphic: Siti Mastura, 2015)

In summary, functional typology (functional information) and actions in LA application (inherent information) must engage to obtain both forms of feedforward and feedback interaction by understanding the fundamental of LA application concept and body movement. The expert emphasized that feedforward and feedback interaction result in a positive input in user cognitive responses and body mechanics (automaticity and muscle memory). Body mechanics are related to the science behind the understanding of internal and external acting on a human body and the effects produced by these acts such as action and reaction. Table 5.6 shows the codes for every technique in inherent information to aid the ergonomic rapport analysis in following section.

Table 5.6: Codes for every component in inherent information

INHERENT INFORMATION	TECHNIQUE	CODE
Body movement	*Pelampas* (hand drill)	Ps
	Belebat (LA hand drill)	Bt
	north	N
	east	E
	south	S
	west	W
	northeast	NE

Table 5.6, continued: Codes for every component in inherent information

INHERENT INFORMATION	TECHNIQUE	CODE
Body movement	northwest	NW
	southeast	SE
	southwest	SW
	footwork	F
	tapak tiga (triangle step)	TST
	langkah segi tiga (triangle stepping).	LST
	tapak empat (4 point stepping in square shape)	TE
	tapak melilit (entwine step)	TM

5.4 Analysis of Ergonomic Rapport with LA User Body Movement

As presented earlier in the Table 5.3 (p. 177), the analysis of ergonomic rapport of LA functional information has identified 6 types of techniques application: *sauk* (S-us), *layang* (L-ss), *cangkuk* (C-h), *hentak* (H-bs), *tumbuk* (T-p) and *ketuk* (K-k). Meanwhile, inherent information comprises of the fundamental knowledge of intangible (concept and philosophies) and physical application (body conditioning). These results were synthesized to analyse the ergonomic rapport with the LA user movement. As the ergonomic rapport of physical movement of LA usage of the expert user was visually analysed, the LA user body mechanics were placed into a discussion. Therefore, the researcher looked into the principles of body mechanics to help the analysis of LA user movement towards LA techniques that affects action and reaction, which mainly involved a compound movement.

Triangulation of the results from the documents, respondent agreement (a majority by n=11, see Table 5.2, p. 167-168) and observation with the LA expert suggested that L-ss is a technique always related to movement efficiency. Apart of L-ss and C-hk, the

S-us is always synonym with LA application proving that these specific techniques were ergonomically applicable. The expert stated that economic movement in these particular techniques ensures the body mechanics' efficiency.

5.4.1 Body Movement of S*auk* (S-Us) Technique in LA Application

S-us (s*auk*) technique is used in several manners. Based on the observation and recorded movement in the training session, four body movements in standing position of serial S-us technique were identified that are S-us1, S-us2, S-us3 and S-us4. The S-us1 was rather simple compared to the other three, which need the user moves his hand upward to a vertical direction (Figure 5.18a).

On the contrary, Figure 5.18b demonstrates the S-us2 technique in standing position which requires the user to launch the LA in cross upward stab direction starting from lower right to upper left (depending which hand holds the LA). The movement also requires the user to turn (*kelek*) his upper body (hip and waist) during the transition. At the same time, the other hand is placed on the neck for protection from the incoming threats.

Meanwhile, the S-us3 has a similar movement launched from the opposite side (Figure 5.18c). This time, a step ahead to NE direction of right foot movement is applied based on eight cardinal directions (*lapan arah mata angin*). Again, the other hand is placed on the neck for protection. The advantage of using S-us3 movement is that it is normally used as a counter attack after S-us2, which is a reaction of a follow-up movement. In summary, S-us1 to S-su3 uses an economic movement of body mechanics that is one stroke of action. Nevertheless, these simple movements compliment the curvy design of LA artefact as the user is able to use it effectively with minimal movement.

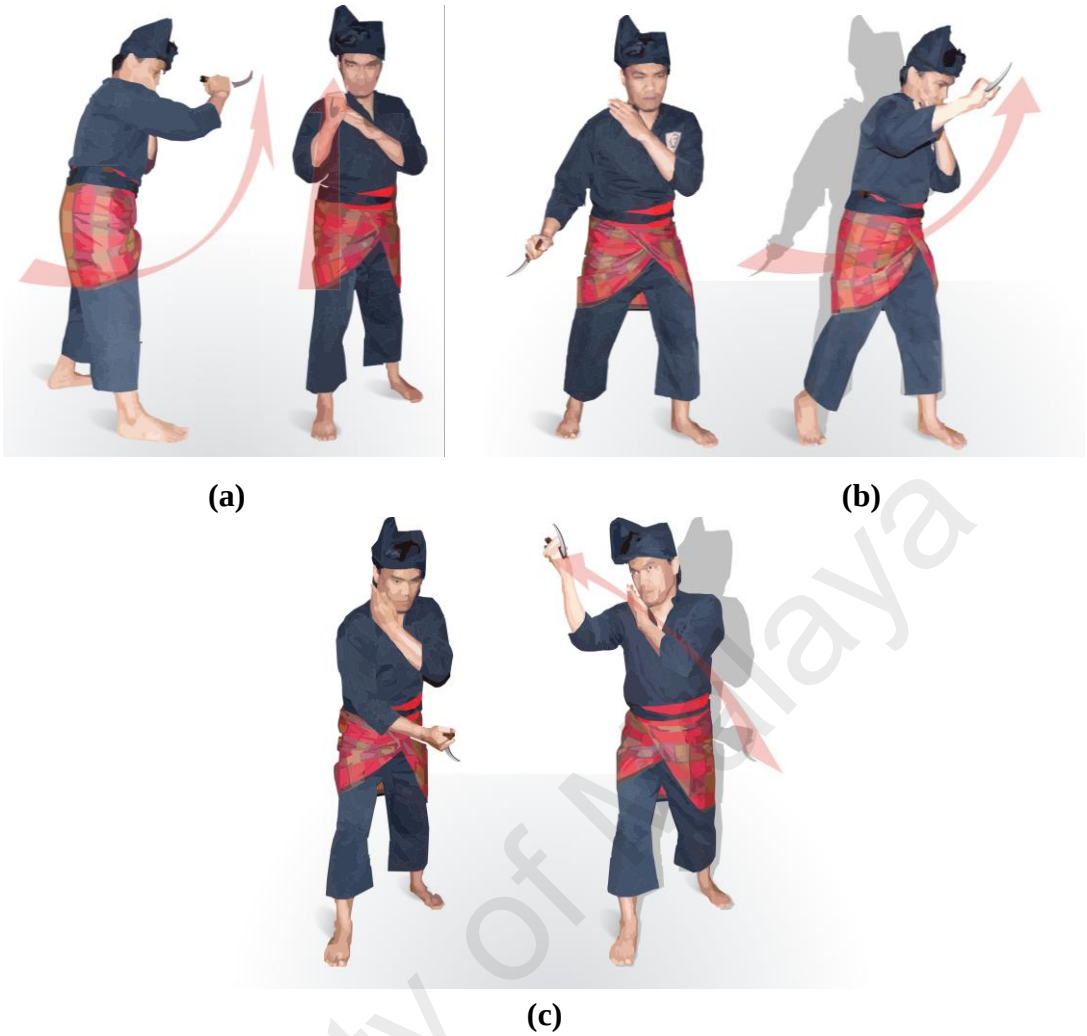


Figure 5.18: (a) S-us1 movement, (b) S-us2 movement, (c) S-us3 movement (Graphic: Siti Mastura, 2015)

Based on the above basic serial S-us movements, the formation of S-us4 is a combination of S-us2, NE stepping and body deflection involving an action to create a following reaction. Figure 5.19 demonstrates how the user initiates the S-us4 technique with a step ahead towards NE cardinal direction and dragging the other leg to the same direction for self-clearance out from the attack. Again, the other hand is always placed on the neck for protection. This particular hand stroke and stepping movement prove that the use of Ps, Bt and footwork potentially forms dynamic muscle memory and automaticity. Thus, the result suggests that body automaticity of body mechanics compliments the cognitive ability that stores the functional information of LA artefact technique.

Figure 5.19: Movement of S-us4 involved an action to form a reaction.
(Graphic: Siti Mastura, 2015)

Relatively, as the S-us movement complements the LA curvy weapon that is designed with a double sharp edge (inner and outer edge), the second reaction of *hentak* (H-bs) or back strike can be used to add a follow-up impact either on the same spot or otherwise. The expert demonstrated a compound movement that combined S-us2, N stepping and H-bs or PB-bs as a result from S-us action (Figure 5.20).

The research found that the compound movement has multiplied the functionality of the LA artefact. This shows that the user does not feel limited even with the simple curvy design of LA and has proven how AE works during aesthetic interaction for the inherent knowledge.

Figure 5.20: Compound movement of H-bs technique or PB-bs technique. (Graphic: Siti Mastura, 2015)

5.4.2 Body Movement of *Layang* (L-ss) Technique in LA Application

In the observation during the training session, the researcher also found that the body movement of *layang* (L-ss) technique has three basic serial movement coded as L-ss1, L-ss2 and L-ss3. These three movements have appropriate ergonomic position mostly preferred by the trained users. The expert explained that the L-ss movement is a comfortable and practical position that has several advantages to avoid self-injuries such as: 1) opportunity to hit target until 3 to 4 points of attacks; 2) stability of body weight; and 3) consistent agility, speed and momentum of the swing movement.

First, Figure 5.21a shows L-ss1 technique that requires the user to launch the LA in a horizontal motion across the upper part of the opponent's body. However, this movement may vary depending on the targeted points of attack; for instance, L-ss2 in

Figure 5.21b targeted the middle body area and L-ss3 in Figure 5.21c to the lower area. Similarly, these movements also requires the user to turn their upper body (hip and waist) during the across motion. At the same time, the other hand is placed on the neck for protection.

Also, every action of L-ss movement may create a following reaction if the user intended to reverse his hand to make a back slash using the outer sharp edge of LA. In this position, this study found that usage philosophy (PS, PN and CBU) also is successfully applied with the manipulation on sharp double-edged design of LA as they know both directions could result in severe injuries.

(a)

(b)

Figure 5.21: (a) L-Ss1 movement to upper point of attack, (b) L-Ss2 movement to middle point of attack. (Graphic: Siti Mastura, 2015)

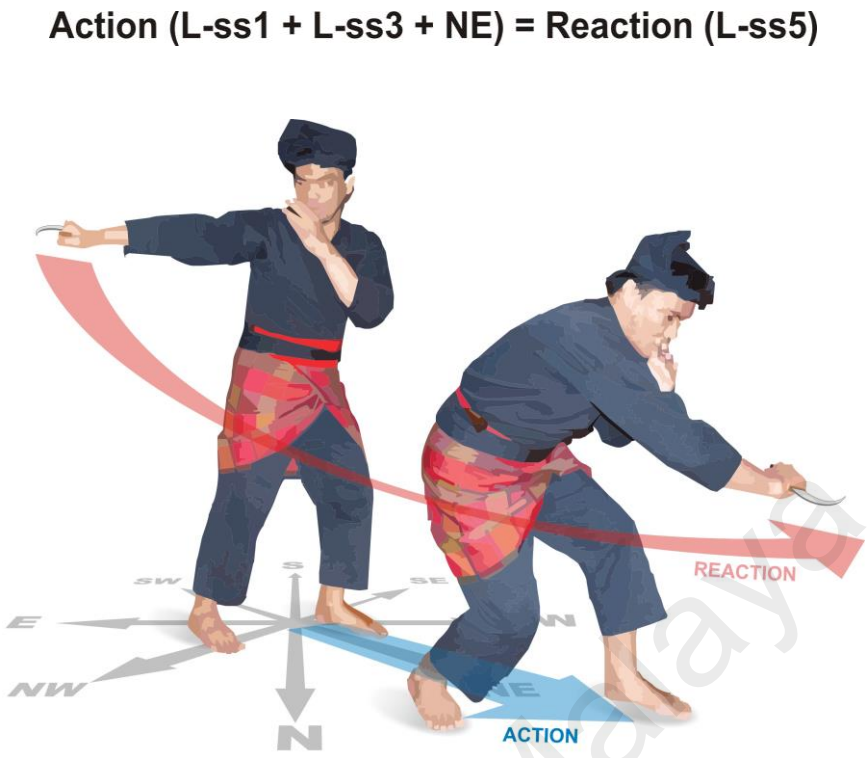
(c)

Figure 5.21, continued (c) L-Ss3 movement to lower point of attack. (Graphic: Siti Mastura, 2015)

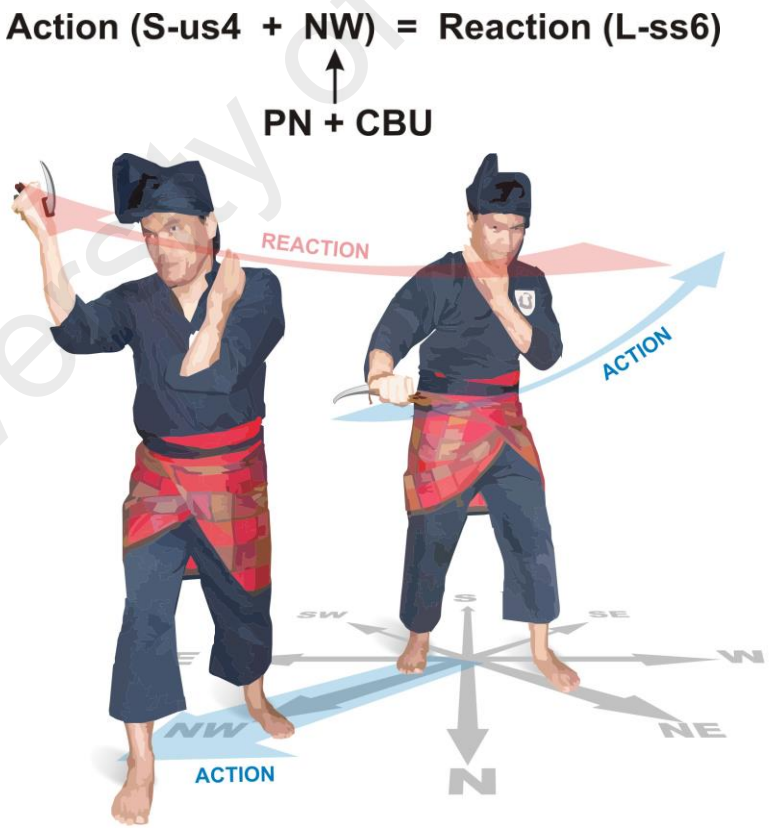
Meanwhile, the usage philosophy of SAB (upper lower attack) is efficiently formed with the combination of L-ss1 and L-ss3 movement (Figure 5.22). This showed how a denoted usage philosophy is vital to guide the LA application using only one type of technique, yet less movement was used to result in efficient reaction of the L-ss4 movement. The movement was applied in standing and crouching position in order to stabilize the body movement.

Figure 5.22: L-ss4 movement formed with the combination of L-ss1 and L-ss3 technique using the philosophy of SAB.
(Graphic: Siti Mastura, 2015)

Meanwhile, the combination of L-ss1, L-ss3 and a stepping to NE was to result in L-ss5 movement (Figure 5.23a). This movement is to target the lower area point of attack. Besides body deflection, the stepping to NE direction is intended to deceive the opponent when the LA user initiates the attack. In comparison, Figure 5.23b shows how the L-ss6 movement created from double actions of L-ss2 and S-us4 movement is followed by stepping to NW direction. Two usage philosophies of PN and CBU were inferred in L-ss6 movement. In turn, this particular movement has raised three vital outcomes: 1) first attack to rip open the bowel which causes fatal injuries; 2) second attack to injure the upper points such as neck and face; and 3) body deflection.



(a)



(b)

Figure 5.23: (a) L-Ss5 movement to NE direction, (b) L-Ss6 movement is a combination of double actions of backward L-Ss and a stepping to NW. (Graphic: Siti Mastura, 2015)

These notions practically used the simple yet deadly movement to the attacker or opponent. As per noted by the expert, this research found that these series of L-ss5 and L-ss6 movement have proven the use of physiological consideration in body mechanics that is body weight distribution, leg shuffling for stability and crouching position to stabilize the body gravity. The analysis also showed how the user is able to use two types of techniques at the same time forming the offensive and defensive movement. The formation presented an ergonomic rapport on how the user manipulated the LA with one style of handling and technique proving the artefact effectiveness notion.

5.4.3 Body Movement of *Cangkuk* (Ck-h) Technique in LA Application

In this analysis, the researcher found *cangkuk* technique (Ck-h) is applied in a similar motion like L-ss movement, but in opposite blade position. This type of movement compliments the LA design of curvy blade. When inherent information of the LA design is obtained, even a novice user could anticipate how the movement of Ck-h is. The technique depends on the type of counter attack and purpose of attack.

However, many novice users unfamiliar with LA usage variations refuse to acknowledge the benefits of extended transition techniques of LA and limit themselves to a static blade position and grip style. As Ck-h could have a vicious function during the compound movement, the expert proved that this movement is very effective when he was able to precisely target the joints and neck of the opponent with only one attack. Therefore, in this section, several basic Ck-h movements are described.

In general, Ck-h1 is the most standard hooking movement. The movement would look like handling a sickle and targeting the selected point of attack. The wrist must be flexible to change the LA position, according to the intended direction. For instance, Figure 5.24a shows the user moving a hand across downward with slanted angle from upper to middle point of attack. The direction of this movement is interchangeable

either left to right or vice versa, whereby the repetition of this movement is also applicable. Similarly, Ck-h2 use the same context of direction but in aligned movement. (5.24b).

(a)

(b)

Figure 5.24: (a) Ck-h1 movement in cross downward motion, (b) Ck-h2 movement using across motion from left to right.
(Graphic: Siti Mastura, 2015)

On the other hand, there is a unique transition technique observed when the expert used the LA in the compound movement of Ck-h. The expert user combined two techniques (double actions) of L-ss3 and Ck-h2 in the attack and applied the usage philosophy of PS, PA and SAB to result in reaction of Ck-h3 movement. However, the

researcher was strongly requested not to further document or visualizes this particular technique. This movement is a tradition of knowledge that the expert wants to preserve. The researcher believes the reason is due to some functional information of certain ethos of ideology that must be preserved and sustained within the member only. This principle must be respected by the person outside the culture. Hence, positive interrelationship could be sustained.

5.5 Analysis of User Behaviour Pattern in Compound Movements (CM)

In the video recording taken during the training session, the expert used a combination of two contexts in a series of compound movement. The analysis examined the results of user-artefact interaction in the user behaviour[4] pattern with combination between functional information and inherent information to identify the level of injury after the strikes. The video recording was analysed to verify movement efficiency. Figure 5.25 shows the vertical and horizontal translation of the 5 CMs result based on the total usage of techniques and philosophies.

The result indicated that CM5 is the highest possibilities to cause fatal injuries (f=3 over CM=5). Moderate amount of techniques (t=5) and low application of usage philosophy (p=4) was found as the major contributing factor to result in sufficient fatal impact. Through observation, the result showed how the expert used the two techniques (S-us and L-ss) and several type of usage philosophy (PN, PS, and CBU) through a series of strokes at the vital point of attack. Therefore, a high rate of deadly injuries resulted.

On the other hand, the CM1 and CM3 had an identical result of fatal injury (f=2) after the same amount of techniques were used. However, CM3 was found to be the

[4] Behavior is the way a person or thing acts or reacts. http://www.yourdictionary.com/behavior

least efficient when the movement comprised many techniques (*t*=7) and philosophies (*p*=7), and caused more non-fatal injuries than fatal. Similarly, CM4 used almost the same amount of techniques (*t*=6) yet caused identical amount of non-fatal injuries (*nf*=4) and one fatal injury only (*f*=1). Meanwhile, CM1 and CM2 had the same amount of fatal and non-fatal injuries (*f*=2 and *nf*= 4), with both CM applying the same amount of philosophies (*n*=3) application.

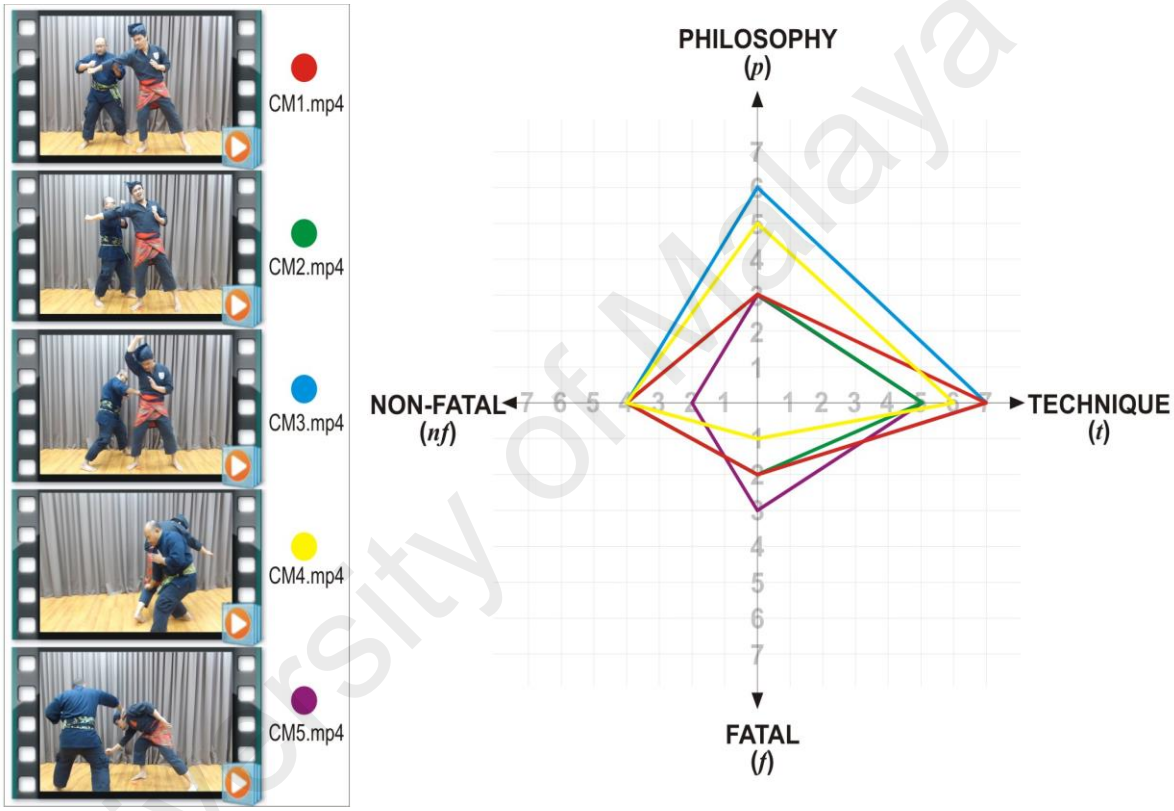


Figure 5.25: Vertical and horizontal translation of 5 compound movement analyses applying the technique and usage philosophy identifying the level of injuries. (Graphic: Siti Mastura, 2015)

To highlight the finding, the S-us (*sauk*), Ck-h (*cangkuk*) and L-ss (*layang*) techniques are highly recommended to pair with deadly usage philosophy such as CBU, PN and PS. In turn, this research found that usage philosophy supported the user's movement in making a decision to make efficient moves and to ascertain the LA effectiveness. Hence, this result suggested that 50% of techniques (*t*) and usage

philosophy (*p*) from the total blows of LA compound movements could ensure high fatal and sufficient non-fatal injuries (Figure 5.26).

$$\frac{½\ (t)(p)}{\text{total CM}} = \textbf{High}\ (f) + \textbf{Moderate}\ (nf)$$

Figure 5.26: Summarized formula of technique (*t*) and philosophy (*p*) application to result in fatal and non-fatal injuries. (Source: Siti Mastura, 2015)

5.6 Key Conclusion

The pragmatic analysis shows that the significant finding in the fundamental of LA intangible knowledge and physical knowledge can significantly influence LA application through function typology and user body movement rapport. The ergonomic rapport of LA techniques shows the interrelationship between the usage philosophy and the understanding of vital point of human body to ensure LA effectiveness either to end the attack with fatal wound or immobilization of the attacker or opponent. These finding could provide important information on artefact and movement effectiveness especially in self-defence and martial art.

By the same token, analysis of user body movement has revealed the user's appreciation on the functionality of LA artefact design. Moreover, the economic and dynamic movement, muscle memory, automaticity and body mechanics of the user are physiological and cognitive responses that evolved during the feed-forward and feedback process of user's motor skill. Therefore, the LA artefact typology and the philosophy (ART) have a significant contribution to comply and to secure effective usage function and body mechanics. Meanwhile, the respondents' agreement on the actions types of technique and the philosophy (ACT) is a major indication of how to

validate the functional information in formulating the inherent experience or pre-existent experience.

Both results accomplished the content of functional information and inherent information in the pragmatic analysis. Therefore, this research summarized the feed-forward and feedback in aesthetic interaction to obtain high efficiency in body reaction movement (*RiMV*). High efficiency depends on the involvement of artefact functional information of artefact typoplogy and philosophy (ART) and inherent information of action technique and philosophy (ACT) shown in the following Figure 5.27.

***ART* (Typoplogy of Artefact + philosophy)**
+
ACT* (technique + philosophy)** **= ↑ efficiency of *RiMV

Figure 5.27: Movement formula to obtain high efficiency of user body reaction.
(Source: Siti Mastura, 2015)

As Locher et al. (2010) has suggested the dynamic interaction between two major components in Aesthetic Interaction framework, the results from this study on artefact effectiveness (design) and movement efficiency (user) has proven to help aesthetic interaction establish the aesthetic experience systematization based on local ideas.

CHAPTER 6: ANALYSIS OF USER EYE BEHAVIOUR ON LA DESIGN IN EYE TRACKING

6.1 Introduction

This chapter examines the role of pre-existent experience on design evaluation of traditional LA artefact associated with specific skill usage in eye tracking technology. The descriptive analyses conducted for this study were twofold to answer the sub-RQ3 and the theoretical propositions. First, the behavioural responses data based on user pragmatic rapport were recorded in the MI-UXLab using frequency analysis of mean score and qualitative feedback to understand the viewer's eye preference in the whole LA artefact design through the physical image presented. The syntactic analysis covered the component, the structure of the design and the material.

Secondly, the syntactic analysis for artefact effectiveness and movement efficiency covered the component, the structure of the design and the material, using the time to first fixation data, retrospective think aloud with eye tracking (RTE) feedbacks and heat map (hotspot) visualization, which represents the viewer's visual attention and eye preference towards the each of LA design (stimuli). Also, LA design preference for movement efficiency was analysed using gaze-plot data, RTA, fixation duration and fixation count. Results on the artefact effectiveness and movement efficiency mainly used the data from visual attention to elicit the process on how the user's mind interacts with syntactical properties of the stimulus (LA artefact) obtaining the use of pre-existent experience.

6.2 Analysis of Behavioural Response Data

In behavioural response analysis, the data were obtained based on participants' responses when seeing the images. This section identifies the interrelationship between

the user perception and syntactic properties of the artefact in decision making by using their pre-existent experience. To achieve interrelationship identification, the participants were anticipated to provide feedbacks after their vision interacts with the stimulus to establish the aesthetic experience. In this section, the participants' judgment of syntactical criteria namely design, component structure, size and material for six images were identified. The 6 images were obtained from classified LA in chapter 4. The position of every image was random to avoid bias evaluation during the ranking process (Figure 6.1).

Figure 6.1: 6 images of LA artefact obtained from artefact classification finding as printed version with material indication at bottom of the LA pictures.
(Graphic: Siti Mastura, 2015)

Using three specific questions on 'artefact effectiveness', 'material' and 'movement efficiency', the participants were asked to rank the images based on 6-point Likert scale (1 (mostly preferred = MP), 2 (preferred = P), 3 (somewhat preferred = SP), 4 (somewhat less preferred = SLP), 5 (less preferred = LP), 6 (mostly less preferred = MLP). The 6-point scale was chosen to have an even number of ratings on the scale to obtain participants' preference that can be either positive or negative response to the stimuli (refer Appendix E.III., p. 325). To note, neutral rating (forced response) was not considered as necessary and therefore not included. The reason being that a participant could only have a truly neutral attitude towards the object if he is very familiar with the subject. The data were collected from Mi-UXLab database and analysed using frequency analysis.

6.2.1 Relationship of Design Preference between Artefact Effectiveness and Movement Efficiency

The results of the frequency analysis were used to identify the relationship between the user perception and syntactic properties for these images. The frequency analyses provide percentage scores and mean scores to quantify overall result based on design evaluation. In Table 6.1, the researcher summarized the total of 6 ranking scales into two groups, that is high preference (1 = MP, 2 = P, 3 = SWP) and low preference (4 = LP, 5 = SWLP, 6 = MLP). Then, the image which received the highest and lowest scores were analysed with the support of qualitative feedbacks after the ranking procedure. As qualitative feedback also revealed some promising insights, the comparisons between mean score results provide clearer understanding between the two groups of preference.

Based on three high preferences ranking group, majority of the participants highly preferred the images of 1, 3, 4 and 6 by 62.5% to 75%. In qualitative feedbacks, the participants responded that the artefact on the images have the appropriate measurement of angle, length and radius of the curvy blade, which could result in an effective cutting sphere and cause severe injuries. Accurate blade measurement with ergonomic grip position (the blade must expose more than the gripping line by at least 50%, refer to page 169) will result to high effectiveness even though only a minor swing slash or upward ripping movement is used. Besides that, 7 out of 8 participants significantly preferred the hilt with ring hole to insert the finger and secure the grip compared to the hilt that lacks ring hole. Interestingly, the participants ranked the design according to minimal uses of technique and body movement also known as economic movement (E3, E5 and E9).

In comparison, between three low preferences ranking group, Image 5 received the highest percentage at 87.5% of the participants. The qualitative feedbacks analysis indicated negative feedbacks from participants who highlighted the uncommon criteria of Image 5 compared to what they normally use. They added that the artefact in Image 5 is not an LA as it has limited ergonomic criteria and safety features that could affect the quality of handling and cause inefficient skill usage. This result was expected as this image has a significant difference between the characteristic of its blade and hilt, although one of the participants claimed that the artefact is LA. Similarly, the frequency analysis shows identical high percentage (50%) of SWLP in Image 2 and MLP in Image 5. The researcher found that both designs have similar criteria of hilt without ring, which contributed to it being less preferred design.

Table 6.1: Percentage analysis of preference ranking of LA artefact images

	1 = MP	**2 = P**	**3 = SWP**	**Total**	**4 = LP**	**5 = SWLP**	**6 = MLP**	**Total**	**N**
	%	%	%	**%**	%	%	%	**%**	
Image 1	12.5	25	37.5	**75**	12.5	0	12.5	**25**	8
Image 2	12.5	12.5	0	**25**	0	50	25	**75**	8
Image 3	0	25	37.5	**62.5**	37.5	0	0	**37.5**	8
Image 4	25	25	12.5	**62.5**	12.5	12.5	12.5	**37.5**	8
Image 5	12.5	12.5	0	**25**	12.5	12.5	50	**75**	8
Image 6	37.5	12.5	12.5	**62.5**	25	12.5	0	**37.5**	8

*MP (mostly preferred), P (preferred), SWP (somewhat preferred), SWLP (somewhat less preferred), LP (less preferred), MLP (mostly less preferred).

The results from the frequency analysis were also used to identify the interrelationship between the LA user and LA artefact in the images. In doing so, percentage values of three preferred scales (mostly preferred, preferred and somewhat preferred) from the high preference category were plotted into graph to show the level of artefact effectiveness (Figure 6.2).

Surprisingly, the percentages for images in the high preference graph fluctuated when the images were randomly positioned. The fluctuation showed that the participants were consistent during ranking the images they saw without any bias evaluation due to design differences. The graph shows that the design in Images 1, 3, 4 and 6 have strong possibilities of effectiveness as the preference percentage is high. As discussed previously, one of the possible reasons that led to this dynamic evaluation is probably due to strong agreement by participants on measurement criteria and ergonomic handling, which is crucial to ensure usage effectiveness. For instance, the participants were convinced with the design of Image 1 once they saw it as it is the closest to an effective design.

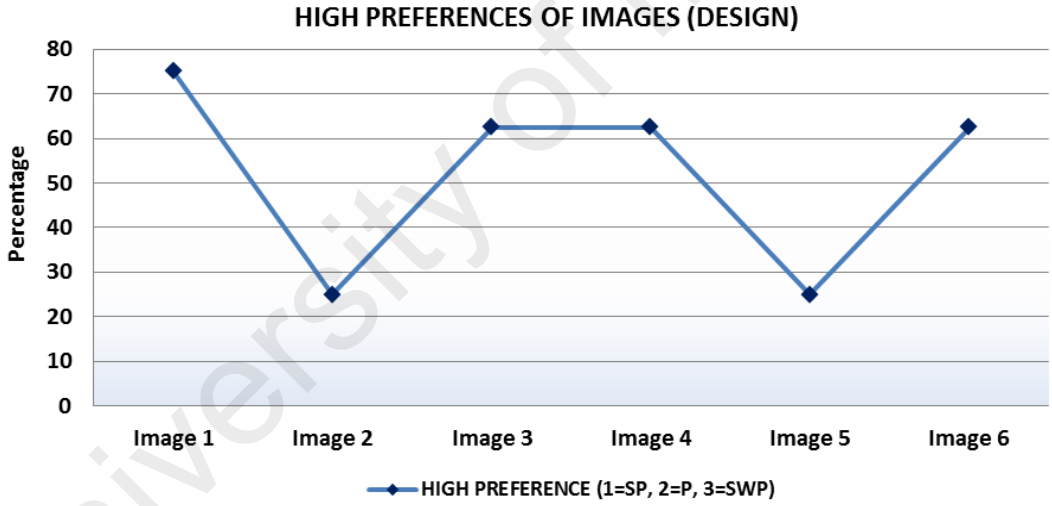


Figure 6.2: This graph depicts the three scales of mostly preferred, preferred and somewhat preferred that categorized as high preferences category. (Source: Siti Mastura, 2015)

6.2.2 Relationship of Material Preference with Artefact Effectiveness and Movement Efficiency

In this section, the frequency analysis on material preferences also used the same six LA images as stimuli. Similarly, the data entered in Mi-UXLab are also grouped into high preferences and low preference ranking as shown in Table 6.2. Majority of the

participants preferred Images 1 and 6, having an identical highest percentage of preference at 87.5% for the strong and traditional material of horn. They believe that the buffalo horn used in the design of image 1 is a strong and durable material. Moreover, in the context of effectiveness, some of the participants explained how the buffalo horn plays an important role in usage and fabrication. Half of the participants mentioned about the spirit of horn representing the *roh* (spirit) of being a man, masculinity and the strong pride of the buffalo. On the other hand, they explained the traditional LA fabrication process using *damar* (natural adhesive substances from a tree) as glue to fix the blade *puting* (stud) into the horn hilt cavity. According to their experience with blacksmiths, the blood that flowed onto the joint part causes a stronger fix. However, the researcher suggested of having a future experiment to support this notion.

Meanwhile, Image 6 received identical percentage value (87.5%) indicating that the Black *Kemuning* wood is also a favourable material because it has medicinal purposes. The participants agreed with several ways on how to use the Black *Kemuning* as a traditional remedy. One of them is by scrapping the wood into a fine powder and diluting it in a glass of water to make a tonic. This could help cure any kind of poisoning. Another method is to put the powder on the wound to stop the bleeding. Also, one can use the Black *Kemuning* hilt by rubbing it on a bitten wound by poisonous animal to neutralize the venom. Therefore, most participants preferred to have their Black *Kemuning* hilt or sheath in a natural finish and without any varnish coating.

Meanwhile, in terms of blade material, half of the participants preferred forged iron made from several types of selected iron known as *besi pamor* (damascene iron) shown in Image 1 and 6. Traditionally, forged iron is strong and durable enough to stand hard

impact or to cause deeper penetration. Three of the participants stated that the Malay damascene blade of LA is intentionally made to be a poisonous weapon. However, they emphasized that *besi baja* or tempered steel is stronger for aggressive usage. They perceived the images to function as an effective tool in a close fight in Malay battle.

In comparison, Image 5 received the lowest preferred SLP mean score with a total percentage of 87.5%. Surprisingly, the researcher found that all the participants were not commenting on the image because they are uninterested in the material used compared to other design. This is probably due to the artefact's syntactic properties which do not attract their preference.

Table 6.2: Analysis of material preference ranking of LA artefact images

	1 = MP	**2 = P**	**3 = SWP**	**Total %**	**4 = LP**	**5 = SWLP**	**6 = MLP**	**Total %**	**N**
	%	%	%		%	%	%		
Image 1	50	25	12.5	**87.5**	12.5	0	0	**12.5**	8
Image 2	0	0	37.5	**37.5**	25	37.5	0	**62.5**	8
Image 3	12.5	25	12.5	**50**	37.5	0	12.5	**50**	8
Image 4	0	25	0	**25**	25	12.5	37.5	**75**	8
Image 5	12.5	0	0	**12.5**	0	37.5	50	**87.5**	8
Image 6	25	25	37.5	**87.5**	0	12.5	0	**12.5**	8

*MP (mostly preferred), P (preferred), SWP (somewhat preferred), SWLP (somewhat less preferred), LP (less preferred), MLP (mostly less preferred).

Results from the frequency analysis were also depicted in a line graph to identify the interrelationship between the LA user and LA material usage based on the percentage value in grouped preference scales. The graph presented in Figure 6.3 is based on the percentage value in grouped preference scales (mostly preferred, preferred and somewhat preferred).

The percentage of the images in the high preference graph shows a decrease from Image 1 through 5. Interestingly, the graph had sudden increase for Image 6. This finding is unexpected since the percentage of the image was anticipated to decrease continuously when the participants were influenced by the common interpretation on material in the following images. The increases of percentage showed how most participants are highly aware of the importance of suitable material application in Image 6 (Black *Kemuning* wood) to ensure practicality and usefulness as medicinal purposes.

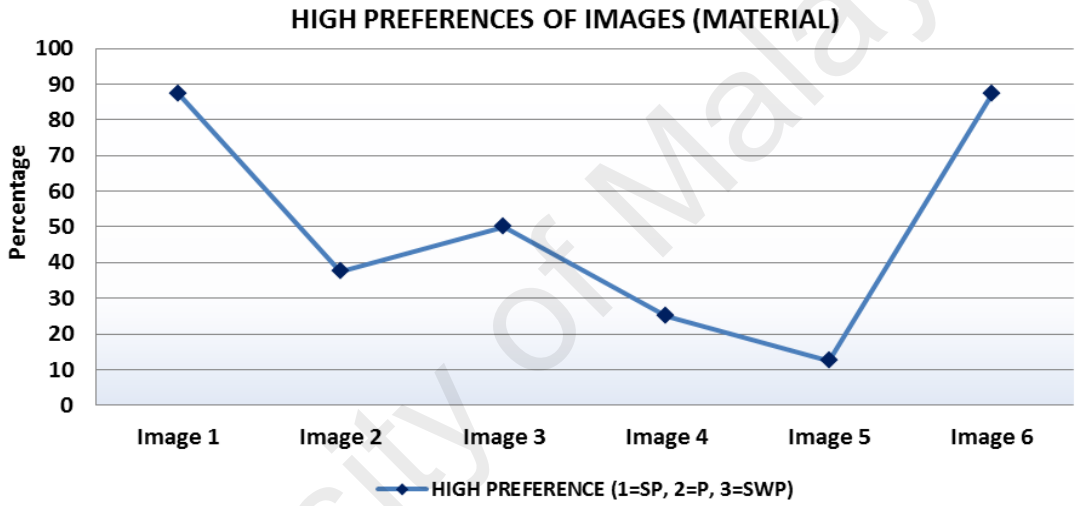


Figure 6.3: This graph depicts the three scales of mostly preferred, preferred and somewhat preferred on six images as high preferences category. (Source: Siti Mastura, 2015)

6.2.3 Summary of Behavioural Responses

Through these results, the researcher gained agreement on several aspects. In terms of design, the results suggest that the majority of participants believe the importance of design identification as they are aware of the critical requirement which comes from being familiar with its usage. They strongly agreed with the justification process on every specific syntactical criterion of LA artefact to establish artefact classification. For instance, these results initially confirmed the triangulated finding in Chapter 4 that improper design criteria such as an overly wide curvy angle of the blade, shorter blade

length and the absence of ring hole in LA design affects the user's preference in artefact effectiveness and movement efficiency.

Another interesting finding shows that majority of the participants agreed with the type of material used in LA artefact. Firstly, horn and Black *Kemuning* wood are the most suitable material for LA in terms of practicality and multi-functionality to complement the usefulness. Secondly, the high preference on both types of materials in the images showed that the participants have high knowledge on the function of the specific material. For instance, they know how to obtain a good quality of strength, durability and also the use of the material as medicinal material. This result proven the participant has positive behaviour in observing the images although in various material usage.

In viewing behaviour, although the arrangement of the images with different sizes and designs was randomized, dynamic evaluation was successfully perceived with consistent responses conveying both positive and negative feedbacks. This result shows how the participants comprehended every critical measure in artefact evaluation due to their ability to use their relevant pre-existent experience. The researcher concluded that the analytical observation of the images could elevate scientific thinking from local indigenous knowledge and at the same time contribute to data acquisition. Therefore, these behavioural results play an important role to prove the findings in Chapters 4 and 5 to establish artefact classification, artefact effectiveness and movement efficiency. Then, the results were compared to the following eye tracking results.

6.3 Syntactic Analysis on AOI for LA Components Using Eye Tracking: Time to First Fixation, RTE and Heat Maps

Syntactic analysis has been proven to provide useful perspectives on ergonomic rapport or on how functional artefact should be designed according to the proper usage

and user movement (Boucharenc, 2008). In this analysis, the results were analysed and inferred using data of time to first fixation and RTE for each image with the support of the heat map visualization. The fixated area indicated the participants' attention on the design displayed on the monitor. Dupont et al. (2014) and Duchowski (2007) support that significant finding of larger amount of fixations in the same observation time will increase the observer's capacity to identify, recognize and memorize what was presented on the image. RTE is a primary data of the participants' behaviour to analyse what they are thinking, how they are solving the task and how they are reacting to the various elements. Once the data concluded considering either positive or negative feedbacks, the researcher inferred the heat map visualization to consolidate the feedback points.

The analysis are based on the three main syntactic components of the area of interest (AOI) namely the blade, hilt and sheath of every LA image (Figure 6.4) which were observed by the participants (refer Appendix E.IV., p. 328). All six LA images were cropped based on the 3 AOIs with polygonal cropping to generate numerical data of time to first fixation in Figure 6.7.

Figure 6.4: The 6 heat map images cropped with polygonal cropping to on AOI for time of fixation analysis. (Graphic: Siti Mastura, 2015)

Unfortunately, data from 1 out of 8 participants cannot be generated due to a recording error. Probably, it is because of the small eye size of the participant. Yet the number of total participants still meets the minimum requirement when conducting a

qualitative eye tracking study (Nielsen & Pernice, 2009; Rösler, 2012). Figure 6.5 shows the heat map visualization depicting most preferred areas in the artefact images from 7 participants. In the heat map visualization data of Figure 6.5, the red hot spot area shows the longest time of eye fixation on the preferred syntactic area.

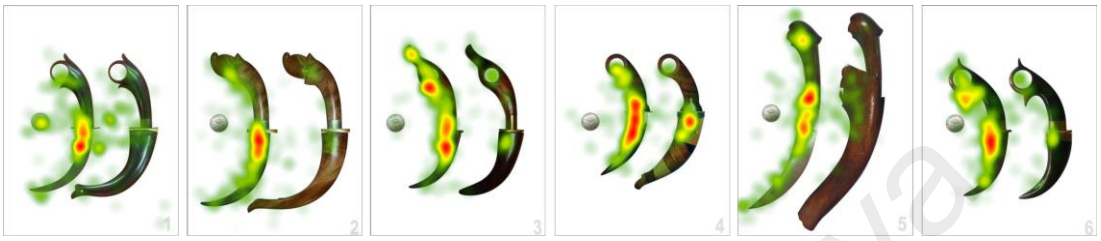


Figure 6.5: Heat map depicting most preferred areas in 6 artefacts from 7 participants. (Source: Siti Mastura, 2015)

In the fixation analysis, Figure 6.6 shows the scoring percentage for time to first fixation on every syntactical component from six images to gain an overall picture of which independent variable (blade, hilt or sheath) participants fixate on first. The finding shows that the participants fixated at hilt with the highest score (92%), despite every six designs being different. Meanwhile, the blade follows with the total score of 88%. The sheath has the lowest score of time to first fixation (62%).

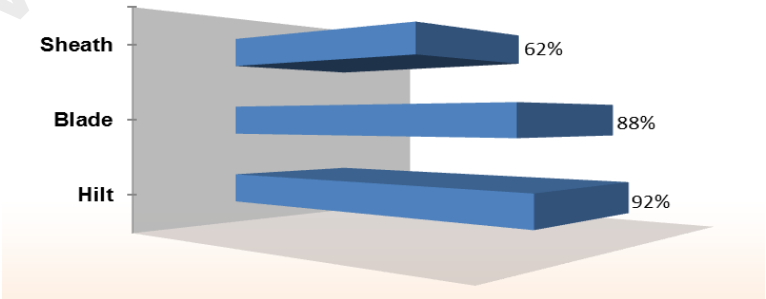


Figure 6.6: Fixation percentage analysis on every AOI (syntactical component of hilt, blade and sheath) depicts from six images. (Source: Siti Mastura, 2015)

The mean scores of time to first fixation are reported based on four duration ranges in Table 6.3. Meanwhile, the following syntactic analysis of every component shows the

result of time to first fixation in Figure 6.7. The time to first fixation data indicated the fastest and slowest fixated time between 6 images within 10 seconds.

Table 6.3: Four duration ranges for time to first fixation analysis

Time to First Fixation (duration range)	Very Fast	0-1 sec
	Fast	1.1-3 sec
	Slow	3.1 to 10 sec
	None	No fixation (-)

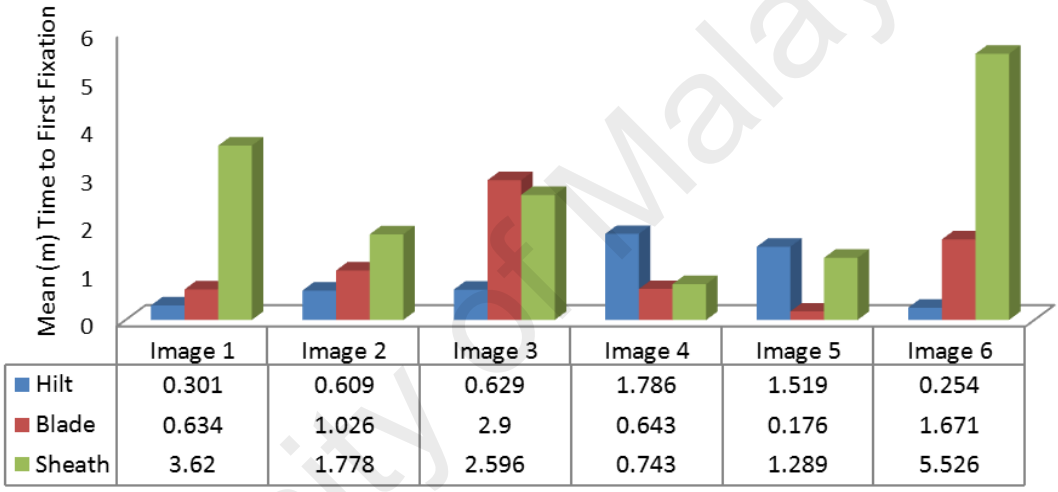


	Image 1	Image 2	Image 3	Image 4	Image 5	Image 6
Hilt	0.301	0.609	0.629	1.786	1.519	0.254
Blade	0.634	1.026	2.9	0.643	0.176	1.671
Sheath	3.62	1.778	2.596	0.743	1.289	5.526

Figure 6.7: Mean analysis of time to first fixation on three main syntactic components of every six images. (Source: Siti Mastura, 2015)

6.3.1 Syntactic Analysis on AOI of Main Syntactical Component 1: Hilt

Figure 6.7 shows the comparison of the mean scores of time to first fixation for every syntactical component. Mean analysis indicated that image 4 has the slowest mean score of time to first fixation (*m* =1.786). As RTE result supports, this suggests that the participants were more likely to take some time to fixate on the hilt design as they (expert user) know that simpler hilt design in Image 4 provides definite effectiveness in LA usage compared to others. They highly preferred the hilt with ring hole, hand anatomical character and less additional sub-component which means better ergonomic grip position, suitable to the LA owner's hand size.

Conversely, Image 6 has the lowest average time to first fixation (*m*=0.254) which suggests that the hilt design attracts the participants faster. They responded during the RTE that inappropriate position and size of sub-component (horn) on image 6 could result in inflexible use of the techniques. The result suggests that the hilt in Image 6 is likely for aesthetic purposes unless it was designed based on a personal grip preference, how an individual moves and use of the techniques.

Similarly, the RTE shows that 6 out of 7 participants have given identical componential concerns regarding the ornamentation on hilt in Images 2 and 3. The similar mean scores of time to fixation (Image 2 by *m*=0.609 and Image 3 by *m* =0.629) show that the participants are attracted to the sub-component in this design that is horn or *balung/tajung*. As the component in Image 3 (Figure 6.8a) has certain roles such as to 'punch' and to 'knock' for 'warning' during LA initiation, they also stated that the horn (*balung/tajung*) design is a gender representation for the artefact. In comparison, the carving motif of cashew seed (*biji gajus*) on the hilt of image 2 (Figure 6.8b) is likely for aesthetic purposes. Some of the participants assumed that the artefact was designed according to personal grip preference, aesthetic appeal and how an individual moves and use their techniques.

(a) **(b)**

Figure 6.8: (a) 'Horn' (*balung/tajung*) as sub-component of the hilt (b) *Biji gajus* (cashew seed) motif carving on the hilt
(Source: Siti Mastura, 2015)

Surprisingly, all the heat maps in Figure 6.9 shows the most fixated areas in artefact images are between the blade and the hilt area. Analysis of the red spot on the heat map visualizations shows that the fixated area is focusing on the 'guard' between the hilt and the blade (Images 1, 2, 3, 4 and 6). The RTE analysis shows that 5 out of 7 participants agreed that the guard component causes difficulties to grip the LA firmly and to use manoeuvre technique. According to the participants' experience, the unnecessary modification of LA hilt area could result in an ineffective initiation, disruptive artefact handling and lack of dexterity in movement. Although the guard design is suitable with the purpose of protecting the hand from any possible injuries, it does not provide a major function in the required technique of LA usage. In fact, half of the participants believe that the existence of guard in LA is an influence from other weapons such as colonial sword, Pattani sword, Arabic sword or even the *jembiah* (curvy dagger) (Gardner, 1936; Mubin, 2011). The researcher found that the additional sub-component in LA had been innovated based on personal preference of design and collective design influences. Moreover, the high preference for the simplest hilt design confirmed that the hilt with ring hole is more ergonomic to grip and to use. Thus, this result proves the behavioural analysis that 87.5% of the participants agreed on this context.

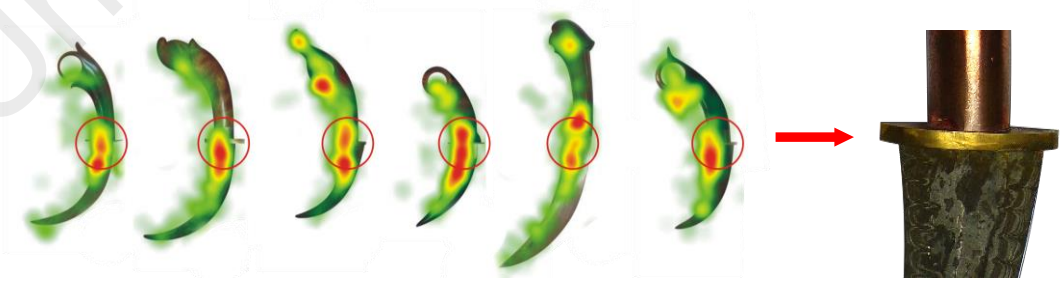


Figure 6.9: Circles on heat map images to indicate the fixation on guard sub-component of the LA. (Graphic: Siti Mastura, 2015)

Surprisingly, in this result, although the hilt is a prominent marker in the LA design and usage, the time to first fixation data from the eye trackers shows that it is not

statistically significant [F(5,35) = 0.894; p = 0.496]. This result suggests that the participants who are vastly familiar with the hilt design have excessively viewed the other components, for instance, they are more attracted at the six different blades compared to the hilt. If participants are satisfied with the blade design of LA and don't want to move elsewhere, it's great if the design allows them to spend their time on the good functional component that play major role in artefact effectiveness and movement efficiency.

Also, these results suggest that natural human behaviour influenced the participants' eye movement in making evaluation. It is common for participants to read from top to bottom, so the participants could have stared at the hilt first, however that does not mean that the hilt attracted their attention first. These results may also be associated with the time to first fixation that involved a particular sub-component (guard) that distracts their perceiving of the images. Table 6.4 summarizes all the collected data of time to first fixation. Interestingly, the m=0 value suggests that the participants have very fast reaction, either positive or negative, to see what certain images consisted of.

Table 6.4: Summary of mean analysis of time to first fixation on hilt in every image

Hilt	**Mean (*m*) Time to First Fixation (Image 1)**	**Mean (*m*) Time to First Fixation (Image 2)**	**Mean (*m*) Time to First Fixation (Image 3)**	**Mean (*m*) Time to First Fixation (Image 4)**	**Mean (*m*) Time to First Fixation (Image 5)**	**Mean (*m*) Time to First Fixation (Image 6)**
E1	0.28	0.37	0.58	3.44	0.8	0.1
E2	0.06	0	0.17	0.79	0.5	0.27
E3	1.01	0.28	0.25	4.69	4.91	0.66
E4	0	0.33	0.35	1.03	0.43	0.44
E5	0.42	0.66	3.05	0.94	1.4	0
E7	0	0.43	0	1.1	0.72	0.31
E8	0.34	2.19	0	0.51	1.87	0
Average *m*	**0.301**	**0.609**	**0.629**	**1.786**	**1.519**	**0.254**

6.3.2 Syntactic Analysis on AOI of Main Syntactical Component: Blade

In Table 6.5, the average mean of time to first fixation for blade component shows that Image 5 received the fastest time (m=0.176). Probably, the fast fixation result was caused by the physical blade appearance. Relatively, in RTE analysis, the fast fixation result indicates that 6 out of 7 participant have less preference on the blade's curvy shape as it has bigger radius than it is supposed to be (which is at least 45 degrees angle and the blade length is between eyes to ear).

Conversely, although the blade of Image 3 has the slowest mean score (m=2.900), the RTE analysis found that the participants believe that if the blade width is proportioned with the length, the cutting sphere would be more efficient. These results are proven when participants' agreements were consistent on the blade criteria that good curve angle and length enhance the usage technique. In addition, according to the heat map analysis, Figure 6.10 compares the Images 3 with 5 to present the difference in participants' eye fixation. The red spot in the heat map in Image 3 is rather uniform and localized compared to Image 5. The scattered green spot in Image 5 suggests how the eye behaviour of participants tried to evaluate the radius of the blade due to the significant weirdness.

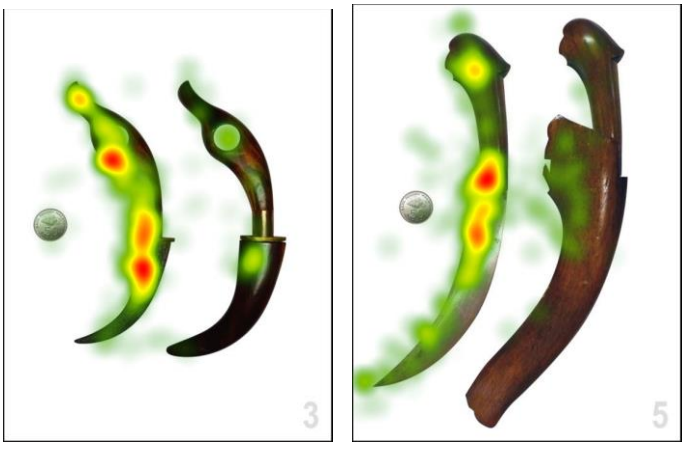


Figure 6.10: Hot spot comparison in heat map visualization of Image 3 (Left), and Image 5 (Right). (Source: Siti Mastura, 2015)

The researcher also learned from the participants about the inappropriateness in blade measurement could lessen the effective impact of upward stabbing (*sauk*), swing slashing (*layang*) and hooking (*cangkuk*). This finding confirmed the behavioural result that the lack of ergonomic factor and low safety factor affects the quality of handling, artefact effectiveness and inefficient skill usage.

Overall, the results show that the average fixation score on blade is high (88%). Interestingly, among the 3 independent variables, if the participants would characterize them based on the effectiveness, the time to first fixation data from the eye trackers shows that the participants fixated at the blade area of interest the most with a significant F-score [$F(5,35) = 3.128$; $p < 0.05$]. This shows that there is a significant effect of showing different images of blades to the participant to identify the effectiveness level while fixating at the LA (time to first fixation).

The results supported by 80% of the participants suggest that they are attracted to the blade due to: 1) the hand movement in LA usage such as swing-slash, upright stab and ripping off the targeted part complemented the function of the blade with good curvy angle and length; and 2) the blade initiated with tactical moves could easily cut off the nervous system, jugular vein, joints, the flesh, and eye socket, and even breaking the bone. These findings are parallel with the earlier result on behavioural responses.

Table 6.5: Summary of mean analysis of time to first fixation on blade in every image

Blade	Mean (*m*) Time to First Fixation (Image 1)	Mean (*m*) Time to First Fixation (Image 2)	Mean (*m*) Time to First Fixation (Image 3)	Mean (*m*) Time to First Fixation (Image 4)	Mean (*m*) Time to First Fixation (Image 5)	Mean (*m*) Time to First Fixation (Image 6)
E1	0.89	0.89	0.42	0.79	0	0.36
E2	0.44	2.11	3.41	0	0	2.79
E3	0.41	0.5	2.4	0.37	0.3	0.38
E4	0.85	1.14	2.27	3.01	0	0.97
E5	-	1.35	9.88	0.06	0.12	5.5
E7	0.88	0.68	1.44	0.27	0.44	0.43
E8	0.59	0.51	0.48	0	0.37	1.27
Average *m*	**0.677**	**1.026**	**2.900**	**0.643**	**0.176**	**1.671**

6.3.3 Syntactic Analysis of Main Syntactical Component 3: Sheath

These results present significant differences of mean score between the fastest (m= 0.743) and slowest (m=5.526) time of first fixation. In Table 6.6, artefact image 4 has the lowest score (m=0.743) amongst all the mean scores of time of first fixation. This suggests that the participants' eyes are faster attracted to the sheath design of Image 4 compared to the other five designs. In RTE, analysis shows a high preference in the sheath design of Image 4 due to the usage of various materials.

Meanwhile, the hot spot of heat map visualization in Figure 6.11 shows that their fixation on particular area of semi-precious stone, high quality of wood and decorative material, e.g., silver and pewter. They stated that these materials serve as aesthetical element to represents the status of the owner. Incorporation of different materials serves as a desirable aesthetic factor by certain LA participants and craftsmen to attribute meaning to object design.

Figure 6.11: The heat map depicted in image 4 shows the hotspots which are localized on the aesthetical element on Sheath. (Source: Siti Mastura, 2015)

In contrast, Image 6 showed the highest average mean score of time of first fixation (m=5.526). In the RTE analysis, most of the participants took some time to favour the finishing and material quality of the particular sheath. Although the material used in Image 6 has medicinal purposes which is not true for Image 4, this finding however showed that aesthetic appeal applied on certain parts of LA component could facilitate design preference in eye tracking.

Hence, the above results suggest that the sheath component has less connection in LA artefact effectiveness and movement efficiency as the sheath which serves to protect the owner from getting injured by the sharp or poisonous blade. Although the sheath received the lowest score of time to first fixation (62%), the participants fixated at the sheath area of interest with a significant F score ($F(5,35) = 5.487$; $p < 0.05$). As the previous study fails to elucidate further about LA sheath component, information regarding the function of sheath was ameliorated by the RTE and eye fixation result through the eye tracking test in this study.

Table 6.6 shows the hyphen-minus (-) in the time to first fixation result suggesting that the data contains insignificant preference when the 5 out of 7 participants' eye is not fixated at all on the sheath component of Image 2 (n=2), Image 3 (n=2), Image 6 (n=2), Image 1 (n=1). Based on the RTE analysis, several reasons were identified by the researcher of the cause of empty data in time to first fixation and these are: 1) the participants' eye are small; 2) the participants' eye lashes are long and covering the retina; 3) the participants were not aware or were not interested on certain syntactic feature of LA design. For instance, four participants stated that they did not fixate at the certain sheath area and they was more focussed on safety features, the material used, attractiveness and aesthetics appearance.

Table 6.6: Summary of mean analysis of time to first fixation on sheath in every image

Sheath	Mean (*m*) Time to First Fixation (image 1)	Mean (*m*) Time to First Fixation (image 2)	Mean (*m*) Time to First Fixation (image 3)	Mean (*m*) Time to First Fixation (image 4)	Mean (*m*) Time to First Fixation (image 5)	Mean (*m*) Time to First Fixation (image 6)
E1	3.47	5.72	2.68	1.4	0.06	4
E2	5.12	-	3.63	0.29	0.35	-
E3	6.42	0	-	0	0	8.1
E4	0.35	1.76	3.17	0.7	2.32	5.27
E5	-	0.1	0	0.53	0	-
E7	1.79	1.31	-	1.35	5.8	5.41
E8	4.57	-	3.5	0.93	0.49	4.85
Total *m*	3.620	1.778	2.596	0.743	1.289	5.526

6.4 Key Conclusion

The use of the eye-tracking test provides an opportunity to help the process of design evaluation of several sources of Malay traditional artefact design to understand user experience and object identification. The eye tracking analysis exposed content that revealed crucial factor in the effectiveness of artefact usage and design preference from the participant. Prior works have showed mixed results concerning the interaction

between visualizing the memory and eye fixation analysis using various types of stimuli.

As fixation pattern is a popular metrics employed by prior researchers, the finding on the time of first fixation and heat map visualization has a dynamic interaction when the participants' cultural memory and usage experience is recalled and manipulated in an implicit manner. The pattern of empirical and visual data is useful to understand the participants' eye behaviour towards stimuli by determining where and how long participants focused their attention (Locher, 2006). Concurrently, the eye tracking test did evaluate experienced participants and found very interesting eye behaviour. Their eye gaze plots keep alternating between specific locations on the stimuli which shows how their minds keep recalling the information from pre-existent experience of the artefact.

Interestingly, the fixation on the heat map visualization (for instance, localisation red hotspot on specific element of 'guard' on Image 1, 2, 3, 4 and 6) demonstrated a vital source in obtaining feedbacks about how some component could affect aesthetic judgement positively and negatively. The participant (trained user of the artefact) presented interesting feedbacks in both negative and positive way to justify their preference by recalling their cultural memory which is comprised of the philosophy of artefact and the philosophical movement. This concurred with Locher et al.'s (2010) study on interaction framework comprising the coupling of the person context and artefact context. Therefore, this finding is in agreement with Locher et al.'s notion on the dynamic use of interrelated functional information of artefact typology and inherent information of body movement in participant cognitive activities. Under this condition, although Dupont et al. (2014) states that interpretation and perception through the eye behaviour of the viewer towards the stimuli could be associated with current

experience, the participants are more particular of what they know through their pre-existent experience while perceiving and interpreting the Malay cultural artefact as the stimuli.

More interestingly, the finding reveals several answers concerning the debated issue of LA artefact classification related to provide evidence to support that, in fact, the LA artefact in Malay traditional weaponry identification could be classified accordingly using the syntactic analysis. Through the two significant results from time to first fixation and RTE syntactic analysis on the LA artefact components, the findings have confirmed the specific yet vital physical requirement in the design to ensure its effective and efficient usage for explicating and establishing design characteristic of the LA artefact. The physical requirement includes the anatomical measurement for functional shape, the association of functional material usage and structure durability to result to an awe-inspiring impact. Thus, the eye tracking result supports the finding from previous ethnography study in Chapter 4 that LA is a type of weapon for aggressive use that needs minimal component design modification.

Throughout obtaining the above results, the researcher found that the pre-existent experience has successfully assisted the eye tracking test when the significant F-value and mean score of time to first fixation showed that 80% of the participants were attracted to the blade component compared to the hilt and sheath. This finding increases the validity of the behavioural analysis by 75%. In line with Rösler's (2012) statement, the heat map visualization on the area of interest (AOI) is really useful to get a general idea about which design elements in LA attracted the participants' attention and which items were not fixated at all based on what the participants have experienced.

To conclude, several evidences provide a direction to reinforce object identification of cultural artefact facilitated by vision responses that highlighted vital association of

pre-existent user experience in understanding the design-experience-driven of pragmatic orientation. Towards the end of the discussion, although three variables were tested using this analysis, the limitation of this study is its use of descriptive interpretation on behavioural responses and statistical descriptive analysis for eye tracking result instead of complex statistical analysis. Therefore, further study using statistical analysis could be undertaken as a tool to assess the relationship between the eye behaviour in gaze pattern and expert preference towards design elements.

CHAPTER 7: DISCUSSION AND CONCLUSION

7.1 Introduction

This chapter addresses the important findings of this thesis to establish the design-user interrelationship guideline application to pioneer the development of tacit knowledge and behavioural ergonomic knowledge for the design community in the new culture environment. The sub-RQ4 is accomplished when the researcher has experienced such understanding from mutual observations and testing experience. Therefore, it would suffice to cover this aspect when discussing the problem statement.

This chapter is organized into four main sections. The first section summarizes significant findings. The second section discusses the implication of these findings for future interpretation and use of intangible knowledge in cultural product designing and behavioural study area. The third section outlines recommendations for future research. The last section provides a conclusion of the study.

7.2 Summary of the Major Findings

Cultural artefact is known as an iconic item that serves as a distinctive knowledge resource for understanding a particular cultural identity, innovative technology, people's worldview and local expertise in the field between the experts and new generation. As this study employed Malay LA artefact a case study, meaningful contexts that sometimes posited as outer feature were revealed. Although this particular heritage item is physically displayed in local museums, there is a lack of functional information that can help public, designers, ethnographers and behavioural researchers to better understand tangible and tacit knowledge of its artefact design and typology, behavioural and pragmatic knowledge that might be used in greater accordance with empirical

evidence for cognitive input. Therefore, this research attempts to understand the interrelationship between a user and an artefact, and how it can be used appropriately in developing a design-user system for Malay cultural design (MCD).

The main contribution based on the research objectives from syntactic dimensioning in LA design and pragmatic dimensioning in expert AE elements to systematize DUs would provide structural comprehension of user's behavioural ergonomic and cognitive perspective in Malay design. To achieve the study's objectives in Section 1.5 (refer p. 11), a total of seventeen LA samples were selected from LA users' collection. The artefacts were chosen based on the physical dimensioning sampling of the syntactic characteristic such as the design features, the component of structures and the material.

The gatekeeper who was actively involved in traditional Malay weapon is a *silat* master and an expert in LA artefact usage. He is the main informant who contributed significantly in data acquisition and also provided access to related informants. A total of nineteen informants were interviewed and observed in the ethnography at several states in Peninsular Malaysia. They are experienced users (n=10) and blacksmiths (n=9). Among the users, a total of eight experienced users from seven types of *silat* martial art were recruited for the eye tracking test as they have strong relevance in terms of experience, background, achievement and expertise. The mean age is fifty years old.

For the purpose of discussion, the summary of findings is divided into four sections. The first section highlights the results of the artefact classifications for the physical characteristics, artefact terminology and non-physical data of LA artefact philosophies. The second section discusses the user knowledge through the experience of artefact application, usage typology, pragmatic behaviour and physical body movement. The third section examines the interrelationship between user and LA artefact to discuss the effects of user mind systems on artefact design effectiveness and movement efficiency.

Lastly, the fourth section highlights the finding of triangulated results of AE concentricity integrating information of artefact context, person context and intangible knowledge context.

7.2.1 Syntactic Dimensioning of Malay LA Artefact Characteristic for Artefact Classification

One of the main research questions (RQ1) posed in the study asks to identify the design characteristics of Malay LA artefact for artefact classification. To answer this question, document analysis of design character and intangible information of LA artefact was done and has provided general information on the artefact which led to further data inquiry through artefact analysis, participant observation as well as interview.

In Chapter 4 (refer p.130), the matched pattern from these three sources assisted the analytical assessment on relevant samples through syntactic dimensioning with detailed descriptions about the samples. The analytical assessment of syntactic dimensioning on 6 LA samples was conducted to understand how the cultural artefact was designed in terms of structure, component details, material and functional relationship (refer Table 4.2 to 4.7, p. 134-147). Therefore, triangulated results from this assessment flow revealed the physical design characteristic of the LA artefact which is the main finding on tangible knowledge.

This knowledge inclusion contributes to the establishment of analytical assessment model for cultural artefact classification (Figure 7.1). The syntactic dimension analysis flows in a top-down fashion showed by the arrow movement drawn from the collected data led to the 4 major items to aid the classification process.

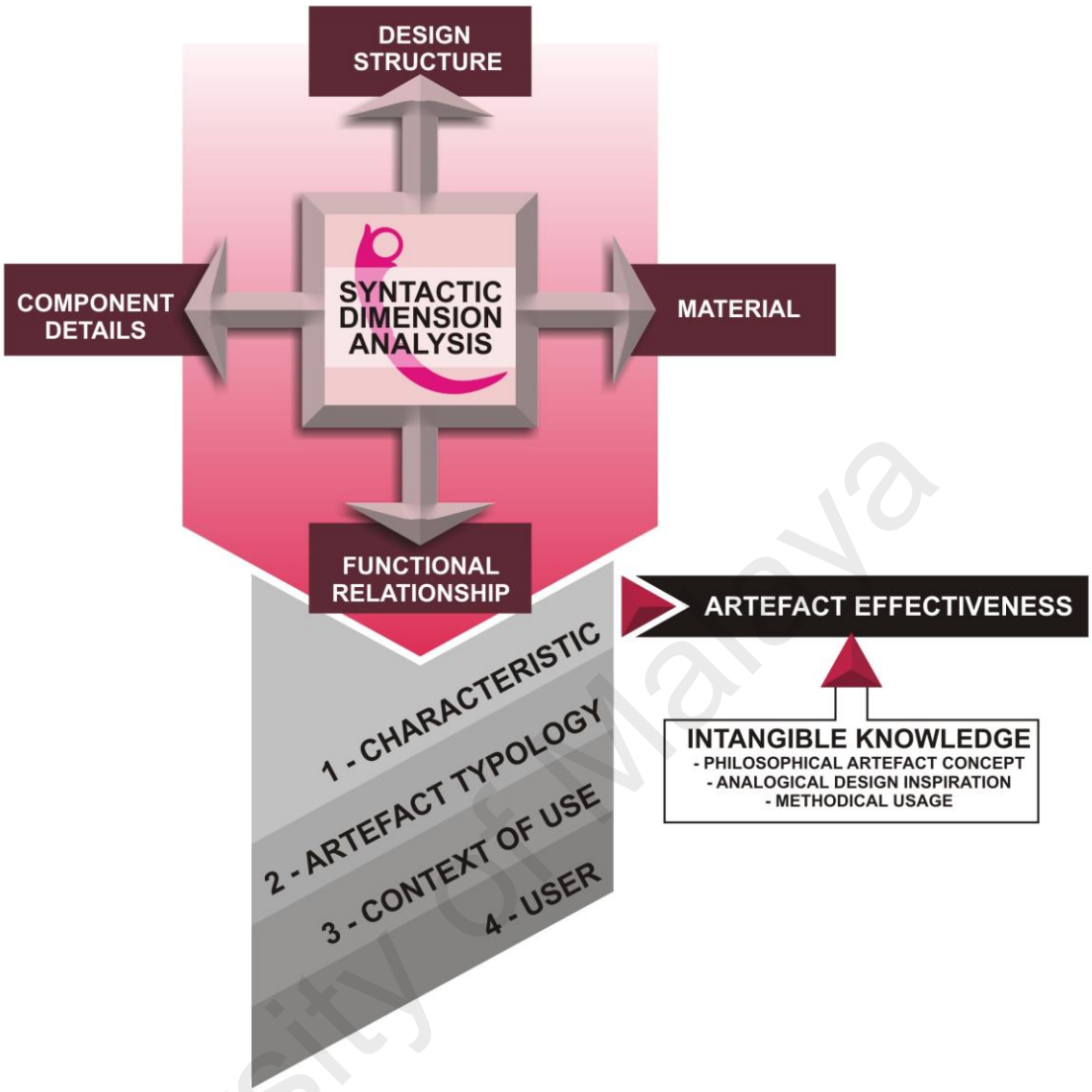


Figure 7.1: Analytical assessment flow for artefact classification process. (Graphic: Siti Mastura, 2015)

This information helped the study to conduct a syntactic analysis of each of the six artefacts in the context of advantages and disadvantages of each design. Simultaneously, the finding enhances the limited cultural data in the previous documentation of small range Malay weapons. Both tangible and tacit information on LA artefact were updated. The data inaccuracy in previous artefact classifications highlighted by Hill (1956) has misrepresented information on Malay artefacts. Thus, the information refinement contributed by this study mitigates the issue raised, especially the LA artefact. The results also corroborate that coupling the application of analytical

observation by Petersen et al. (2004) and syntactical analysis by Boucharenc (2008) complemented the artefact analysis to instate proper information on the Malay artefact classification.

At the same time, the findings also resulted in applicable AI framework suggested by Locher et al. to ease the structuring of the non-physical knowledge in dynamic AI through form and functionality of artefact context (2010, refer p. 73). Here, the AI was successfully engaged when the users and blacksmiths used analogical abstraction in the artefact philosophies to justify the idea projection of particular design. The justification establishes the intangible knowledge of Malay worldview that also helps to churn out factual terminology. In this situation, this study found that the intangible knowledge of factual terminology heavily leans on their surrounding scene, which shows how the Malay appreciated the role of nature intervention.

Towards the end, the tangible and intangible knowledge successfully corroborates findings in the subject of persuasion in the process of designing a concept, prototyping the idea and lastly producing the outcome in a determined term for the LA artefact. It includes the interpretive experiences in artefact usage of user and artefact fabrication by LA maker that had a relatively high agreement on physical characteristic and pragmatic criteria of animal representation to advocate the significant terminology of LA artefact.

Previously, several studies (refer Section 2.3.2, p. 29) have identified the interwoven experiences of design and culture as an important factor to establish appropriate categorization for design characteristic and intangible knowledge identification of cultural artefact. In this study, the finding has mitigated the profound comprehension of artefact knowledge and increases the understanding of design evolution through improvisation of conventional approaches in capturing the Malay LA artefact information into an appropriate term and categorized characteristics in proper artefact

classification. Furthermore, the knowledge gained through the inferences of documents and user knowledge understanding on the physical characteristic of LA artefact and the tacit knowledge of artefact philosophies could provide transferable evidence of artefact usage data. For example, the result shows that the eminent criteria in artefact design (blade and hilt), methodical usage and philosophical artefact concept play a significant role for attribute effectiveness factor in artefact application (refer Table 4.8, p. 156). Although there were issues in certain context relating to terminology and physical characteristic, its affect in expressing the idea is very small (refer Section 2.3 to 2.3.2, p. 25-29). The data obtained from artefact analysis and verbal input help to further explain underlying reasons for this notion.

On the other hand, the perspective of design innovation varies from the blacksmiths to the users who have different aesthetical interpretation. For instance, in comparison with Malay LA, from the researcher observation on medieval weapons such as bow arrow and knives found in Landesmuseum Wurttemberg, Stuttgart, Germany that the forged iron is rarely applied with particular damascene pattern (Figure 7.2). Their focus is in designing the tool according to the purpose of the weapon. For example, there are 17 types of arrow tip that used for 17 purposes and target points of archery. Meanwhile, their knives are rather thicker as it used for stabbing compared to the Malay knives. The smith uses bird feather and certain physical quality of wood to ensure the precision of archery initiation instead of decoration.

Meanwhile, in term of weapon making process, traditionally, the German blacksmith sharpening the blade by using stone-wheel that mechanically operated by up and down motion on a paddle under the wheel, whereby the Malays is rather particular which they use file to achieve a certain shape and design of the blade. This shows how pragmatism approach frequently sees aesthetic as specific kind of explicit evidence that interrelates

between context, culture, history and the user and yet expands in wider art context (Shusterman, 2000; Lin, 2007).

Figure 7.2: German blacksmith use forged iron used for medieval weapon such as arrow tips and knives (Left and Middle), The smith use variety of materials for precision initiation (Right). (Photos: Siti Mastura, 2013)

In conclusion, the benefits in structuring this information would allow answering several inquiries that linger around the aspect of Malay cultural design innovation, pragmatic design evaluation on artefact effectiveness, syntactical characteristic and user knowledge understanding. It seems that the interrelated data of artefact context were successfully obtained in accordance with Petersen et al.'s (2004) second approach of pragmatism and Locher et al.'s (2010) Aesthetic Interaction (AI) framework.

7.2.2 Expert User Knowledge in Pragmatic Behaviour and Physical Movement Experience

The second research question asks what aesthetic experience dimensions of Malay LA weapon artefact that can be used for the development of design-user interrelationship knowledge are. By reviewing literature related to AE, this study attempts to find the interrelation between the artefact typology, usage effectiveness and physical movement of psychomotor skills using pragmatic analysis to obtain the knowledge of LA user (see Section 2.9.1, p. 59). Lacks of information led this study to crucially understand how AE is involved when the user has cultural comprehension in several aspects to successfully perceive the LA design while using the LA artefact.

Therefore, variables related to background, achievements, duration of collective experience and level of expertise helped to define the pragmatic rapport of user dimensions.

Findings from semi-structured interview analysis with group of expert users in Chapter 4 and active or full participant observation with the gate keeper in Chapter 5 revealed that the four variables in LA experts population significantly influenced the level of knowledge in technique usage, bodily motor skill and efficacious philosophical body movement (refer Section 3.5.2.2 and 3.5.2.3, p.103-106) to establish the person context in accordance with Locher et al.'s AI framework. The result is proven when AE nature in interaction theory coupling on artefact context and person context integrates two vital information of functional information and inherent information and successfully increased the efficiency of user body movement during the training. This is expected since research in behaviour during product interaction reports that user with the artefact that responded to behaviour had a different visceral experience (Alonso et at., 2011, refer p. 57). In this situation, theory application, descriptive verbal information and practice demonstration by the gate keeper, Wan Yusmar Wan Yusof play a major role to highly ensure the success of feed-forward and feedback interaction between the user and artefact to engage with positive cognitive responses, intuitive body mechanics and muscle memory, dynamic action and reaction and also high level of automaticity in responding towards internal (skill experiences) and external stimuli (intimidate attacks). Thus, those two types of information also offer an informative guideline for comprehending the underlying behaviour in user movement.

As the functional information underlies the persuasive intrinsic philosophy and functional analogies, the information explained the efficacious representations of persuasive analogies in contributing efficient body movement and increasing the

artefact effectiveness. In comparison, the inherent information in LA application is an accumulative user experience in appreciating the tacit knowledge. Both findings corroborate with Hekkert and Schifferstein (2008) suggestion that the cognition factor would expose useful user information considering the human psychomotor ability.

However, the experience of tacit knowledge must gather through a structural understanding process of the user knowledge fundamentals to establish AE of tactical movement skill, strategic thinking capacity and design interaction in artefact usage. Thus, these results are particularly crucial to ensure the usefulness of intangible knowledge that contributes to body conditioning, dynamic body mechanics and high level of agility, speed and precision. It is also true that this finding corroborates AI principles that experiencing real interactions opens up the full richness of such real interactions (Ross & Wensveen, 2010, refer Table 2.2, p. 49).

7.2.3 Interrelationship System of Artefact and User

The successful integration of determined content in tacit knowledge and the physical knowledge of expert user resulted in an interrelated formation of design-user system (DUs). This interrelated design-user knowledge contributed to behavioural ergonomic data through pragmatic rapport analysis. As Hekkert and Schifferstein (2008) identified three systems work interactively to allow people (user) to provide feedbacks of their experience, the result from expert user data proves how the psychomotor system, sensory system and cognitive system highly influenced the artefact interactions and user actions (refer Table 2.3, p. 54). Moreover, the systems effectively functioned in LA application after the expert user successfully acts, perceives and plans an action with the surrounding external stimuli, particularly from intimidation by the attacker.

The results of DUs implementation are also reflected in LA artefact usability evaluation when the expert used the various efficient techniques in CM with the

application of functional information and inherent information (see Section 5.5, p. 198). These findings show the successful integration of the DUs system that requires a distinctive approach to understanding further the context of the user-product interaction. Alonso et al. (2011) for instance, assert that intangible psychological information also offers inherent feedback to subconscious interaction while experiencing aesthetic feature of LA artefact.

Most of the important findings in this study are highly associated with understanding the context of use of LA artefact, the usability evaluation activity that aims to engage with the user community and the main user, task and environmental characteristics of the situation in which the artefact operated (Maguire, 2001). For instance, although the definition of hidden weapon is subject to the LA size and its ability to be hidden from the opponent by the user, most of the respondents believed that ergonomics in technique and handling typology is one of the important factors that influenced the actual LA function. The respondent of expert users disagree that inexperienced users have the same level of intellectual ability as they act with incongruous movement and behaviour as they are unequipped with the intangible knowledge such as fundamental and functional information and inherent information. Similarly, as the expert expressed his AE of Malay LA weapon artefact through a pragmatic presentation, he strongly emphasized that the fundamental movement cannot be practiced effectively without understanding the intangible knowledge. Therefore, this study suggested a formula to ease the understanding of the amount of usage philosophy to support the user's tacit ability to make efficient moves and to ascertain the LA effectiveness.

This finding suggests that formulations of structured user movement are needed to visualise the feed-forward and feedback AI to obtain high efficiency in body reaction movement (*RiMV*) and to validate the function of inherent pre-existent experience.

Findings in Section 5.6 (p. 200) suggest that the body reaction movement (*RiMV*) complements the analysis of user movement factors such as strength, energy expenditure, precision or acuity of manipulation, speed and repetition demands, required stability and action and reaction, all of which need to be understood and applied.

The finding was formed from each triangulated component which are usage philosophy, artefact typology and user body movement that intersected with information from ergonomic rapport. This finding is in agreement with Boucharenc (2008) that pragmatic dimensions is analysing how the product works and how the artefact is to be used including the use functions, user interface features, anthropometrics and ergonomic of particular conceived design (refer p. 111). This is consistent with other research that highlights the importance of "product experiences depending on the way in which a person interacts with a product" (Hekkert & Schifferstein, 2008, p. 4). This issue prompted the third research question since little is known about empirical approaches to studying user knowledge that involves engaging cultural experiences using ergonomic rapport.

This finding provides evidence to suggest that the interrelationship between user's pre-existent experience and functionality of LA design was dynamically rationalized as an outcome of artefact context and person context investigation to enhance local user-design knowledge. As Locher et al. (2010) has suggested, the dynamic interaction between two major components in AI framework, the finding from the pragmatic analysis results on artefact effectiveness (design) and movement efficiency (user) has proven to help establish the design-user system (DUs) based on local ideas of aesthetic experience. Figure 7.3 below summarizes the notion in schematic representation. In conclusion, it is strikingly clear how expert knowledge shows dynamic and impending

action as an important factor to tactical reactions that are high in structural coexistence and convey valuable interrelationship knowledge for the development of DUs.

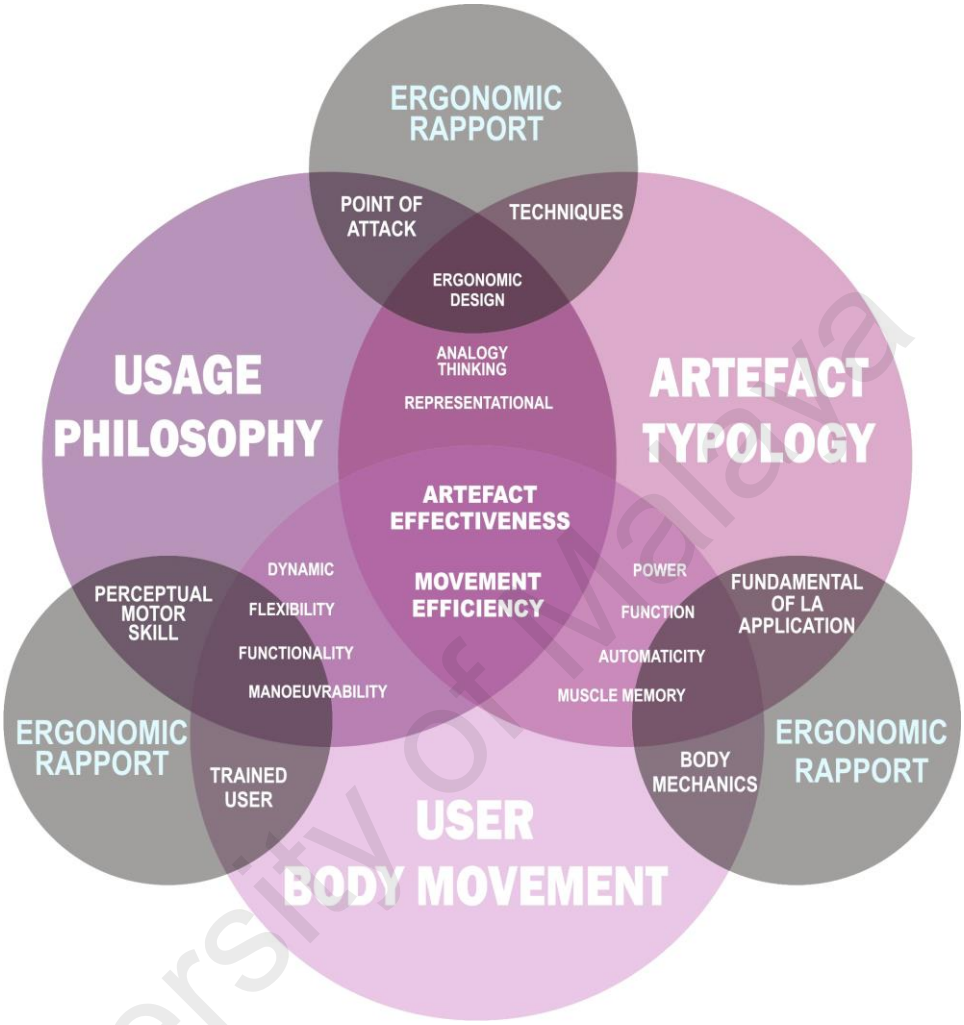


Figure 7.3: Design-User system (DUs) comprises the intangible information of AE for artefact effectiveness (design) and movement efficiency (user)
(Graphic: Siti Mastura, 2014)

7.2.4 User Eye behaviour on LA Designs in Eye Tracking

The study has demonstrated the importance of eye-tracking test to help the process of design evaluation of Malay traditional artefact design to understand user AE and object identification. The analysis was used to identify whether eye tracking result can be a useful instrument to understand the participants' evaluation involving the pre-existent experience of artefact information and pragmatic experience. Also, it was used to identify important content and to validate it as found by the researcher from the earlier

analysis of the artefact context and person context. The outcomes of the analysis strongly suggest that eye tracking significantly enhances the understanding of underlying reasons for participants' responses to artefact design on images and expands the potential to estimate the grounds for future designing purposes.

To examine the potential use of this technology, two types of analysis were conducted which are behavioural responses analysis and syntactic analysis on artefact components. In the behavioural responses analysis, design preference was based on the independent and dependant variables. The interrelationship result between the variables of usage, design and material revealed that the participants' viewing behaviour is consistent and dynamic throughout the ranking process although the images were arranged in random sequence by a different design. Using 6 point Likert scale ranking, the finding indicates that the design-user interrelationship of participant preference on artefact effectiveness and movement efficiency contributes to successful AI, engaging the functional information and inherent information.

Meanwhile, for the syntactic analysis of eye tracking, findings from the time of first fixation, heat map visualization and retrospective think aloud helped to identify the relevant content of expected fixated area in design to reveal the crucial factor of artefact usage effectiveness and movement efficiency. The data of time of first fixation are projected in a descriptive statistical format such as mean score, percentage and frequency. Using five-second exposures, the analysis also provides tangible evidence of pictorial visualization in understanding the elements that attract more attention from the participants. For instance, the localisation of hotspot on the specific element of 'guard' on Images 1, 2, 3, 4 and 6 consistently attracted participants' attention more than anticipated.

Interestingly, this study found that the fixation on the heat map visualization demonstrated a vital source of obtaining different feedbacks about how some artefact component could affect aesthetic judgement positively and negatively. This difference can also be explained in terms of content related attractiveness to different aspects of the images (Massaro et al., 2012). For instance, in this study, the heat map analysis revealed that participants' visual attention was not solely focused on the primary content of the images.

However, this study found that the blacksmith and the novice user can be unaware of certain innovation such as the addition of a small sub-component (guard), could affect the user's performance and artefact use. Also, the association of functional material such as tempered steel and black *Kemuning* wood (known to have medicinal properties) in artefact effectiveness should not be posited as outer features in establishing the syntactic findings. Therefore, the syntactical component evaluation gives specific perspectives on how LA should be designed according to the suitability of the usage and user movement to result in high effectiveness and product efficiency.

Meanwhile, the high preference for the simple design of LA confirmed that the hilt with ring hole is a prominent marker of the artefact and facilitates more ergonomic grip compared to the hilt that lacks ring hole. Therefore, this study found that the models of 'salience mapping' by Itti & Koch (2001) in an eye tracking investigation are very efficient in detecting the physical feature that contributes to artefact ineffectiveness. This is consistent with Wallraven et al.'s finding that 'the eye tracking data (using model saliency) showed that our computational tools are already able to explain some properties of this dialogue' (2009, p. 8). This finding again corroborates with the participants' brief verbal descriptions of the images discussed earlier (refer Sections 6.3.1, p. 213).

As fixation pattern is a popular metrics employed by prior researchers, our novel finding at the time of first fixation and the pattern shows a dynamic interaction when the participants' cultural memory and usage experience is recalled and manipulated in an implicit manner. Concurrently, in this case study, the eye tracking research did evaluate experienced users and found fascinating eye behaviour. Their eye gaze plots keep alternating between specific locations on the stimuli that show how their minds keep recalling the information from a pre-existent experience of the artefact. Although a study by Dupont et al. (2014) states that interpretation and perception through the eye behaviour of the viewer towards the stimuli could be associated with current experience, this study found that the accumulative pre-existent experience supports the eye tracking extensively in defining the syntactical criteria of specific object component.

More interestingly, the study reveals several answers concerning the debated issue of LA artefact classification related to providing evidence to support that in fact, the LA artefact in Malay traditional weaponry identification could be classified accordingly using syntactic analysis. Through syntactic analysis on the LA components, this study confirmed the specific yet vital physical requirement in the design to ensure its effective usage and efficient technique movement application (refer Sections 4.4.3, p. 153 and 5.2.3 in p. 166) for explicating design characteristic of the LA artefact.

Finally, after all eye tracking data were structured to establish cognitive evidence, findings of artefact context and person context are brought back in to complete the final triangulation. This way, the matched pattern data could be achieved according to the theoretical propositions. This triangulation would increase the validity of the cultural artefact investigation. This study found that the eye tracking technology is beneficial for further exploration in artefacts study and has potential for application in future design studies. Also, that the participants made significant negative notification on the

additional feature after the eye tracking test was carried out. A discussion on the implication and improvement of using eye-tracking technology for future studies appears in Section 7.3.1 below.

7.3 Implications of Study

7.3.1 Theoretical Implications

This research has largely exploited three streams of literature, which are the literature on LA as a traditional Malay weapon, AE and computational eye tracking technology. In this relation, discussion of different perspectives and knowledge inferences has been utilized to convey its idea and point of view into the discourse of this architectural intervention. This section will recap the most significant theoretical and practical contributions. In general, this section is divided into three main sub-sections. The first sub-section discusses the implications for developing an informative database for LA artefact classification. It focuses mainly on the use of functional aesthetic of tangible data and non-physical data or the philosophical idea of LA intangible knowledge that contributed to artefact effectiveness. The second sub-section discusses implications related to AI Theory that can offer significant assistance in customizing user experience through the development of a design-user system for MCD.

7.3.1.1 Artefact classification

Findings from this study can aid designers and ethnographers in understanding the functional characteristics of certain cultural artefact that are vital during the artefact classification process according to both tangible information and intangible knowledge. In fact, that information can help to determine the real artefact and exclude those with similar characteristics avoiding the possibility that the viewer might get confused or misunderstand and misinterpret. The results of this study show that artefacts with relevant syntactical characteristics with the usage and design concept are the most

appropriate to be classified in a particular type of LA. This classification is based largely on the findings from triangulated results of high agreement between previous documentation, expert participant feedbacks, participant observation and analytical observation on the artefact.

As for the analytical observation, the physical characteristics such as component, design structure and material should be taken into consideration by designers and ethnographers as they influence the advantages and disadvantages of every artefact when observed for categorization and information refinement purposes. Also, priority should also be given to intangible information such as philosophical measurement and idea depiction that convey full functional design of the artefact. It is recommended to include this intangible knowledge along with artefact context and person context in interaction framework.

7.3.1.2 Malay Aesthetic Experience (MAE) framework and Design-User System (DUs)

Based on the finding, this study provides a systematic design of AI framework for articulating the information processing for Malay cultural artefact (Figure 7.4). This study shows that intangible knowledge of Malay philosophy plays a vital role to enhance the artefact effectiveness and user movement efficiency by ensuring a dynamic interaction between core contexts of person and artefact. As the two contexts were emphasized in AI framework system, this study recommended to include structural intangible knowledge (IK) for revitalizing the framework as it is important for cultural product development in the new culture environment. The components of AI system integrate the artefact context, the person context and the IK context to establish a Malay Aesthetic Experience (MAE) framework underlying DUs. This framework is widely workable as the finding shows a strong interrelationship between these three contexts of

artefact, person and IK. Findings in Chapter 5 have compiled the related information to validate the construction of framework.

Locher et al.'s AI framework states that artefact driven and cognitively driven processes are referred to as bottom-up and top-down processes underlying user-product interaction and the resulting AE (2010, p. 71). The scholars also stated that AE is a product of the dynamic, ongoing interaction between these two components of the system (Locher et al., 2010, p. 72). Similarly, the directions of the arrows in Figure 7.4 indicate a continuous experience of an artefact and dynamic bottom-up/top-down interaction between the properties (form) and functionality of the artefact, the user's sensory-motor-skill and the user's cognitive activity. The artefact itself and the person context play a vital role as the two driving forces of the DUs system that reflect the user's cognitive structures.

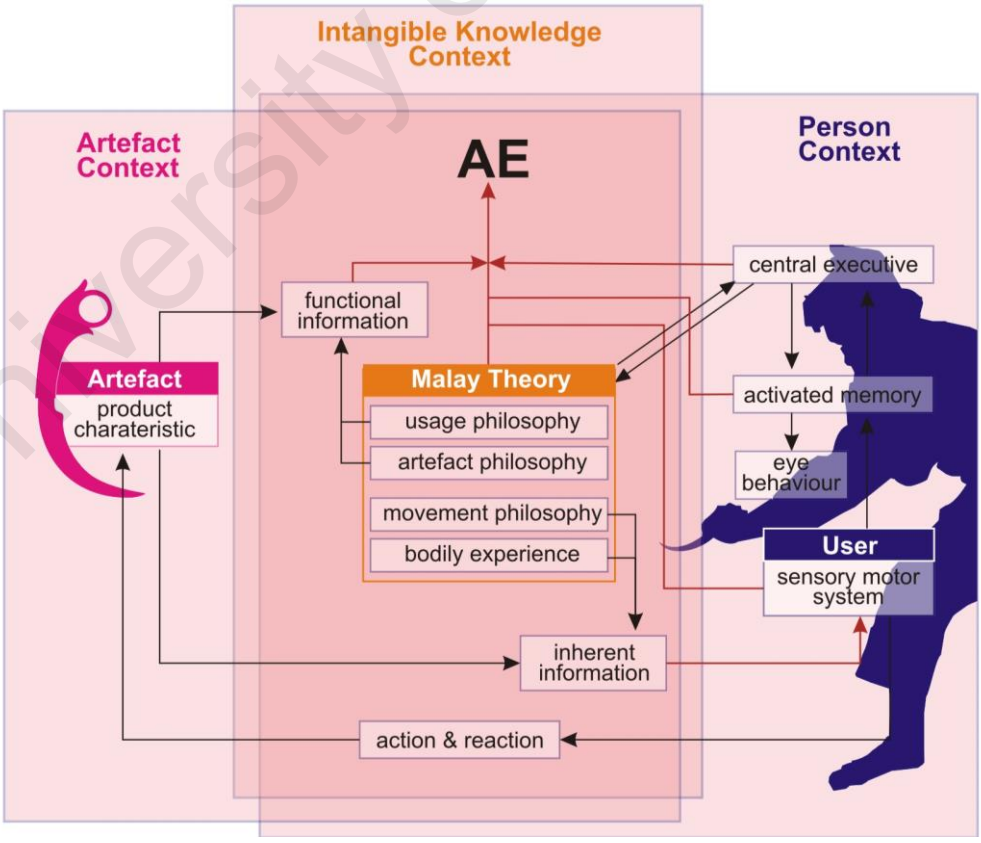


Figure 7.4: Integrated MAE Framework of the AI between intangible knowledge, artefact and person underlying Design-User System (DUs) of Malay artefact AE (Graphic: Siti Mastura, 2014)

With respect to the artefact context, it has been shown that the features of an artefact provide a user with different types of information especially when the aesthetics of an artefact have strong influence to user's interaction. In Locher et al.'s framework, three types of information the user can receive from the interactive system was presented: inherent, augmented, and functional. However, this study found only inherent information and functional information to strongly provide the input for the user interaction to the LA artefact. In turn, this study found that intangible knowledge context is central to both contexts as it provides the tacit information of the functional and the inherent.

In the IK context, the major contributing component to an AI is the user's cognitive structure, which contains several types of information in a form of Malay Theory such as usage philosophy, artefact philosophy, movement philosophy and bodily experience acquired throughout the user's life. The usage philosophy and artefact philosophy contribute to functional information simultaneously enhancing the artefact context. In fact, these two theories play a major role in artefact effectiveness. It is also the repository for the user's perceptions and evaluations of the action motivated by the design. In this functional information, visible functional parts or components of LA artefact inform the user about advantages and disadvantages of the design. Simultaneously, the functional information creates a bottom-up fashion on a user's interaction with an artefact for person context in which the AE takes place as shown in the Figure 7.2. It shows how the combination output happens between artefact and central executive that directs AI as cognitively driven process as shown by the arrows and their direction.

Meanwhile, Section 5.3 (p. 177) presented the inherent information that the perceptual-motor skill of user is tied together with the action possibilities of the product

and it is where the user and LA artefact communicate with the possible intuitive physical interaction from actions to reactions when handling and moving the artefact. Inherent feed forward information consists of movement philosophy and bodily experience that activate the actions when using an artefact and determine how the action can be carried out. The act of using the artefact point to possibilities that both feed-forward information and feedback information are acquired in a bottom-up fashion by the user as indicated by the arrow drawn from the physical characteristic of the artefact to the sensory-motor system in Figure 7.2. It is seen that the accumulative inherent information in the sensory motor system influences dynamic responses to the artefact through reflective action and reaction in artefact application.

The most of important is the central executive in the person context that monitored and directed this interaction which in the present study is conceptualized in the direct voluntary attention to the artefact. Central executive is one of the three components of working memory that performs four important executive processes: "the capacity to focus attention, to divide attention, to switch attention, and to provide a link between working memory and long-term memory" (Baddeley in Locher, 2010, p. 72). This study defines it as pre-existent cultural memory.

Similar to the action of using an artefact in Locher et al's interaction framework, both feed-forward information and feedback information from activated memory are acquired in a bottom-up and top-down fashion in central executive by the user as indicated by the arrow drawn from the sensory-motor system of user to provide information to result in user eye behaviour. Nevertheless, the circulation of DUs in the nature of AE is completed by covering important sources of artefact context, IK context and person context in the new MAE framework as shown by the red arrow wherein the

study is drawn from functional information, Malay Theory, central executive, activated memory and sensory-motor system.

7.3.2 Practical Implications

The findings of this study have important implications not only for developing artefact classification and user information but design-user knowledge system as well. The discussions are mainly related to implications for traditional artefact study and expert behaviour on a cultural artefact that comes from a particular culture. In general, this section is divided into three main sub-sections. Firstly, the discussion covers the implication in bringing the new approach that offer a guideline in traditional Malay artefact study. It focuses mainly on using established artefact information as artefact context, in the use of visualization technology. The second sub-section discusses implications that can offer significant assistance in understanding the expert user perspective through the development of behavioural ergonomic data and transferrable knowledge of user experience as a pioneering approach to studying cultural product development.

7.3.2.1 Eye tracking in traditional artefact study

This study is a critical effort to explore indigenous innovations and generate new way of traditional artefact study. Furthermore, there is a lot more findings that can be excavated to increase the research validity in the newer paradigm of cultural artefact. What emerged in this study is the use of a human-computational method of eye tracking methodology to help the information processing for artefacts study. Interestingly, this study finds that the method can be integrated in the study to sustain tacit knowledge for new designing purposes. The eye tracking used appropriate participants as validation instrument to provide a detailed guideline about planning a user interaction test to reveal

cognitive evidence for knowledge preservation in Malaysian cultural industry (refer Section 3.5.5.2, p. 109 and Section 7.2.4 in p. 236).

This study suggests that the method used is a starting point to get a general idea about which design elements of functional artefact attracted the participants' attention and which items were not fixated at all. Therefore, the result can provide guidance to the next researcher to understand the artefact design context and the person context more. In fact, the eye tracking method has increased the validity of ethnographic finding rather than just depending on triangulation. This study posits that the syntactical component evaluation has the potential to give specific perspectives on how artefacts were originally designed according to their physical criteria, artefact performance and user movement affected by the design.

Likewise, the finding from eye tracking also helped to identify certain design issues that should be overcome, for instance, a design that contained problematic component raises a concern in designing process whether it is based on personal taste, personal ergonomic limitation or to purely for aesthetics only that could affect the usage effectiveness and utility purpose. The qualitative feedbacks from the participants in eye tracking revealed that perhaps there are various interpretations of AE to the artefact designers or makers or rather it is due to the limitation of the fabrication tool. This issue is worth further investigation to improve what has been problematic area among these stakeholders.

In addition to the automatic detection of physical properties of LA artefacts, it has also been shown that participants are capable of rapidly detecting and categorizing learned properties of a stimulus through standard deviation analysis (refer Section 3.6.3, p. 112 and Figure 6.7 in p. 213). For example, this study has demonstrated that a particular syntactic element of the artefact can be detected within ten-second glance at it

after dependent variables such as artefact effectiveness and user movement efficiency are provided. These responses occur rapidly with a direct match in activated memory between the structural features of LA artefact generated by the sensory-motor system and a participant's knowledge stored in his cognitive system (person context).

In the new framework in Figure 7.2, the resulting rapid automatic reaction to the stimulus, represented by the arrow drawn from activated memory directly to the aesthetic experience also contributes to one's first impression of viewing the artefact during the eye tracking test. Therefore, it can be concluded that physical characteristic on LA artefact conceptualised by cultural background and its theory contribute a major influence during the eye tracking test. It provides strong justification that computational method on traditional artefact study is a potential approach for sociology and cultural research and also revitalises the often-ignored local knowledge.

7.3.2.2 Experts knowledge in MCD

The validated and structured cognitive evidence from expert user input using Malay artefacts is the main content in the establishment of local design-user interrelationship system (DUs). The strong influence of this system is delivered effectively by the artefact context and the person context. It helps to mitigate the missing link between both contexts that have been inquired by previous scholars (Che Husna, 2000; Lin, 2007). Therefore, a structural system is needed to merge both the contexts using the transferrable knowledge of expert user experience for DUs.

More importantly, the research gap motivated this study to apply new approaches instead of the conventional observation by demonstrating practical empirical findings. The empirical findings include the data of the eye behaviour of expert users through computational method to artefact design as suggested by Locher (2006) and Laurans et al. (2009). Locher's study demonstrates the valuable potential of eye-movement

research “to reveal the perceptual and cognitive processes that underlie an aesthetic episode” with art item (2006, p. 106). Findings in this study corroborated Locher’s expectation when the eye tracking findings reveal the ergonomic knowledge of the experts’ pragmatic experience through their working memory of central executive to provide specific information of usage application, feedback interaction and logical perception towards the syntactic properties of stimuli.

This information justified the need for DUs establishment based on expert knowledge, validated by the knowledgeable community of local expert users. Therefore, the intangible tacit knowledge could be presented tangibly for education purposes to the newer generation, especially those within the same culture environment. Alternatively, this study found that the pragmatic knowledge of expert user is beneficial for further exploration of varying range of artefacts study and has a potential for application in future design studies. The establishment of this study is a pioneering approach with the application of DUs system in MCD. As previously shown, the Figure 7.1 provides the schematic integration between user and artefact in the coupling of intangible knowledge that led to triangulated core of acquired information for person context and artefact.

7.4 Recommendations for Future Research

This study has revealed that analytical dimensioning evidence of syntactic properties and pragmatic knowledge influence the AE interaction in LA artefact using artefact observation, active participation observation and eye tracking study. Since this study is considered highly exploratory, efforts in understanding the Malay LA artefacts should continue and further investigation should be carried out. Listed in the section below are several recommendations that can be useful for future research.

7.4.1 Application of DUs System and MAE Framework in Artefact Design Study

The research framework used in this study suggests the contexts in understanding the nature of AE in AI process. This study has revealed that other contexts are also important to include into the framework to ensure the effectiveness of knowledge flow between artefact, person and cognitive ability. Thus, this study focused solely on obtaining tangible and intangible evidence such as the artefact design information, artefact philosophy, user knowledge and expert responses from LA users in Peninsula Malaysia. This approach significantly increases the ability to validate the finding that has been a core to structure MAE framework underlying the DUs system. The application of the framework and the system aligns the architectural effort with what should be understood as an optimal outcome in cultural artefact design study. For instance, the investigation could expose the transferable knowledge on the rest of Malay artefacts that has been considered less popular such as *sikin* (machete), *cucuk sanggul* (hair pin), *kapak kecil* (small hatchet) and *lembing* (javelin). Therefore, the identification of Malay culture could be sustained and aligned with the previously more popularized artefact such as *keris*. Also, considering the intention to aid and to enhance the contemporary product designs, this study suggests the application of MAE framework and DUs system in Malay culture design to account the importance of interrelationship between a user and an object for cultural product development in the new culture environment.

7.4.2 Public Attitudes towards Cultural Artefact through Eco-Heritage Tourism

The result of this study is highly influenced by the responses of experts and LA users in Peninsular Malaysia regarding artefact design due to the fact that traditional weapon artefact has been an important tourism item of cultural heritage throughout Malaysian

history. Although the awe-inspiring and jaw-dropping effect of this type of cultural artefact can sometimes be controversial due to the natural response of relating its use to action, this inherent information is useful to provide positive heritage knowledge on how the indigenous locals are creatively inventing tools for survival purposes. This could educate the public on how they can learn and personally experience traditional technology and designing process from the experts by understanding the philosophical knowledge in practical form. Therefore, this could increase the public awareness as a way to promote the Malay theories in designing a functional product.

By the same token, this phenomenon significantly sustains the local knowledge and could be revitalized in cultural modernization accordance (Lin, 2007). Considering this serious attention on the local knowledge that is sometimes misinterpreted by the archive organization, this study suggests reviving the attraction module for the development of eco-heritage tourism to international visitors. The international public is fascinated with learning cultural differences and experiencing local history which often draw them to visit sites associated with historical location instead of typical commercial area. Therefore, correct information is crucial and should be taken seriously by tourism organizations such as local and national museums, travel and tourism agencies and craftsman's associations.

7.4.3 Utilization of Eye Tracking Method in Capturing Tacit Values

This study would like to recommend future studies to utilise the eye tracking method on other socio-cultural artefacts study for the purpose of capturing and documenting their intangible cognitive asset. The study posits that these aesthetical tacit values when well documented are the essence of the cultural civilization. Therefore, effort such as traditional knowledge documentation initiative may be seen as a successful means of protecting and preserving traditional knowledge (Rohaida et al., 2012). Hence, this

study is in line with the need to uphold the socio-cultural aspects in any sustainable knowledge development agenda for nation's sake. In addition, the idea of sustaining traditional experience and intangible knowledge through computational approach could lead towards valued and valid efforts with integrated collaborative work for contemporary product designs.

7.4.4 Expert User vs. Novice User for Eye Tracking Study

A future eye tracking study should consider furthering investigating whether novice users of weapon artefact have different perspectives of design evaluation based on their level and duration of experience. Their interpretive feedbacks in viewing the artefact stimuli could also be undertaken due to the limited number of eligible participants that can be found in Peninsular Malaysia. In fact, such a study could also include whether novice users and experts user have similar or different opinions on cognitive feedbacks. Nevertheless, the motivation variables should appropriate with their level of artefact knowledge as the new user (Margolin, 1997). Furthermore, several factors of weaponry knowledge, traditional martial art and combating system, fundamental philosophy and bodily experience must be considered as being the primary sources of human science knowledge, mainly involving expert physical ability and cognitive ability.

The reasons of adding novice user in artefact study using eye tracking method is to increase the quality of usable data. It is to counter the issue that could arise from this study that some statistical data are debatable. Examples are whether the participant was not interested to look at the stimuli or due to habit and physical attitude of the particular user during the test or the eye is rather small (refer Table 6.6, p. 221). However, future study should be aware that as the participants in Malaysia are new to eye tracking technology and less familiar with UI conventions, they would sometimes simply fixate more or longer. Also, this study would like to consequently remind that certain older

participants, for logistical reasons such as those using regression lenses in glasses, bifocals and various eye diseases that come with age, could conflict with the eye tracker and impact calibration needed to capture the user's gaze (Neilsen & Pernice, 2009).

7.4.5 Practical Stimuli of LA Artefact for Sport Science Study Purpose

The study of cultural artefact is not just limited to the physical entity. Although this study has successfully presented interrelated approach between practical and cognitive activity to excavate pragmatic knowledge of an expert user, further investigation on human body mechanics is another concern to be highlighted such as in the area of sport science study, for instance. Studies have shown that static elements can provide very rich information carried by the images in eye tracking method (Wallraven et al., 2009; Locher, 2006; Shamsul, 2013). Therefore, this study recommends future studies to specifically investigate how moving stimuli of video recording of artefact user tactical movement can be effectively used alongside other interpretive materials. For instance, efforts on identifying the engagement of inherent information and functional information in the movement sequence may help to result in effective level of artefact usage and efficient tactical body action and reaction. This natural consequence is most useful in sport science study.

Furthermore, the finding from combining the design-user knowledge with computational method could support revitalising the module of martial art sports or behavioural research as an alternative to motion capture software and various kinds of ergonomic analysis software. In fact, the recommendation could help professional organization to investigate and understand the action and reaction of dangerous intimidator during crime scene investigation involving sharp weapon.

7.4.6 Statistical Analysis for Design Preference in LA Future Study

To note, the limitation of this study is its use of descriptive analysis on behavioural responses instead of statistical analysis. This study also recommends future LA artefact research for further investigation of users' eye behaviour to improve the empirical and qualitative finding. Although some of the data has debatable F value results for the hilt component from the test of within subjects' effects found to be not significant, this initial statistical finding is a potential issue worth further discussion especially on how syntactic properties affect the gaze behaviour on user preference. Therefore, further study using statistical analysis could be undertaken as a tool to assess the preference towards design aesthetic.

The statistical investigation could also consider interesting feedbacks in both negative and positive way to justify their preference. Enhancement on the stimuli characteristic by redesigning the orientation and manipulation of orthographic view and isometric view of the artefact, sequencing of image arrangements and artefact actual scale in user hand could help. This would help to ease the evaluation process for the moderator who assists the eye tracking test instead of the researcher herself. Importantly, the stimuli enhancement could result in successful viewing data to generate empirical results. Thus, eye-tracking could play a major role in measuring user behaviour using cognitive analysis for understanding the participants' preferences in cultural artefact design.

7.5 Final Conclusions

This study coupling artefact information and aesthetical tacit knowledge promotes local experts community, Malay theories, knowledge of bodily motor skills and design philosophies on syntactic properties that are compiled in three types of important source for AI: artefact context, person context and IK context. Knowledge of these three

contexts benefits product designers and behavioural researchers by providing clear direction for understanding user factor about utility and application needs, usability and practicality requirements, and also cognitive influence to ensure the effective product interaction.

It revealed the validated information to help shed light in artefact information ambiguity, particularly the classification for LA artefact. In fact this study provides detailed information for artefact documentation and informative labelling purposes in most museums in Malaysia. Thus, it helps the younger generation to access accurate information about the traditional Malay weaponry knowledge from positive and academic context for their common knowledge. Furthermore, the positive approach to delivering this kind of knowledge helps to shed away the negative stigma that 'traditional weapons are dangerous'. Therefore, the awareness of understanding the precious knowledge could be appreciated for ever.

However, this study does not try to educate readers on using the weapon artefact, but the finding is to mitigate and neutralize the often horrific perception toward Malay weaponry system and knowledge in the context of mechanical technique application and person behaviour in promoting the AE knowledge in Malay cultural design environment. Furthermore, this study provides numerous insight of human body performance knowledge for martial art sports use in the aspect of the Malay philosophies and creative thinking (Section 7.4.5). Also, LA information is useful for behavioural researchers and crime analysts to understand the character and behaviour of a criminal who used a sharp weapon during intimidation. Therefore, the knowledge can be used to educate the public how to overcome or reduce possible injury to a victim.

Finally, this study expends on the uses of data on physical artefact, behavioural ergonomic and cognitive evidence to provide useful information about the LA, a

traditional Malay weapon, to establish the DUs system and MAE framework for the design community to come up with newer utility product. The system and new framework improvised the western theory to suit the local Malay cultural environment and was developed to make it more generic for other different cultures. The theory establishment that uses Malay philosophical theory of cultural artefact and user AE knowledge is beyond the typical artefact studies that are associated with just physical information and inheritance story. Furthermore, the use of eye tracking technology further validates the system and framework as an important method that uses artefact design as surrogates to understand peoples' cognitive ergonomic behavioural data for the real world. In fact, it is a new approach that ethnographers can utilize for future cultural material study.

This exploratory study has shed light on the design-user knowledge behavioural ergonomic data for new and sustainable cultural product design. The researcher believes this enlightenment would be more acceptable to the local public while giving appreciative excitement to non-local public alike. Most importantly, the intangible product value represents the identity of the culture they originated from thus giving Malaysian design products their Malaysian identity.

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