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Permanent address:

House 36A, Street 39B, Sector I-9/4

Islamabad, Pakistan

Date: 30/12/2011

DAYANG ROHAYA AWANG RAMBLI
Associate Professor
Computer and Information Sciences
Universiti Teknologi PETRONAS
31750 Tronoh
Perak Darul Ridzuan, MALAYSIA

Signature of Supervisor

Name of Supervisor

Assoc. Prof. Dr. D. R. A. Rambli

Date: 30/12/2011

UNIVERSITI TEKNOLOGI PETRONAS

DISSERTATION TITLE: AESTHETIC PERCEPTION AND MOTIVATION MODEL FOR FORMAL AND INFORMAL VISUAL ENVIRONMENTS

by

SADIA RIAZ

The undersigned certify that they have read, and recommend to the Postgraduate Studies Programme for acceptance this thesis for the fulfilment of the requirements for the degree stated.

Signature: _____

DAYANG ROHAYA AWANG RAMBLI
Associate Professor
Computer and Information Sciences
Universiti Teknologi PETRONAS
31750 Tronoh
Perak Darul Ridzuan, MALAYSIA

Main Supervisor: Assoc. Prof. Dr. Dayang Rohaya Awang Rambli

Signature: _____

Dr. Rohani Salleh
Senior Lecturer
Management and Humanities Department
Academic Block 21
Universiti Teknologi PETRONAS
31750 Tronoh
Perak Darul Ridzuan, MALAYSIA

Co-Supervisor: Dr. Rohani Salleh

Signature: _____

Computer & Information Sciences Department
Universiti Teknologi PETRONAS

Head of Department: Dr. Mohd Fadzil Bin Hassan

Date: 30/12/2011

DISSERTATION TITLE: AESTHETIC PERCEPTION AND MOTIVATION MODEL FOR FORMAL AND INFORMAL VISUAL ENVIRONMENTS

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SADIA RIAZ

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BANDAR SERI ISKANDAR,

PERAK

DECEMBER 2011

DECLARATION OF THESIS

Title of thesis	AESTHETIC PERCEPTION AND MOTIVATION MODEL FOR FORMAL AND INFORMAL VISUAL ENVIRONMENTS

I SADIA RIAZ,

hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTP or other institutions.

Witnessed by

DAYANG ROHAYA AWANG RAMBLI
Associate Professor
Computer and Information Sciences
Universiti Teknologi PETRONAS
31750 Tronoh
Perak Darul Ridzuan, MALAYSIA

Signature of Author

Signature of Supervisor

Permanent address:

House 36A, Street 39B, Sector I-9/4

Islamabad, Pakistan

Name of Supervisor

Assoc. Prof. Dr. D. R. A. Rambli

Date: 30-12-2011

Date: 30/12/2011

DEDICATION

This thesis is dedicated to my loving parents, because of whom I am a part of this beautiful world. Every breathe I take is indebted to them because without their knowledge, wisdom, and guidance, I would not have the goals to strive and be the best to reach my dreams!

Thank you for being the best parents
a daughter could ever wish for...
I love you with all my heart
today and forever more...

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ABSTRACT

Researchers claim that aesthetic qualities of Formal Learning Visual Environments (FLVEs) have a persuasive role in intensifying learning motivation. Unfortunately, designers seem to overlook the necessity of aesthetic designing of FLVEs that could sustain Learners' Learning Motivation (LLM). The existing literature on aesthetic designing of FLVEs primarily focuses upon *environment perspective* and *users' perspective*. The existing studies, however, do not take into account, Learners' Aesthetic Perceptions (LAPs) in Informal Visual Environments (IVEs) which may also influence upon LLM. Recent research in this domain suggests that IVEs are producing learners' with a new profile of cognitive skills, such as visual-spatial intelligence and enhanced aesthetic perceptions. It is thus argued that LAPs formed in IVEs may result in establishment of new schemas (set of aesthetic expectations) and make learners' perceptually selective in judging aesthetics.

To aid investigation, based on the literatures and existing theories, aesthetic perception and motivation model is proposed and evaluated by examining learners' new schemas on aesthetics of digital environments. The proposed model has three variables, Learners' Schematic Thinking, Learners' Aesthetic Perceptions, and Learners' Learning Motivation. Groot's empirical research cycle is used to develop the Model Development Framework while Keller's and Malone & Leppers' motivational models are used to develop an aesthetic-emotion scale. Model testing and validation is performed through true-experimental designs to determine model's multivariate interaction effects, prognostication, and fitness.

Results show that LAPs in IVEs significantly influence upon LLM in FLVEs, hence confirming formation of learners' new schema on aesthetics of digital environments. Aesthetic designing guidelines for FLVEs, in harmony with the schema theory within HCI are also proposed for interaction designers to cater for learners' aesthetic expectations in F&IVEs.

ABSTRAK

Para penyelidik menyatakan bahawa kualiti estetik Persekitaran Pembelajaran Formal Visual (FLVEs) mempunyai peranan yang meyakinkan dalam memperkukuhkan Motivasi Pembelajaran (LM), oleh itu, membuatkan interaksi pelajar dengan antara muka FLVE satu faktor yang penting yang perlu dipertimbangkan dalam mereka antara muka. Malangnya, disebalik kepentingan faktor ini, pereka seolah-olah mengabaikan keperluan estetik dalam mereka bentuk FLVEs yang mana boleh mengekalkan Motivasi Pembelajaran Pelajar (LLM). Literatur yang sedia ada pada estetika rekabentuk FLVEs terutamanya tertumpu kepada *perspektif alam sekitar* dan *perspektif pengguna*. Kajian yang sedia ada, bagaimanapun, tidak mengambil kira, Persepsi Estetik Para pelajar (LAPs) dalam Persekitaran Tidak Formal Visual (IVEs) yang juga boleh mempengaruhi LLM di FLVEs. Penyelidikan terkini dalam domain ini menunjukkan bahawa IVEs dapat menghasilkan pelajar dengan profil baru kemahiran kognitif seperti kecerdasan visual-ruang dan meningkatkan persepsi estetik. Adalah dikatakan bahawa LAPs yang terbentuk dalam IVEs boleh mengakibatkan penubuhan skema baru (jangkaan estetik) dengan menjadikan pelajar memilih secora perseptif dalam mengenalpasti estetika yang boleh membawa kepada pembentukan persepsi prejudis estetik.

Untuk membantu siasatan, berdasarkan kesusasteraan dan teori yang sedia ada, persepsi estetik dan model motivasi telah dicadangkan dan dinilai dengan memeriksa skema baru pelajar pada estetika persekitaran digital dan menyiasat kewujudan jurang visual antara LAPs dalam IVEs dan LLM di FLVEs. Model yang dicadangkan mempunyai tiga pembolehubah, (1) Pemikiran skema (LST), (2) Persepsi Estetik Pelajar Pelajar (LAPs), dan (3) Motivasi Pembelajaran (LLM). Berdasarkan Keller dan Malone & Lepper models motivasi, estetik-emosi skala telah dibangunkan melalui analisis faktor tinjauan untuk menerapkan LAPs dalam IVEs dan LLM di FLVEs. Ujian model telah dilaksanakan menerusi reka bentuk uji kaji sebenar, yang berdasarkan pembentukan model mental pelajar melalui klasifikasi LAPs dan ujian

hubungkait pembolehubah. Pengesahan model dilakukan melalui reka bentuk eksperimen sebenar yang lain untuk menentukan kesan multivarian model, kesan interaksi dan rasionalisasi teori.

Keputusan kajian menunjukkan bahawa LAPs di IVEs mempengaruhi LLM di FLVEs dengan ini mengesahkan pembentukkan skema baru pelajar bagi persekitaran digital estatik. Penyelidikan ini juga mencadangkan garis panduan dalam mereka bentuk motivasi estetik untuk FLVEs selaras dengan teori skema dalam HCI.

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LIST OF ABBREVIATIONS

AJS	Aesthetic Judgement Scores
ANOVA	Analysis of Variance
ANCOVA	Analysis of Co-Variance
CI	Contextual Interpretation
CVI	Content Validity Index
EC	Environment Context
EFA	Exploratory Factor Analysis
ETA	Emerging Theme Analysis
FLVEs	Formal Learning Visual Environments
F&IVEs	Formal and Informal Visual Environments
F&IMFs	Formal and Informal Motivational Factors
FLMFs	Formal Learning Motivational Factors
GU	Gestalt Understanding
HCI	Human Computer Interaction
HRM	Hierarchal Regression Modelling
IVEs	Informal Visual Environments
IMFs	Informal Motivational Factors
IMTs	Informal Media Technologies
IDI	Item Discrimination Index
IDV	Item Discrimination Validity
KMO	Keiser-Meyer-Olkin
LLM	Learners' Learning Motivation
LST	Learners' Schematic Thinking
LM	Learning Motivation
LAPs	Learners' Aesthetic Perceptions
LMFs	Learning Motivation Factors
MP	Media Psychologist
MDF	Model Development Framework
MANOVA	Multivariate Analysis of Variance

MANCOVA	Multivariate Analysis of Co-variance
SNWs	Social Networking Websites
SBVs	Standardized Beta Values
TEL	Technology Enhance Learning
TAM	Technology Acceptance Model
UTP	Universiti Teknologi PETRONAS
UMP	Universiti Malaysia PAHANG
VT	Visual Test
WBL	Web-Based Learning
WebMAC	Website Motivational Analysis Checklist
WBLEs	Web-Based Learning Environments

CHAPTER 1

INTRODUCTION

1.1 Research Background

A *"learner"* is a person who is interacting with the learning environment, and is engaged in an active learning process through educational material, delivered by the learning environment [1], while the aesthetics of learning environment refers to how attractive the environment is in terms of *"catching and sustaining learners attention in the content delivered by the learning environment"* [2]. Reeves & Reeves suggest that educators should attempt to stimulate and sustain student's Learning Motivation (LM) in Web-based Learning Environments (WBLEs) through the design of effective interactions [3]. Moore in 1989 [4] had identified three types of interactions that occur between a learner and the learning environment, (1) Learner-Content, (2) Learner-Instructor and (3) Learner-Learner interaction. Later, Hillman *et al.* [5] identified a fourth type of interaction i.e., Learner-Interface Interaction. Lohr [6] is supportive of this form of learners interaction with interface of the learning environment, since visually it is the first thing a learner interacts with, followed by learners interaction with content, instructor and other learners.

In case of Formal Learning Visual Environments (FLVE) significance of Learner-Interface Interaction is more important because Robin & Holmes [7] believe that an aesthetic design has an impact beyond decoration, and according to Gagne's nine events of instruction [8] screen design has the initial role of gaining learners attention. For instance, over 4.6 million U.S. higher education students were taking at least one online course in fall of 2009 [9]. This student percentage represented a 17% increase over the previous year, and the increase is likely to continue as more schools begin offering more online courses. Online learners' community is said to make judgments about the credibility and usability of their courses heavily based in-part on

aesthetics of web content [10], [11], [12]. Studies [13], [14] have also reported that aesthetics of an online course, particularly the layout, the use of graphics, and the ease of use, were important in motivating learners and to keep them persistently engaged in Web-based Learning (WBL). So if Learner-Interface Interaction is not engaging and visually appealing, that means interface or screen design has not grabbed learners adequate attention. Moreover, there is literature evidence to suggest that it can influence upon learners others types of interactions with the learning environment, as well as Learners Learning Motivation (LLM) which is reportedly a growing concern among instructional designers of FLVEs [15]–[17]. The worldwide dropout rate for WBL in 2007-08 was recorded as high as 64% [18], resultantly giving negative impression of WBL and its potential, which are said to a powerful asset, *"only if they are designed and executed well"* [19]. Although, there are various reasons why a learner may drop out of a course, lack of LM is the most critical factor in keeping them in [20]. Frankola [21], in her widely cited article concerning dropout rates in corporate eLearning courses, states that *"learners most frequently reported lack of time, lack of learning motivation, poorly designed courses and incompetent instructors as the reasons for their attrition"*.

Unfortunately, despite the apparent obviousness of this requirement, designers seem to overlook the necessity of aesthetic designing FLVEs that could sustain LLM and attention [16], [17], [22]. Many interface designing experts as well as academics criticize aesthetic designing of FLVEs and some even refer to it as a method of *"hiding poor scholarship"* [23]. On the contrary, aesthetic researchers equate aesthetics designing of FLVEs to that of learners *"desire to learn"* or *"positive attitude towards content"* [17], [24]. As it is believed that use of multimedia alone can not necessarily make a learning environment aesthetic, but how the aesthetics of FLVE motivationally affects learners and pulls their attention [25].

Aesthetics is a branch of philosophy associated with art and beauty [26]. The word aesthetic comes from the Greek, aisthanomai, it means "*to perceive, to sense*" [27]. It is also related to the expression of beauty and is concerned with how individuals perceive objects or make judgments based upon information received as five human sensory inputs [28]. The existing literature on aesthetic-motivational

designing of FLVEs can be examined from two perspectives, (1) *Environment perspective*, which is based on aesthetic qualities of the FLVEs [13], [14], [29]–[33], (2) *Users' perspective,* which is based on Learners Aesthetic Perceptions (LAPs) of FLVEs [7], [10], [11], [34]–[36]. Existing literature and studies primarily focus upon LAPs in FLVEs and how that influence upon learners usability perception and satisfaction. However, no comparison based study, either empirical or theoretical, was found in literature that examined the influence of LAPs in Informal Visual Environments (IVEs) on their LM in FLVEs. IVEs are important, because learners of today live in visually mediated society, dominated by IVEs and Informal Media Technologies (IMTs) in nearly every aspect of their lives. Visuals, images and pictures fill their media from magazines to posters to television to video-games to the internet. Gurri *et al.* [37] stated that *"Nowadays, visual media is everywhere. Images, still and moving have spread across the globe on the wings of new technologies. They bombard us wherever we go, in restaurants, airports, museums, shopping malls, sports arenas, and even in gas stations, no less than at home and in the workplace. Even if we wished, we cannot avoid exposure"*. With such an abundant presence of IVEs and IMTs today, it is can be said that learners interaction with IVEs is likely to occur more recurrently than with a FLVE.

As for the influence of IVEs, literature shows that learners interaction with different IVEs positively influences upon their LM [13], [14], [24]–[26], [38]–[40] and at the same time has led to desensitization, emotional imbalance and aggressive behaviour [41]–[43]. Another positive influence has been reported by researchers like, Greenfield [44] that *"television, video-games, motion-pictures and the internet are producing learners with a new profile of cognitive skills"*. Learners' cognitive skills that are said to be enhanced in IVEs include sophisticated development of their visual-spatial skills, such as iconic representation and spatial visualization [44]. There are other studies too that have reported similar enhancement of users' perception, awareness and cognitive skills in IVEs, e.g., Stavrinoudis *et al.* [45] found that users with higher experience levels in the online visual environments judged content, navigation, and aesthetics more critically than less experienced users. This study also reported that greater exposure to the environment converted novice users to a higher level. Similarly, under Stanford University's three years project, researchers

investigated web credibility perception of approximately 4,500 users, and one of their findings was that users who shopped frequently online had developed a more accurate perception on reliability of websites and could decide in less than 30 seconds if the website was secure or not [46]. Perkins *et al.* [47] reported that users who played more frequently video-games had higher spatial awareness than those users who played less frequently. Fogg *et al.* [12, p.5] found that over 45% of consumers made judgments about the credibility of websites based on aesthetic perception of the site design, *"including layout, typography, font size, and color scheme."* These subjective judgments are based on users' perceptions and there are also studies that report users make these firm and critical aesthetic judgments on visual stimulus in a very short amount of time.

Based on what has been reported by researchers [44]–[47] it can be said that IVEs of today are producing learners with a new schema on aesthetics of digital environments. Learners new schemas on aesthetics are formed due to the media aesthetics of IVEs, because *"television, motion-pictures, internet and visual computer or screen displays may no longer be considered as means of simple message distribution, but essential elements for communicating media aesthetics"* [48]. This resultantly has made learners critical in judging aesthetics FLVEs by establishing *"perceptual filters"* [49] that provide a *"contextual frame of reference and form prejudice aesthetic perceptions"* [48]. This indicates that IVEs influence upon viewers' schemas and learners of FLVEs are also viewers of IVEs which are *"producing learners with a new profile of cognitive skills"* [44]. Inadequate research in aesthetic-motivational designing of FLVEs by examining learners new schemas on aesthetics of IVEs, can be a reason for learners to experience lack of LM, which is a growing concern among instructional and interface designers [50]. The rationale behind can be linked to visual gaps between LAPs in IVEs and LLM in FLVEs. A visual gap exists due to the difference between what learners *aesthetically expect* and *what they see* (aesthetic expectations). These visual gaps create "cognitive fatigue" as according to the control theory of self-regulation [51], *"humans persistently try to reduce gaps between their actual and desired behavior"* and lesser the gaps in what they expect and what they desire, is an indication of experiencing lesser cognitive

fatigue and higher intrinsic motivation, which is crucial for self-regulated learning in FLVEs.

It is therefore suggested that FLVEs must adapt to these changes that IVEs have resulted in formation of learners new schemas on aesthetic of digital environments. This requires taking advantage of learners new strengths in visual-spatial intelligence and aesthetic perceptions and compensating for their weaknesses in information visualisation that requires high order cognitive processes, such as abstract vocabulary, mindfulness, reflection, inductive problem solving, critical thinking, and imagination.

1.2 Problem Statement

The existing literature on aesthetic-motivational designing of FLVEs covers only LAPs in FLVEs and based on studies [44]–[47] it is argued that IVEs of today are producing learners with a new schema on aesthetics of digital environments due to the media aesthetics of IVEs, because *"television, motion-pictures, internet and visual computer or screen displays may no longer be considered as means of simple message distribution, but essential elements for communicating media aesthetics"* [48]. This has resultantly made learners critical in judging aesthetics of FLVEs by establishing *"perceptual filters"* [49] that provide a *"contextual frame of reference and form prejudice aesthetic perceptions"* [48]. It is therefore argued that FLVEs of today are unable to sustain LLM due to the perceptual filters that are based on learners new schema on aesthetics of digital environments. Perceptual limitations of human brain are studied under the discipline of cognitive ergonomics, which is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system [52]. There is literature evidence to support this argument. According to the National Center for Education [53] 92% of educational institutions in US alone are using asynchronous web technologies for their distance education courses offered via formal online learning medium. The asynchronous technologies are defined as "not in real-time" and exclude audio and video technologies. So it can be said that vast preponderance of web-based FLVEs of today are somewhat static web-based information systems. Moreover, 85% of instructional designers of WBLEs agreed to poor designing of

online learning environments and associated the failure *"to having required more time"* than designing traditional classroom preparation [54]. Similarly, it is said that *"good learners learn, in spite of bad learning environments"* [19]. Nevertheless, it cannot be expected that all learners in a WBLE will be intrinsically motivated enough and have the required skills and perceptions to navigate and learn from online learning environments, *"particularly if they are only digital reincarnations of poor face-to-face learning environments and practices"* [19]. The worldwide dropout rate for WBL in 2007-08 was recorded as high as 64% [18] and researchers [20], [21], [55] have mostly credited lack of LLM to be one of the critical factors for high number of drop-outs in WBLEs and some have even said that reality the reasons of experiencing lack of learning motivation in WBL are likely to be *"deeper and far more complex than originally thought"* [56]. One such relatively unidentified, deeper and complex reason may possibly be associated with learners' perceptual limitation, developed due to their interaction with IVEs. Some learners perceive aesthetics of FLVEs visually appealing due to the spatial composition of the images, photographs, individual colors, color combination or the texture used in design, while others may feel disengaged, because it is known that human brain stores information on human experiences which is used to filter unnecessary information, fill in the visual gaps and to make constant comparisons to what is there and what our brain wants us to see [13]. This filtration of the brain makes learners perceptually selective in judging aesthetics [48] and when it creates a big difference between what learners aesthetically expect and what they see, they get cognitively fatigued [57] due to the involvement of high order cognitive processes. This may influence upon LLM in a FLVE, because according to the control theory of self-regulations [51], *"humans persistently try to reduce gaps between their actual and desired behavior"* and less gaps in their actual and desired behavior is an indication of experiencing less cognitive fatigue and higher intrinsic motivation, which is crucial for self-regulated learning in FLVEs.

The existing literature on aesthetic-motivational designing of FLVEs [7], [10], [11], [34]–[36] extensively covers research and studies on assessing learners aesthetic needs and examines LAPs in FLVEs only. However, no study/research, either empirical or theoretical, was found in literature that has examined influence of LAPs

in IVEs on their LM in FLVEs. It is thus important to conduct a research that examines learners new schemas on aesthetics of digital environments and investigate existence of visual gaps between LAPs in IVEs and LLM in FLVEs. To aid investigation, an aesthetic perception and motivation model for Formal and Informal Visual Environments (F&IVEs) is proposed.

1.3 Research Aim

HCI researchers have repeatedly raised a concern on lack of aesthetic consideration in user testing and evaluation of systems, this research thus aims to examine LAPs and how their usability perceptions are influenced in F&IVEs. Another aim of this research is to develop an aesthetic perception and motivation model for F&IVEs that can be tested and validated through empirical results and theoretical rationalization. The model will examine learners' new schemas on aesthetics of digital environments and investigate the existence of visual gaps between LAPs in IVEs and LLM in FLVEs.

1.4 Research Questions

RQ1: How learners learning motivation and aesthetic needs are associated with Formal & Informal Motivational Factors (F&IMFs) in F&IVEs?

RQ2: How to develop a scale based on F&IMFs to measure LAPs and LLM in F&IVEs?

RQ3: How do the preliminary empirical analyses result in formation of learners mental models and infer relationship among research variables?

RQ4: How to validate results of aesthetic perception and motivation model for F&IVEs?

1.5 Research Objectives

1. To investigate the influence of F&IMFs on learners' motivation and aesthetic needs in F&IVEs.

2. To develop a scale based on F&IMFs by examining associated aesthetic-emotions to embed LAPs in IVEs and LLM in FLVEs.

3. To test association between/among variables for model development.

4. To validate aesthetic perception and motivation model by examining its multivariate interaction effects, prognostication and fitness.

1.6 Model Development Framework (MDF)

Since this research is explorative, requires empirical/theoretical support to address research gaps and answer research questions, therefore, the proposed Model Development Framework (MDF) is based on the five stages of empirical research cycle namely, (i) *observation, (ii) induction, (iii) deduction, (iv) testing and (v) evaluation.* The five phases of MDF are as follows:

MDF Phase 1 **(Model Conceptualization)** was designed as an ***observation stage*** of empirical research cycle. It is mostly covered in Chapter 1 and Chapter 2 of this thesis, where literature review, empirical studies and arguments have been extensively discussed to identify research gaps and to provide basis for hypothesis testing. Moreover, based on extensive literature review, model conceptualization also occurred during this phase.

MDF Phase 2 **(Users' Needs Assessment)** was designed as an ***induction stage*** of the empirical research cycle. Learners' motivation and aesthetic needs in F&IVEs were assessed during this phase and overall research methodology was formulated to be used as a direction of research from the beginning to the final.

MDF Phase 3 **(Scale Development)** was designed as a ***deduction stage*** of the empirical research cycle, and included visual experimentations for developing a scale that embedded LAPs and LLM through their aesthetic-emotions in F&IVEs.

MDF Phase 4 **(Model Testing)** was designed as a ***testing stage*** of the empirical research cycle, and was implemented through a case study based on a true experimental design involving pre-posttesting of F&IVEs. The model conceptualized in the MDF Phase 1 and 2 was tested to form learners mental models and to interpret association between research variables and their sub-measuring constructs.

MDF Phase 5 **(Model Validation)** was designed as an ***evaluation stage*** of the empirical research cycle. It required application of the developed model in Phase 4 of the MDF into another case study based on a true experimental design involving pre-posttesting of F&IVEs for model validation.

Validity techniques were applied through all phases of the MDF. Data analysis was performed in Predictive Analytics Software (PASW) v.18.

1.7 Scope of Research

The research has been undertaken to determine LAPs (examined through learners new schema or set of aesthetic expectations) in IVEs and how that influence upon LLM (examined through aesthetic-emotions) in FLVEs. This dissertation therefore provides a general aesthetic perception and motivation model for F&IVEs that are web-based in nature and meet validity measures set for conducting true experimental designs involving pre-posttesting. The variables used in developing of the model are limited to (1) Learners Schematic Thinking, (2) Learners Aesthetic Perceptions, and (3) Learners' Learning Motivation. The three variables are equated through aesthetic-emotions, treated as adjectives, associated with F&IMFs in models given by Keller and Malone & Lepper [58], [59]. The scale developed in Phase 3 of the MDF was identified with four aesthetic-motivational dimensions (usability perception, visual & aesthetic appeal, cognitive engagement, satisfaction) and was used as dependent/outcome variables for measuring visual gaps in LAPs in IVE and LLM in FLVE. The targeted groups of this study were learners (Male/Female, Age 18-25) who were enrolled in a degree program (undergraduate, post-graduate) of institutions that had ongoing e-learning systems in place.

1.8 Research Contribution

This research argues that FLVEs of today are unable to sustain LLM due to perceptual filters or perceptual limitations created by IVEs due to the formation learners' new schema on aesthetics of digital environments. Therefore, based on results of evaluation and analyses of real case studies, this research makes following contributions.

1. A general framework of aesthetic perception and motivation model for F&IVEs to examine learners' new schemas on aesthetics of digital environments and investigate existence of visual gaps between LAPs in IVEs and LLM in FLVEs.

2. For effective, efficient and satisfying human interaction with systems, this research contributes a new method/approach for examining human perceptual limitations in visual environments.

3. The research acts as a stepping stone for instructional and interface designers to apply learners' new schemas in designing of FLVEs. This contribution is in support of schema theory within HCI, which is used as a guiding principle in designing of interfaces and states that users will be better in using a system if it is based on familiar design schemata that they have.

4. The research makes a contribution towards Technology Acceptance Model (TAM) as some of the external variables for in this research are adapted from it. External variables in TAM are based on users' cognitive reasoning and involve cognitive processes, serving as technology acceptance parameters. The proposed aesthetic perception and motivation model is consisted of external variables serving as parameters with which learners judge aesthetics of F&IVEs in a *contextual frame of reference* due to the *perceptual filters* that are established in the form a new schema on aesthetics of digital environments.

5. The research also contributes an IS theory based on empirical findings in support of the proposed aesthetic perception and motivation model. Theory building from case studies is considered to produce novel theory and is testable with constructs that can be readily measured and hypotheses that can be proven false.

6. Another important contribution of this research is the development of aesthetic-emotion scale to measure LAPs and LLM in F&IVEs. The four identified aesthetic-motivational dimensions of the scale will provide a basis for future studies to formally introduce design guidelines and/or aesthetic-motivational metrics in the e-learning context.

1.9 Organization of Thesis

This thesis is divided into 7 Chapters.

Chapter 1 provides research overview. It describes the research background, problem statement, research aim and objectives, research contributions, and outlines the overall Chapters of this dissertation.

Chapter 2 comprises of literature reviews for identification of the research gap(s), measuring constructs of three research variables (LST, LAPs, LLM) and their sub-measuring constructs for model conceptualization and development.

Chapter 3 presents the model development framework based on empirical research cycle and also introduces five phases adopted for model development, testing and validation.

Chapter 4 presents the research methodology including step-by-step methods, procedures, validity techniques, scales and statistical procedures adopted and applied during each phase of the model development framework. A complete description is presented to ensure correct path for model development.

Chapter 5 presents results of 20 hypotheses to address corresponding four research questions.

Chapter 6 is dedicated to discussion on hypotheses testing results in support of arguments addressing research gaps and research questions.

Chapter 7 summarizes the content of dissertation including the four research objectives, research benefits, direction for future research and also presents aesthetic-emotions based designing guidelines for F&IVEs.

CHAPTER 2

LITERATURE REVIEW

2.0 Chapter Overview

This Chapter has been organized to identify research gaps. Section 2.1 discusses Formal Learning Visual Environments (FLVEs) and significance of their aesthetic designing with respect to Learner-Interface Interaction to optimise Learners' Learning Motivation (LLM). This section also reviews existing studies that can be examined from two perspective, (i) aesthetic qualities of FLVEs, and (ii) learners' aesthetic perceptions (LAPs) in FLVEs. Section 2.2 is devoted to Informal Visual Environments (IVEs) and examines IVEs influence on viewers including their LLM. This section also reviews important studies where researchers have reported users' developing different new profiles of cognitive skills due to their interaction with IVEs, providing a basis to argue that learners' new schemas on aesthetics of digital environments are being formed. Section 2.3 identifies research gap and presents supporting arguments based on literatures, psychological reasoning and proposes an aesthetic perception and motivation model to address the research gap. Sections 2.4, 2.5, 2.6 identify measuring constructs of the three variables (Learners' Schematic Thinking, Learners' Aesthetic Perception, Learning Motivation) for model conceptualization,. Finally, Section 2.7 presents Chapter summary.

2.1 Formal Learning Visual Environment (FLVEs)

Formal Learning Visual Environment (FLVE) is a part of formal learning process which is planned in characteristics and occurs as a result of activities that are held and planned within a structured learning setting. Australian Education Council [60]

defines formal learning as learning typically provided by education or training institutions. It is organized and well-executed in terms of learning objectives and also leads to certification at the end. Within FLVE, Web-based Learning (WBL) or E-learning is a term that encompasses all forms of Technology-Enhanced Learning (TEL) [61]. A Web-based Learning Environment (WBLE) is mediated via the Internet/Intranet and connected to a computer with hyperlinks to resources outside the instructional domain. American Society for Training & Development [62] estimated that in 2000-10, U.S. organizations spent $154.39 billion on employee WBL and development. This indicates that geographical access and cost barriers to learning are now reduced due to WBL [15], [63].

Designing of any FLVE, either face-to-face or WBL, should be as such that basic core requirements of learning such as learning skills, interaction, feedback, content usability and performance evaluation are all well inculcated within the instructional design [64]. This is not an easy task, and requires decision on every step and procedure which is crucial for ensuring effectiveness of the design, from the choice of the learning objectives to the choice of the assessment strategies [65]. The task of designing becomes more complicated in case of WBL, due to little or no face-to-face interaction with the learners. This is a distinguishing factor between FLVE of face-to-face and WBL as the language through which communication takes place in later is reduced to print, sound, graphics and interactions between learners and instructors are reduced to levels that require interactive support of technology [66]. This capability of WBLE to integrate different multimedia types such as text, picture, audio, animation and video is a very unique characteristic [67] and its designing for optimizing Learners' Learning Motivation (LLM) with reference to the stated instructional objectives has become an important area of research. To optimize LLM, WBLEs should keep learners' f ully engaged, attentive and motivated becaus e if they are inappropriately designed it can result in distracting learners', decreasing their learning performance and motivation [65]. The rationale behind learning distraction is linked to cognitive processes and different cognitive learning styles of learners' because both extremely attractive things, as well as extremely boring things, can create a distraction [68]. Likewise, learning is a process that takes place in learner's mind and body. Our

minds and bodies work together to help us pay attention, solve problems, remember solutions and to achieve this, our *"physiological states must support our mental efforts"* [69]. So it can be said that much of learners' learning in a FLVE is based upon systematic psychological behaviours, and for effective learning a corresponding systematic framework is essential [70].

It is said that motivated learners are likely to achieve higher levels of success, and motivation is considered an important factor in a FLVE [71]. A good FLVE is expected to be rich enough to sustain learners' attention, while keeping their learning motivation high [72]. There is research evidence that shows a positive correlation of LLM and their achievements, or proved that motivation is an important factor predictive of achievement [73]. Despite the apparent obviousness of this requirement, designers seem to overlook the necessity of providing a rich learning activity that could sustain LLM and attention [22]. Reeves & Reeves suggested that educators should attempt to stimulate and sustain student's learning motivation through the design of effective interactions [3]. Again much has been written with regards to designing of effective interactions and a significant amount of research indicates that it is a crucial component for the success of WBL, which heavily depends upon LLM [4], [5], [74], [75].

Moore [4] had identified three types of interactions that occur between a learner and the FLVE, namely; (1) Learner-Content, (2) Learner-Instructor and (3) Learner-Learner Interaction. Later, Hillman *et al.* [5] identified a fourth type of learners' interaction with FLVE; i.e., Learner-Interface Interaction. Researchers [6] support this form of learners' interaction with learning interface of learning environment since visually it is the first thing learner interacts with. This is followed by learners' interaction with content, instructor and other learners. In case of FLVE, significance of Learner-Interface Interaction is extremely significant because researchers [7] believe that an aesthetic design has an impact beyond decoration. According to Gagne's nine events of instruction [8] screen design has the initial role of gaining learners' attention.

A *"learner"* is a person who is interacting with the learning environment, and is engaged in an active learning process through educational material, delivered by the

learning environment [1], while the aesthetics of FLVEs refers to how attractive the environment is in terms of catching and sustaining learners' attention in the content delivered by the learning environment [2]. Over 4.6 million U.S. higher education students (learners) were taking at least one online course in fall of 2009 [9]. This student percentage represented a 17% increase over the previous year, and the increase is likely to continue as more schools begin offering more online courses. Online learners' community is said to make judgments about the credibility and usability of their courses heavily based in-part on aesthetics of web content [10], [12]. Studies [13], [14] have reported that aesthetics of an online course, particularly the layout, the use of graphics, and the ease of use, were important in motivating learners' and to keep them persistently engaged in WBL. So if Learner-Interface Interaction is not engaging and visually appealing that means interface or screen design has not adequately grabbed learners' attention [8] and there is literature evidence to suggest that it can influence upon learners' others types of interactions including LLM.

2.1.1 Battle of Perceptions: Aesthetics Versus Usability

Before elaborating further upon Learners' Aesthetic Perceptions (LAPs) and aesthetic designing of FLVEs, literature review is presented to discuss why *aesthetic perception* is preferred over a more contemporary concept *usability perception* in this research.

Within HCI there has been an ongoing battle of perceptions. Usability gurus or experts insist upon developing interfaces simple and easy so that tasks may be accomplished easily, while the effectiveness and efficiency of the system could be maximized. The stance of graphic designers, however, is to develop aesthetic user-interfaces for getting attention and creating an aesthetic experience for the viewers. Between the two, usability has been of a great concern within the HCI community but making its direct comparison with aesthetics is unfair, and is only possible if aesthetics is destroyed to some sort of measuring instrument. The usability versus aesthetics is one of the oldest debates between interaction designers and graphic designers. The never ending argument is based on is it more important for a system to function well or to look good?

Usability experts consider aesthetics to be non-instrumental when comparing it with more instrumental components such as usability and functionality [76]. The said stance on aesthetics has been negated by researchers [77], [78] because for computers, usability acts like a realistic tool that determines effectiveness, efficiency and satisfaction. Quite the opposite, aesthetics is a matter of contemplative reasoning and whole interaction experience of humans with computers is based upon their aesthetic-judgments [68]. However, in process of interface designing, both aspects should be evaluated by preliminarily research, considerations, modification and redesigning [79]. There is a significant amount of research that supports the view that design, aesthetics and usability are inexorably linked [10], [12], [26], [80]–[83]. Still many interface designing experts as well as academics criticize aesthetic designing of user-interfaces and some even refer to it as a method of *"hiding poor scholarship"* [23]. On the contrary, aesthetic researchers equate aesthetics designing of FLVEs to that of learners' desire to learn or positive attitude towards content [17]. As it is believed that use of multimedia alone can not necessarily make a learning environment aesthetic, but how the aesthetic feel of FLVE motivationally affects learners [25].

Moreover, HCI researcher [84] believe that usability testing which occurs today focuses mainly on the actual usability of the system and not the role aesthetics plays into the perceived and reported usability in determining user satisfaction with an application. In another study it has been reported that within HCI an emerging research area is to investigate how humans perceive aesthetics, and how from psychological point of view, their aesthetic perceptions eventually influence upon their usability perceptions [85]. This indicates that usability tests today are not designed to attempt to assess the aesthetic appeal of an interface, or how that might impact the perceived usability and user satisfaction of an interface. Realizing that HCI researchers have repeatedly raised a common concern on lack of aesthetic consideration in user testing and evaluation of systems, this research is based on to examine LAPs and how their usability perceptions are influenced in visual environments.

2.1.2 Aesthetic-Motivational Designing of FLVEs

Aesthetics is a branch of philosophy associated with art and beauty [26]. The word aesthetic comes from the Greek, aisthanomai, meaning "*to perceive, to sense*" [27]. It is also related to the expression of beauty and is concerned with how individuals perceive objects or make judgments based upon information received as five human sensory inputs [28]. The sense or perception of aesthetics is not something that forms passively; rather it is an active process where impressions are embossed on viewer's mind due to constant responding of brain to the environment and objects for making meaning, deriving an idea or some kind of satisfaction [86].

Research increasingly suggests that for effective Learner-Interface Interaction, instructional designers consider *aesthetic qualities* of FLVEs and *learners' aesthetic perceptions of FLVEs.* This section reviews literature and studies conducted on aesthetic-motivational designing of FLVE, based on (1) Environment Perspective, and (2) User's Perspective.

2.1.2.1 Environment Perspective: Aesthetic Qualities of FLVEs

The environment perspective on aesthetic designing of FLVEs is related to *aesthetic qualities* of the learning environment. Online instructors have repeatedly expressed their highest concerns on aesthetic qualities of the layout, interface and content material in online teaching [54]. This is because aesthetic qualities of the learning environment have a persuasive role in intensifying LLM [24]. Moreover, it is said to have a very strong impact on the learning experience and amount of knowledge to be retained by learners [29]. This is because all interactions in WBL occur through the visual and audio presentation [30]. Numerous studies on aesthetic qualities of learning environments, with both visual and video-based imagery, have demonstrated that learners' engagement, grasp of conceptual information and LLM is improved when they are exposed to visual content [13], [14], [31]–[33] in online learning environments. Childers *et al.* [87] said that an attractively designed web page can make a learner to attend WBL, which is also supported by Heijden [88] that visual aesthetics can grab learners' attention to continue exploring WBLE. Thiessen [89]

reported that visual attractiveness of WBLE "*added value*" to the overall learners' learning experience, which shared a strong correlation with LLM.

In another study, Hancock [90] devised and tested a specific set of aesthetics standards for online courses and studied the effect of aesthetic qualities on LLM. He first developed aesthetically neutral course content, which he distributed through a web-based course management system to a control group. Later, he developed aesthetically pleasing course content with aesthetic qualities on several subject areas and distributed among his experimental group. The aesthetic qualities incorporated in designing of learning material included use of image, choice of colors, size, font and placement of bars etc. Although, there was not much of difference in data collected through opinion surveys from control and experimental groups, LM was still considerably higher (in the form of anticipated GPA) for all questions in the aesthetic group. This supports the idea that both aesthetic quality and content quality are critical for designing of online visual environments because good design means that beauty and usability are in balance [81, p.42].

2.1.2.2 Users' Perspective: Learners' Aesthetic Perceptions in FLVEs

The users' perspective on aesthetic designing of FLVEs is related to LAPs in terms of how visual elements of the learning environment are perceived to be aesthetic by them. Jasni *et al.* [2] found out that aesthetically pleasing layouts of a WBLE motivated students more in learning Mandarin language. The study was based on LAPs and stressed upon aesthetic designing of WBLE by stating that learners' aesthetic perceptions should not be ignored or overlooked in designing effective learning interfaces for educational purposes.

Another study reported that learners' perceived attractiveness of WBLE was an important determinant of accepting the system [91]. This study used Technology Acceptance Model (TAM) to investigate how learners' perceived attractiveness influenced upon system's usefulness and ease of use and reported a strong correlation among the three variables. McCarthy & Samors [92] investigated how LAPs of an online course influenced upon their satisfaction on achieving learning objectives.

McCarthy & Samors [92] argue that determining LAPs will provide direction to instructional designers on *what to target for* in designing of online learning environments. In another study [89] it has been reported that learners' perception of WBL interface hovered between two adjectives, *"modern"* and *"novel"*, providing a precise direction to designers to what to inculcate within the interface design of the WBLE. Tseng *et al.* [93] also reported findings of their study on LLM in WBLE that it was closely associated with learners' perception of how *inventive*, *impressive*, *appealing*, and *aesthetic* the design was. Stenalt & Godsk [94] reported their findings that FLVEs need to support the Web 2.0 technologies and allow for greater aesthetic control so as to engage learners' cognitively. A study [36] conducted on learners' usability perception reported that LAPs positively influenced upon their usability perception of the learning environment. In another study, LAPs were reported as an important determinant in designing effective communication between the learning environment and the learner [95]. Recent research in this domain too, has been extensively supporting the connection between LAPs and usability of the FLVEs [96].

The literature reviewed in this section discusses aesthetic designing of FLVEs which is examined by researchers from two perspectives, *environment perspective* and *users' perspective*. Literature reveals significance of aesthetic-motivational designing of FLVEs to sustain LLM and also establishes a strong association of both perspectives in terms of optimising LLM in FLVEs.

2.2 Informal Visual Environments (IVEs)

Organization for Economic Corporation & Development [97] defines informal learning as part of carrying out daily-work, family and leisure related activities. Therefore, contemporary understanding of informal learning is that it happens outside formal education system and does not lead to a certified qualification [98]. Informal learning occurs via Informal Visual Environments (IVEs), e.g., video-games, television, motion-pictures, and internet [60], [99] as a result of activities and interests of individuals and groups.

Today learners' of a FLVE live in visually mediated society, dominated by IVEs and Informal Media Technologies (IMTs) in nearly every aspect of their lives. Visuals, images and pictures fill their media from magazines to posters to television to video-games to the internet. IVEs employ tactics based upon applied media aesthetics to engage their viewers cognitively. The potential of informal visual world can be realized from the statistical fact that in the first year of YouTube's launch, it had 6.1 million videos, with 1.73 billion views using 45 terabytes of storage. That's about 5000 home-computers worth [100]. Total worldwide time spent watching YouTube was 9 thousand, 3 hundred and 5 years. Today YouTube is the dominant provider of online video in the United States, with a market share of around 43 percent and more than 14 billion videos viewed in May 2010 [100]. Gurri *et al.* [37] states that nowadays visual media is everywhere as images and stills have spread across the globe on the wings of new technologies. They have bombard us wherever we go, in restaurants, airports, museums, shopping malls, sports arenas, and even in gas stations, no less than at home and in the workplace. Even if we wished, we cannot avoid exposure. With such an abundant presence of IVEs and IMTs today, it can be said that learners' interaction with IVEs is likely to occur more recurrently than with a FLVE. The question is if this interaction has any influence on learners?

Numerous studies with both visual and video-based imagery have demonstrated that learners' engagement and grasp of conceptual information is improved when they are exposed to visual content in IVEs of video-games and motion-pictures [13], [14], [31]–[33]. Plethora of research on investigating influence of IVEs on LLM is there, e.g., researchers [38], [39] reported that video-games provide instructive benefits and there is substantial evidence that they may not motivate the players intrinsically, but learners may be motivated to use them for learning purposes [38]. Computer and video-games offer a virtual play environment and follow set of instructions to make players abide by the game rules, engage them by way of goal-setting, challenges, interaction, story-telling and feed-back mechanism [40]. Pedagogical institutions have been resisting to the temptation and ever growing influence of Social Networking Websites (SNWs) on learners and have considered them to be repulsive in nature. Until recently, the same institutions had to accept the significance of collaborative development and sharing which is the main characteristic of SNWs (e.g., facebook,

myspace, twitter) and has captivated today's generation [101]. Likewise, moviemakers spend millions of dollars to use formal and narrative devices for acquiring and depicting creativity in their movies by way of accurate timing of cuts, framing content in a shot, the placement of objects in scene, directions to actors, music sound and dialogs for narrating a story to viewers [102]. A motion-picture projects a series of still pictures on the celluloid screen so as to create a world of visual illusion and to engage viewer's neural and cognitive processes [103]. The purpose is to affect viewers emotionally and leave memorable mark on their minds. It has further been reported [104] that different genre of movies (e.g., historical or period dramas, or science fictions) can instigate productive discussion, enable intelligent questioning on part of learners, enhance their visual processing, imaginations and motivate them intrinsically to learn. Likewise, television has become the most popular type of communication and entertainment, and because of its popularity, it clearly has a far-reaching effect on human life, in particular, on people's behaviour and learning adaptability [41]. In addition to this, literature also reports some repulsive influences of IVEs, e.g., prevalence of violent video-games [42], pornographic and highly exaggerating motion-pictures [105], hard-lined advertisements [42] and reality based television programs [43] have lead to desensitization, emotional imbalance and aggressive behaviour in their viewers [41].

At the same time, there are some researchers who have studied and reported the influence of IVEs from a different perspective, notably Greenfield [44] who argues that IVEs of television, video-games, motion-pictures and the internet are producing learners with a new profile of cognitive skills. The word "cognition" is defined as "the act of knowing" or "knowledge" [106] and cognitive skills refer to those skills that make it possible for learners *to know* or *be aware of*. The four cognitive skills that are important for successful learning include, (1) Concentration, (2) Perception, (3) Memory, (4) Logical Thinking [107]. Learners' cognitive skills that are said to be enhanced in IVEs, according to Greenfield [44] include sophisticated development of their visual-spatial skills, such as iconic representation and spatial visualization. Spatial awareness refers to a person's ability to judge the location of themselves in relation to the objects around them [47]. There are other studies too that have reported similar enhancement of users' perception, awareness and cognitive skills in IVEs,

e.g., Stavrinoudis *et al.* [45] found that users with higher experience levels in the online visual environments judged content, navigation, and aesthetics more critically than less experienced users. This study also reported that greater exposure to the environment converted novice users to a higher level. Similarly, under Stanford University's three years project, researchers investigated web credibility perception of approximately 4,500 users, and one of their findings was that users who shopped frequently online had developed a more accurate perception on reliability of websites and could decide in less than 30 seconds if the website was secure or not [46]. Perkins *et al.* [47] reported that users who played more frequently video-games had higher spatial awareness than those users who played less frequently. Fogg *et al.* [12, p.5] found that over 45% of consumers made judgments about the credibility of websites based on the site design, including layout, typography, font size, and color scheme. These subjective judgments are based on users' aesthetic perceptions and there are also studies that report users make these subjective judgments on visual stimulus in a very short amount of time [10] another study [7] reported that subjects judged the credibility of the content of a website based on its appearance in 3.42 seconds.

Other than mentioned above, there is an additional influence of the cognitive skills developed by users in IVEs, especially with respect to their aesthetic perceptions. There are several studies conducted on different IVEs that have demonstrated that users' established aesthetic perceptions are so strong at times that they tend to affect system's perceived usability [11], [34]. A study [11] investigated users' satisfaction level with an application based on how aesthetically appealing and pleasing it looked to them. It was reported that users' aesthetic perception of the system positively enhanced systems perceived usability, even when the system was not really usable. Likewise iPhone™ [108], [109] is a popular consumer electronic device, mostly liked for beauty of the design, intuitive visual interface, and sharp graphics. It is interesting to note that final recommendations for this smart phone were "Excellent" in spite of the fact that the phone component did not perform to expectations in tests. The iPhone™ has become an international product success and if this product was any less attractive it would not have met with the same level of success.

Based on studies reviewed in this section, [44]–[47], it can be said that IVEs of today are producing learners' with a new schema on aesthetics of digital environments. Learners' new schemas on aesthetics of digital environments are formed due to their interaction with different IVEs which are rich in media aesthetics as researchers claim that television, motion-pictures, internet and visual computer or screen displays may no longer be considered as means of simple message distribution, but essential elements for communicating media aesthetics [48]. This resultantly has made learners' critical in judging aesthetics FLVEs by establishing perceptual filters [49] that provide a contextual frame of reference and form prejudice aesthetic perceptions [48].

Media aesthetics of IVEs are based upon visual and sound cues for identifying and understanding objects and conditions in the visual world [110]. Such cues are presented in the form of images, sounds, music in motion-pictures, television, video-games, internet and various media display screens, in order to direct viewers' attention and increase the influence of those elements shaping their impression and understanding of visual environments. This influences upon viewers schematic thinking [111]. For instance, in the film snow-white and the seven dwarfs, snow-white is given a poisonous apple by an old woman, but the viewers know that the woman is evil. It is because the old woman activates viewers' schema that alerts them of her devious intentions. Such as her dark cloth, drawn face, high voice, hunched poster, and dry complexion, all elements drop on an established character schema in alignment with the fairytale. Viewers' schematic thinking is directed by their aesthetic perceptions by selecting information that agrees with *what they want to see* and screen out other data that might interfere with their mind-constructs. This is because with the onslaught of changing stimuli and to make our environment more manageable, our schemas establish perceptual filters and make us perceive stable patterns rather than unrelated event details [49]. Moreover, such habitual (media aesthetic) cue reductions can make learners' perceptually selective and lead to prejudiced aesthetic perceptions. Boring [57], [112] in article titled 'Cognitive Science: At the Crossroads of Computers and the Mind' say that human brain constantly distorts what a person sees, by using imaginations and taking bout shortcuts it (brain) perceives what is there from past-experiences (schemas) rather than having to build-up images each time from the

scratch. This suggests that learners' new schema on aesthetics of digital environments that are formed due to the media aesthetics of IVEs become learners' aesthetic perceptions with which they judge the aesthetics of FLVEs.

From literature it is thus established that IVEs influence upon viewers' schemas and learners of FLVEs are also viewers of IVEs which are producing learners with a new profile of cognitive skills [44]. Therefore, this research has been undertaken to examine influence of learners' new schemas on aesthetic of digital environments in IVEs on their LM in FLVEs. Findings of this research will be pivotal to assess aesthetic-motivational designing of FLVEs of today. Moreover, it is also suggested that FLVEs must adapt to changes caused by IVEs that have resulted in formation of learners' new schema on aesthetics of digital environments by taking advantage of learners' new strengths in visual-spatial intelligence and aesthetic perceptions and by compensating for their weaknesses in information visualisation that requires high order cognitive processes. To further build an understanding of learners' new schemas, schema theory in HCI, which is an information processing strategy for perception and cognition, is discussed in the next section.

2.2.1 Schema Theory in HCI

Edward Branigan [303] defines schema or schemata as an arrangement of knowledge already possessed by the perceiver that is used to predict and classify new sensory data. It is described as a cognitive process in which brain organizes information and compares it with past experiences in order to make meaning. Schema is one of the most important tools based on pre-existing assumptions about the way the world is organized [113]. Media Psychologist [114] defines schema as a cognitive model that we unconsciously use to organize and interpret information. Schemas give us shortcuts to interpret information–essential to our ability to navigate in the world. Using shortcuts also mean that certain information is missed in favor of both efficiency and also information that is consistent with our current beliefs and expectations. Schemas can reinforce our mental shortcuts and stereotypes. Stereotypes are a cognitive model that facilitates information processing and decision-making and not, by definition, negative or positive. It is the content and the resultant decisions and

behaviors that can be viewed as good or bad depending upon one's perspective, cultural norms, and functional (or not) behaviors and thoughts. This can also make it harder to learn new information or understand experiences that does do not fit within existing schemas.

Within HCI, schema theories of memory are considered to be tremendously useful in designing and testing of interfaces. The schema theory [115] emphasizes that users' memory is made up of schemata models that they have developed due to their past experiences. As a guiding principle in designing of interfaces, it is believed that users will be better in using a system if it is based on familiar design schemata that they already possess. If interfaces are designed according to users' schemata, they are likely to experience less distraction in using new systems as they will be cognitively less burdened due to interacting with a more familiar system's interface [115]. The schema theory is also helpful in testing new designs and interfaces. The theory implies that subjects who are very familiar with computers and use them frequently will learn more quickly than subjects who rarely use those [116]. This explains that new profile of cognitive skills that studies like [44]–[47] have reported, are supported by schema theory and this further strengthen the argument that learners' new schema (on aesthetics of digital environments) are established due to their interaction with IVEs.

Artificial Intelligence researchers [117]–[118] have also implemented schema theory to investigate how information processes can shape users' perception and action alike and also determine their expectations based on users actual and perceived interactions with objects [120]. Similarly, Ursyn [121] in article titled "Aesthetic Expectations for Information Visualization" also stressed upon raising the level of aesthetic designing by combining computer based information visualization techniques with principles of aesthetic designing and emphasized upon knowledge visualization by fulfilling aesthetic expectations of users. Users' aesthetic expectations are formed through a cognitive process in which brain organizes, filters information and compares information with their past experiences (schema) in order to derive a meaning. This means that filtration carried out by brain uses learners' new schema on aesthetics of digital environments (set of aesthetic expectations), i.e., *what*

it aesthetically expects. The difference between what human brain *expects* and what it *actually sees* is referred as "Visual Gap" in neuroscience [51]. This means difference between what learners' *aesthetically expect* and *what they see* can create a visual gap. This gap instigates "cognitive fatigue" as according to the control theory of self-regulations humans persistently try to reduce gaps between their actual and desired behaviour and existence of higher gaps means higher cognitive fatigue, which can influence upon self-regulated behaviour [51]. This means lesser gaps in actual and desired behaviour is an indication of experiencing less cognitive fatigue and stronger self-regulated behaviour and vice versa. This may also be true for learners' self-regulated learning behaviour in FLVEs.

Therefore, FLVEs must adapt to these changes that have resulted in formation of learners' new schemas by taking advantage of learners' new strengths in visual-spatial intelligence and aesthetic perceptions and compensating for their weaknesses in information visualisation that requires higher order cognitive processes (such as abstract vocabulary, mindfulness, reflection, inductive problem solving, critical thinking, and imagination) that can instigate cognitive fatigue.

Learners' new schemas on aesthetics of digital environments are investigated in this research because if designers continually apply their own schemas in designing of interfaces, they will only be affecting learners who share similar schemas to them [122]. This is particularly important to ensure effective Learner-Interface Interaction to sustain LLM in FLVE, because interaction does not just happen; it must be facilitated by intentional efforts on the part of the designers too [74], [123], [124].

Based on what has been discussed in Section 2.1 and Section 2.2, research gap is identified and discussed in the next section.

2.3 Research Gap

Following research gaps are identified from literatures and addressed in this research.

1. The literature reviewed in Section 2.1 discusses aesthetic-motivational designing of FLVEs to improve Learner-Interface Interaction experience and to enhance LLM.

Aesthetic-motivational designing of FLVEs is examined by researchers from two perspectives, *environment perspective* and *users' perspective*. The literature establishes a strong association of both perspectives with LLM. However, it primarily examines the influence of LAPs in FLVEs and how LLM is influenced. No comparison study, either empirical or theoretical, was found in literature that examined influence of LAPs in IVEs and if it had any influence on LLM in FLVEs. Furthermore, influence of Formal Learning Motivational Factors (FLMFs) and Informal Motivational Factors (IMFs) to assess learners' motivation and aesthetic needs in F&IVEs also has not been adequately researched and lacks empirical justification, which is important for this research as the proposed aesthetic perception and motivation model is meant for both F&IVEs.

2. This research examines learners' new schemas on aesthetics of digital environments that are formed due to their interaction with IVEs and also investigates existence of visual gaps between LAPs in IVEs and LLM in FLVEs. As this research involved two different visual environments (formal and informal in nature) and assessment of two different variables (LAPs and LLM) in F&IVEs, it required a measuring scale that could embed LAPs in IVEs with that of LLM in FLVEs. The scale was also to be used as an *outcome or dependent variable* in this research. From literature review in Section 2.6.3 it was established that both aesthetic perceptions and motivation are emotional states, and can be integrated through aesthetic-emotions. However, no study was found where users' aesthetic perceptions in context of their aesthetic-emotions associated with motivational variables were investigated. This highlighted a potential research gap.

3. It has been discussed that aesthetic-motivational designing of FLVEs is an area of concern among instructional and interface designers and based on studies reviewed in Section 2.2, [44]–[47], it can be said that IVEs of today are producing learners' with a new schema on aesthetics of digital environments due to the media aesthetics of IVEs, because television, motion-pictures, internet and visual computer or screen displays may no longer be considered as means of simple message distribution, but essential elements for communicating media aesthetics [48]. This has resultantly made learners' critical in judging aesthetics of FLVEs by establishing *"perceptual filters"* [49] that

provide a contextual frame of reference and form prejudice aesthetic perceptions [48]. In this research, it is therefore argued that FLVEs of today are unable to sustain LLM due to learners' perceptual filters that are created due to the formation of learners' new schema on aesthetics of digital environments in IVEs. Perceptual limitations of human brain are studied under the discipline of cognitive ergonomics, which is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system [52]. There is literature evidence to support this argument as according to National Center for Education [53] 92% of educational institutions in US alone are using asynchronous web technologies for their distance education courses offered via formal online learning medium. The asynchronous technologies are defined as "not in real-time" and exclude audio and video technologies. So it can be said that vast preponderance of web-based FLVEs of today are somewhat static web-based information systems. Moreover, 85% of instructional designers of online learning environments agreed to poor designing of online learning environments and associated the failure *"to having required more time"* than designing traditional classroom preparation [54]. WBLEs of today are *"only digital reincarnations of poor face-to-face learning environments and practices"* [19]. Moreover, as discussed in Section 2.6.1, the worldwide dropout rate for WBL in 2007-08 was recorded as high as 64% [18] and researchers [20], [21], [55] have mostly credited lack of LM to be one of the critical factors for high number of drop-outs in WBLE and some have even said that reality the reasons of experiencing lack of LM in WBL are likely to be deeper and far more complex than originally thought [56]. One such relatively unidentified, deeper and complex reason may possibly be associated with learners' perceptual limitation developed due to their interaction with IVEs. It is known that human brain stores information on human experiences which is used to filter unnecessary information, fill in the visual gaps and to make constant comparisons to what is there and what our brain wants to see [13]. This filtration of the brain makes learners' perceptually selective in judging aesthetics [48]. When the filtration creates a big difference between what learners' aesthetically expect and what they see, they get cognitively fatigued [57]. This happens because of the involvement of high order cognitive processes that create visual gaps due to difference between LAP and LLM in F&IVEs. Likewise, the control theory of self-regulations [51] states that humans

persistently try to reduce gaps between their actual and desired behavior. This means less gaps in actual and desired behavior is an indication of less cognitive fatigue and high intrinsic motivation, which is crucial for self-regulated learning in FLVEs. Since there is no empirical and theoretical evidence to support these arguments this research aims to conduct empirical investigations (based quantitative research methods) to examine the influence of learners' new schemas on aesthetics of IVEs on their LM in FLVEs. This research also aims to develop a theoretical justification (based on qualitative research method) of the empirical findings.

To aid investigation, an aesthetic perception and motivation model for F&IVEs is proposed. Subsequent sections of this Chapter will present literature for identifying measuring constructs and sub-measuring constructs of the three research variables, (1) Learners' Schematic Thinking (LST), (2) Learners' Aesthetic Perceptions (LAPs), (3) Learners' Learning Motivation (LLM).

2.4 Implementation of Learners' Schematic Thinking (LST)

Numerous studies have been conducted where respondents' schematic thinking is used to depict their mental models, which is an explanation of someone's thought process about how something works in the real world. It is a representation of the surrounding world, the relationships between its various parts and a person's intuitive perception about their own acts and their consequences. Mental models help shape our behavior and define our approach to solving problems and carrying out tasks [125], e.g.

- Consumer behavior researchers have frequently employed schema theory as the theoretical underpinning of their investigations for classification of consumers as with a likelihood of High purchase power, Medium purchase power and Low purchase power [126].

- Clinical & Medical researchers frequently use patient's schematic thinking by classifying them on the basis of negative or positive schemas [127], depression classification schemas as high, medium or low [128], Healthy versus non-healthy eating habits schema [129] to predict their future behavioral intentions or actions.

- Motivation researchers [130] have used LST to study a good student self-schema versus a bad student self-schema.

- Instructional and interface designers [131] have also studied LST by examining how they express their competencies, learning goals and learning styles and used the information for offering personalized e-learning services.

According to Media Psychologist [132] schematic thinking functions to provide contextual interpretation of our media interaction behavior and gestalt understanding, where many things come together to make a whole. This means just like many forms in Gestalt come together and create a new perception of shape, many things come together to make a new meaning or a contextual interpretation of the situation. Moreover, the proposed aesthetic perception and motivation model should consider LST specifically not meant for a generic learner. Since, every learner is likely to have a unique "Gestalt" of experience, personality, biology, and social/environmental contexts that will influence on how he/she will experience, understand or perceive media aesthetics of IVEs. Therefore, by implementing LST through formation of learners' mental models, hypothesizing learners' sets of aesthetic expectations or influence of LAPs in IVEs on LLM in FLVEs can be facilitated. In Section 2.3.2, thus, literature with respect to formation of learners' mental models is presented which is based upon Contextual Interpretation (CI) and Gestalt Understanding (GU).

2.4.1 Formation of Learners' Mental Models

This section determines measuring constructs for CI and GU that are required for the formation of learners' mental models.

2.4.1.1 Contextual Interpretation

Contextual Interpretation (C I) is based on learners' understanding of their visual media interaction behavior or attitude towards its usage [133, pp.107]. Humans are constantly engaged in judging one aspect of the event with another aspect or another event and contextualistic aesthetics provides a convenient frame of reference for

applying media aesthetics [134]. The various fields of applied media aesthetics such as light, space, time, motion and sound are also contextual in nature, and they interact to generate a communication effect. For example, in a movie a man is shown walking along the edge of the bluff above the ocean beach, and the story depicts that he is going to meet his wife after a long time, so the bright colors of the sunny day, sound of laughter and gentle surf, his body language all work as aesthetic contextual elements that determine what is expected in the next scene. The context basically establishes a code for viewers and dictates their perceptual process to react, feel and interpret aesthetics in a dictated manner. Research has shown that human perceptual processes exhibit sufficient consistency in making accurate predictions as to how people will respond to a specific aesthetic stimuli and contextual patterns [49], [134]. For instance, there are two awkward hand-written sign-boards; one is on cheap eggs for sale, while the other one is related to cheap driving lessons. Our schemas may direct us to respond positively to the eggs for sale sign- board, but it may probably not respond that positively for the one on driving lessons. This is because in context of driving lessons, unprofessionally hand-written sign-board reminds us of amateurishness, lack of safety and failure.

The CI of any event or scene is determined by contextual factors that reinforce viewers' schemas, formulate characteristics of the surrounding environment and ensure effective collaboration between the two. In case of news processing, for example, the contextual factors that reinforce viewers' schemas are their lifestyle, political socialization, prior knowledge and life experiences, current needs for various types of information, and attitudinal factors such as interest in news and perceived credibility of sources [135]. Likewise, contextual factors influencing upon users' perception with respect to systems' ease of use and usefulness are included in the widely accepted TAM [136].

TAM is drawn as an extension of theory of reasoned action and explains how users accept and use technology on the basis of perceived usefulness and perceived ease-of-use of the system. According to Davis [137], perceived usefulness is *"the degree to which a person believes that using a particular system would enhance his or her job performance"*. Later, Venkatesh and Davis [138] presented TAM II, as an

extension of original model, and explained perceived usefulness and usage intentions in context of influencing cognitive processes. Their testing results strongly supported the extended model. Davis [139] also introduced a number of external variables in TAM influencing upon perceived usefulness and perceived ease of use of the system and many other researchers have also contributed to the list of external variables [136]. TAM has more than seven hundred citations to its credit and has been adapted and extended in many ways to date.

To establish learners' mental models, CI factors that may reinforce LST to reflect upon their IVEs interaction behaviour or attitude are adapted from the TAM, because TAM looks at technology acceptance parameters, while the proposed model looks at parameters, with which learners' view and judge aesthetics of F&IVEs, hence enabling formation of their mental models. The external variables adapted from TAM model are shown in Table 2.1 and explanation of each is presented as under:

- External variable *"image"* in TAM examines the degree to which use of an innovation is perceived to enhance one's image or status in one's social system [140]. This variable is adapted as *"self-concept"* in the proposed model as it will determine the degree to which interacting with IVEs and Informal Media Technologies (IMTs) is perceived to enhance learners' self-concept, hence acting as a parameter to judge aesthetics of FLVEs.

- External variable *"self-efficacy"* in TAM examines the belief the one has the capability to perform a particular behavior [141]. This variable is adapted as *"self-efficacy"* in the proposed model, as it will determine the degree to which learners' consider they have the required expertise to interact with IVEs and IMTs, hence acting as a parameter to judge aesthetics of FLVEs.

- External variable *"computer playfulness"* in TAM examines the degree of cognitive spontaneity in microcomputer interactions [142]. This variable is adapted as *"visual media engagement"* in the proposed model, as it will determine the degree to which learners' experience cognitive engagement when interacting with IVEs and IMTs, hence acting as a parameter to judge aesthetics of FLVEs.

- External variable *"visibility"* in TAM examines the degree to which the innovation is visible in the organization [140]. This variable is adapted as *"self-enhancement"* in the proposed model, as it will determine the degree to which positive influences of IVEs and IMTs is visible in learners' personality and act as a parameter to judge aesthetics of FLVEs.

- External variable *"computer attitude"* in TAM examines the degree to which a person likes or dislikes the object [143]. This variable is adapted as *"visual media interaction attitude"* in the proposed model, as it will determine the degree to which a learner likes or dislikes interacting with IVEs and IMTs, and act as parameter to judge aesthetics of FLVEs.

- External variable *"personal innovativeness"* in TAM examines the degree to which an individual is willing to try out any new technology [144]. This variable is adapted as *"visual media innovativeness"* in the proposed model, as it will determine learners adventurous side with respect to trying out new IMTs, and act as parameter to judge aesthetics of FLVEs.

- External variable *"perceived enjoyment"* in TAM examines the extent to which the activity of using system is perceived to be enjoyable [144]. This variable is adapted as *"visual media attribution"* in the proposed model, as it will determine the extent to which learners IMTs and IVEs interaction behavior is perceived to be gratifying and enjoyable.

- External variable *"media persuasion"* is a non-TAM variable, defined as the extent to which media changes attitudes and behaviours of users through persuasion and social influences [145]. This variable is used in researches involving consumer behaviour and has been adapted as *"visual media persuasion"* in the proposed model, as it will determine impact of learners' cognitive comparison relative to their self-concept, and act as a parameter to judge aesthetics of FLVEs (Table 2.2).

- Likewise, variable *"salience"* is a non-TAM variable, and is based upon visual perception principles that are used in the study of perception and

cognition [146]. This variable has been adapted as *"visual media salience"* in the proposed model to account for learners' new profile of cognitive skills inculcated by IVEs, including visual-spatial intelligence and aesthetic perceptions [44]. It determines learners' ability to detect aesthetic elements in IVEs and will act as a parameter to form learners' mental models and judge aesthetics of FLVEs (Table 2.2).

Other than CI factors presented in Table 2.1 and Table 2.2, CI is also influenced by Environmental Contexts (EC), which refers to social surroundings in which a learner grows up, his/her economic position, where he/she has been educated and adopted cultural or societal norms from, and the people and institutions with whom he/she interacts with [147]. EC measuring constructs influencing upon CI are adapted from literature and presented in Table 2.3.

Table 2.1: Sub-measuring Constructs for Contextual Interpretation (TAM)

External Variables TAM	Definition	Referred Articles	Adapted as
Image	The degree to which use of an innovation is perceived to enhance one's image or status in one's social system.	[140]	Self-Concept: The degree to which interacting with IVEs is perceived to enhance one's image or status in one's social system.
Self-Efficacy	The belief that one has the capability to perform a particular behavior.	[141]	Self-Efficacy: The belief that one has the expertise required for interacting IVEs.
Computer Playfulness	The degree of cognitively spontaneity in microcomputer interactions.	[142]	Visual Media Engagement: The degree of cognitive engagement experienced when interacting with IVEs.
Visibility	The degree to which the innovation is visible in the organization.	[140]	Self-Enhancement: The degree to which positive influence of IVEs is visible in one's personality.
Computer Attitude	The degree to which a person likes or dislikes the object.	[143]	Visual Media Interaction Attitude: The degree to which a person likes or dislikes interacting with IVEs.
Personal Innovativeness	An individual trait reflecting willingness to try out any new technology.	[142]	Visual Media Innovativeness: A personality trait reflecting on one's adventurous side with respect to sharing comfort with IVEs and IMTs.
Perceived Enjoyment	The extent to which the activity of using a specific system is perceived to be enjoyable aside from any performance consequences resulting from system usage.	[144]	Visual Media Attribution: The extent to which interacting with IVEs are perceived to be enjoyable and gratifying.

Table 2.2: Sub-measuring Constructs for Contextual Interpretation (Literature)

External Variables Non-TAM	Definition	Referred Articles	Adapted as
Media Persuasion	The extent to which media changes attitudes or behaviors of the users through persuasion and social influence, but not through coercion.	[145]	Visual Media Persuasion: Impact of cognitive comparison relative to self-image.
Salience	It is based upon visual perception principles and is a concept used in the study of perception and cognition to refer to any aspect of a stimulus that for any of many reasons stands out of the rest.	[146]	Visual Media Salience: Once ability to detect aesthetic elements in visual environments.

Table 2.3: Environmental Context Measuring Constructs (Literature)

Environmental Context	Referred Article	Adapted Description
Social Surroundings	[148]	Positive behavior of family and social surroundings in support of using and interacting with visual media technologies.
Cultural Norms	[149]	Facilitation provided by culture in technological adoptions.
Situational Variables	[150]	Situational variables are factors that influence upon users' visual media interacting behavior, e.g., timing, reasons for interacting and individual physiological and mood states can also affect any particular situation.
Socio-Economic Environment	[151]	Family-income, education level, status consciousness, ownership

2.4.1.2 Gestalt Understanding

Human brain is programmed to notice shapes and recognize patterns for making sense of the things. For example, in 2001, new high resolution images and 3D altimetry from NASA's Mars Global Surveyor spacecraft revealed a 'Face on Mars' [152] and in 2007, son of a Texas bar owner saw the face of the 'Virgin Mary in a Lemon Slice' [153]. See Figure 2.1and Figure 2.2, respectively.

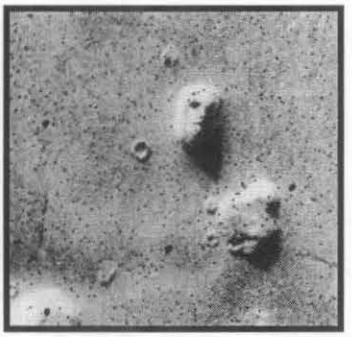


Figure 2.1: Face on Mars.

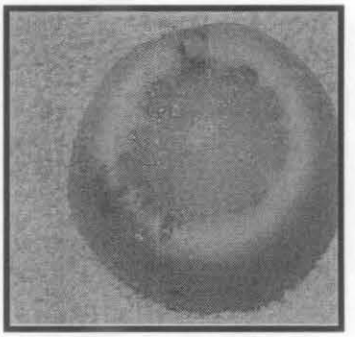


Figure 2.2: Virgin Mary in a Lemon Slice.

Gestalt Understanding (GU) is a tool for humans to group elements, figure out simplistic ways for interpreting their experiences and try to abridge what they perceive and experience in the real world. The basis of Gestalt is Pregnanz, a German word, which is a translation of the word Consciousness. Pregnanz means that humans tend to order their experiences in a manner that is regular, orderly, symmetric and simple. Mechsner [154] in his notable acclaimed research work, that also earned 2nd prize in the Wolfgang Metzger Award 2002 for significant contribution to Gestalt theory stated that Gestalt factors are of great importance when it comes to understanding tendencies and performance in human behavior and activity, be it in productive thinking, in arts, in shaping personality or in social phenomena. This indicates that GU is one such survival tool that allows us to see patterns and organize chaos of the world around us, since it is the rule our brain follows for reducing the overwhelming complexity of the perceptual visual world.

Gestalt psychology was co-founded and originated by German psychologists namely, Wolfgang Kohler, Max Wertheimer and Kurt Koffka in early 20th century [133]. The crux of their research was how humans as species respond to their environment and read it in a very unique but simplistic context. It was emphasized

that instead of breaking down thoughts and behavior into smallest element, the impact of the whole of experience is important, and the *whole is different than the sum of its parts*. For Gestaltists, there is a structural connection of human senses that follows a unified frame of response when confronted with stimuli. These structural connections are studied under Gestalt visual perception principles, which are pattern making principles for enhancing cognitive processing and explain how people organize visual elements into groups or unified wholes when certain principles are applied. These principles of organization provide perceptual shorthand for quickly processing and interpreting basic shapes, allowing a pattern to emerge as a whole. According to [155] Gestalt principles form a basic building block in understanding how context influences our perception.

Traditionally HCI is a highly interdisciplinary field bridging the research between psychological research and computer science. Within HCI studies, Gestalt visual perception principles are widely accepted in designing of user interfaces. Chang et al [156] emphasize that Gestalt principles of similarity and proximity apply to both the haptic and visual grouping elements in user-interface designing. Likewise, Fraher [157] extensively examined by performing a series of informal user observations to study how a Gestalt approach can be used to enhance engagement and promote user interaction. Flieder [158] placed a great emphasis on a Gestalt principle, Prägnanz and referred to it as being fundamental in achieving overall coherence in user-interface designing.

Gestalt Visual Perception Principles: Most of the Gestalt principles give the impression that they are very much similar and closely related. This is because all principles direct towards achieving overall coherence and unity in an aesthetic design, so it can be said that they are in a strong relationship. Similarly, human perception is also mediated by such relationships; e.g. how things appear to be similar or dissimilar, how they contrast or blend with one another, and how arrangements of things suggest hierarchies and are affected by Contextual Interpretation. Table 2.4 presents literature on sub-measuring constructs for Gestalt Understanding.

Table 2.4: Sub-measuring Constructs for Gestalt Understanding (Literature)

Organization Law	Description	Referred Articles
Proximity	The closer objects are to each other, the more likely they are to be perceived as a group	[159]
Symmetry	Objects must be balanced or symmetrical to be seen as complete or whole	[160]
Similarity	Objects that are similar, with like components or attributes are more likely to be organised together	[161]
Common Fate	Objects with a common movement, that move in the same direction, at the same pace , at the same time are organised as a group	[159]
Good Continuation	Objects will be grouped as a whole if they are co-linear, or follow a direction	[160], [162]
Isomorphism	Is similarity that can be behavioural or perceptual, and can be a response based on the viewers previous experiences? This law is the basis for symbolism.	[160], [161]
Closure	In perception there is the tendency to complete unfinished or partially obscured objects. Kanizsa's triangle (right) is one of the most recognisable examples of this.	[159]
Figure Ground	Viewers will perceive an object (figure) and a surface (ground) even in shapes are grouped together. This law also defines use of contrast.	[159] [161]
Focal Point	The idea that a point of interest, something emphasised or different will catch and hold the viewers attention	[161]
Simplicity	This is the law that states that people will visualise according to the simplest way of grouping items – and the effort to simplify complex items is unconscious	[160]
Prägnanz	Prägnanz means, in simple terms, "good form" and refers to organising shapes to simple forms [96]. Figures are seen as their simple elements instead of complicated shapes.	[160]
Unity	Is the law of arrangement, where elements and structures have a visual connection and look like they belong together, in unity [96]. Unity is one of the general principles of visual design.	[163]

Research suggests that Gestalt visual perception principles can provide instructional designers with an understanding of LAPs and cognition in a FLVE [162], so to form learners' mental models; GU is incorporated in the proposed aesthetic perception and motivation model for F&IVEs. Moreover, Gestalt principles are ubiquitously accepted and applied in designing of F&IVEs because they affect

users in a predetermined manner, and pave way to leverage upon the physiological and cognitive responses that are hard wired into users' brain [164]. It is for this reason, aesthetic design theory also applies laws and principles of Gestalt psychology to perform visual analysis and assess various aspects of a visual design from aesthetic appeal perspective [164]. In FLVEs, aesthetics have a direct influence upon learners' interacting behaviour, motivation and amount of knowledge to be retained [29]. Gestalt principles have implication for aesthetic designing of FLVEs by promoting focus learning, better than conventional "*memory and recall*" approaches that are currently in practices [165]. This is apparently because learners' understanding of the Gestalt will make them look at the whole of the picture and not at the sum of its parts or elements.

2.5 Learners' Aesthetic Perceptions (LAPs)

The second variable of the conceptualized model is called *Learners' Aesthetic Perceptions*, which together with Learners' Schematic Thinking will be used to form learners' mental models. To identify measuring constructs of LAPs, Usability Heuristics in HCI are reviewed.

2.5.1 Usability Heuristics in HCI

Usability concerns in interface designing are dealt under Usability Heuristics. Heuristics within HCI are regarded as mental rules of thumb, based on common senses [166]. One such heuristic is aesthetic and minimalist designing. The term 'Aesthetic' [167] means to create and appreciate beauty in philosophy and it is the study of sensory or sensory-emotional values, sometimes referred as judgments of sentiment and taste, while the term minimalist draws its origin from Japanese traditional design and architecture. It is used to describe a trend in design and architecture where the subject is reduced to its necessary elements.

Aesthetic and minimalist designing heuristic provides guideline for designing of user-interfaces aesthetically, and suggests dialogues should not contain information

which is irrelevant or rarely needed. Since, every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility [168]. To develop measuring constructs of LAPs, principle of design are reviewed in the next section.

2.5.2 Principles of Aesthetic Designing

There are numerous philosophies and fundamentals of aesthetic designing as suggested by authors from time to time. For example, American philosophers, Hospers [169] believed an aesthetic design to be a combination of elements, forms, expression, symbol, truth, criticism and value. Dutton [170] argued it to be a visual integration of virtuosity, pleasure, style, criticism, imitation, special focus and imagination. Likewise, Breadsley [171] believed aesthetics to be a form of unity, complexity and intensity, while Graham [172] approached aesthetics from the perspective of pleasure, beauty, emotion, and understanding.

Modern aesthetic researchers, Evans & Thomas [173] have attempted to bridge the gap between the philosophical and the practical designing by proposing primary (unity, variety, hierarchy, proportion) and secondary (scale, balance, rhythm, repetition, proximity) principles of aesthetic design. Likewise, Williams [174] suggestions are very general and easy to apply to specific instances, as the entire concept of visual design is narrowed down to four basic principles of contrast, repetition, alignment, and proximity. Each of these principles may be applied to any visual element (type, color, size, line thickness, shape, space, etc.) and is usually used in conjunction with the other principles. Guidelines given by Nielson [175] focus on usability and they are basically a series of do's and don'ts to consider when creating web pages that can be functional and easy to use. Although, his criteria for an appropriate web page do not focus on the creation of an aesthetic environment, the aesthetic presentation should not be detrimental to the learning experience. Therefore, all visual elements must be functionally efficient as well as aesthetically effective. E.g., Pages should load quickly, pictures and graphics should not be distracting, and visual elements should not interfere with a learner's access to course content.

The modern aesthetic researchers emphasize upon the principles of designing as it is believed to be the recipe for a good work of art that can combine visual elements to create an aesthetic placement of things. Literature on principles of designing is thus reviewed to identify measuring constructs for LAPs in F&IVEs (Table 2.5).

Table 2.5: Sub-measuring Constructs for Learners' Aesthetic Perceptions

Aesthetic Designing Principles	**Aesthetic Designing Constructs**
Hierarchy	Establishes: a focal point of interest, establishes a pattern of movement and flow, legibility of the content and layout, clarity of the content and layout. Provides: information through convention and repetition and highlights actions or activities that can be performed.
Visual Expression of Hierarchy	Use of large size visual elements, specific colors, projected values and positive white space to express visual hierarchy.
Emphasis	Use of : visual elements to draw emphasis upon focal point of interest, contrasting colors or scale to draw emphasis upon focal point of interest, logo for promotion and image branding, focal point of interest to endorse services.
Contrast	Contrast in: size of visual elements, relative position of visual elements, use of colors, use of textures, use of shapes, visual orientation
Tension	Proportion, Asymmetrical tension, Movement, Emotional drama
Balance	Balance in: size of visual elements, use of colors, creating Density, packing more elements into a given space to give more weight to that space, valuing darker objects to give more weight than lighter objects, creating white space or positive space.
Rhythm	Consistency of design pattern and layout in interior pages and consistency in sustaining the feel and maintaining visual interest.
Flow	Visual flow in interaction design, Verbal flow in layout design
Depth	Illusion of 2 dimensional shapes, sizes, value and color of visual elements. Texture techniques to create depth.
Scale	Size of visual elements, use of colors, visual elements, projecting value, while space in relation to the format of the design. Readability of the typographic scale, Space scaling between the textual lines, Harmony of visual elements in terms of their proportion.
Movement	Creative use of lines, shapes and visual elements to suggest direction or guide visual orientation.
Unity	Coherence or overall aesthetic appeal

- ***Hierarchy*** – This aspect of visual designing makes the interface aesthetic by setting priorities for quick orientation by viewers [176]. It emphasizes upon the

most important thing, object or element in the layout by making it appear as visually most attractive, convincing and also indicates hierarchy of the layout, in terms of what is expected next or last.

- ***Visual Expression of Hierarchy*** – A design cannot be aesthetic, unless it communicates something, and visual expression of hierarchy refers to designing effective communication between the related visual elements. This is an extremely important concept for aesthetic designing of interfaces since it affects how viewers view or perceive aesthetics [177]. This is achieved by adjusting the visual weights of the following visual elements:

- ***Emphasis*** – Emphasis in design provides the focal point for grabbing attention, since it is a way of making visual elements most important and stand out in the design [178]. Emphasis is sometimes called dominance, which is a principle of design that relates to emphasis and visual weight in a composition and leads eyes movements first to that place. An aesthetic website should start with a great brand image and emphasis should be drawn to its logo, since branding is an extremely important aspect that tends to communicate primary message or corporate identity of the company to the viewers, with a strong sense of presence using cultures, lifestyle, and attitude or all those things associated with the brand image. Translation of these factors into a communicative look and feel depends upon creating a visual expression of hierarchy as well as focusing emphasis.

- ***Contrast*** – Aesthetic designing largely depends upon creating or suggesting contrasts, which are used to define hierarchies, manipulate relationships of visual elements, and exploit context to enhance or redefine those relationships, with the purpose to convey meaning. Contrast is the tool of emphasis and helps in setting hierarchy, focusing attention and creating drama [176]. It is an excellent way to show differences between elements on the page [178]. For example opposite colors create an aesthetic contrast for viewers, like big and small, black and white, square and circle - these are all contrasts. Likewise, contrasting change in font's size, weight, family can also be aesthetic for viewers. In a layout, contrast helps lead the reader's eye into and through layout including visual elements such as

graphical, textual, or interactive. With creative use of contrast, learners can be influenced in terms of making choices and prompting specific actions [179].

- ***Tension*** – Tension is created by manipulating relative position of visual elements [178]. Throwing things off a little make design aesthetically pleasing. Proportion is used in comparison of dimensions or distribution of forms and is used to help define symmetry and visual weight that often create a sense of tension that attracts the viewer's eye. Likewise, tension is also created by intentionally avoiding balance in the design and making layouts asymmetrical [179]. Asymmetrical layouts are generally more dynamic and by intentionally ignoring balance the designer can create tension, express movement, or convey a mood such as anger, excitement, joy, or casual amusement for an aesthetic experience.

- ***Balance*** – Balance is one of the most essential aesthetic design principles since it facilitates in crafting of an aesthetically pleasing experience, and provides control in sustaining viewers' visual momentum and flow in the design [94]. Balance in an interface design is created around the gravitational axis and depends upon the weight of various visual elements and their respective distance from the axis.

- ***Rhythm*** – Rhythm helps in making sense of design pattern in minds of viewers by creating pacing across the multi-pages. Rhythm is the regular repeating occurrence of visual elements and has an extremely soothing effect on viewer's eyes [176]. If it follows a set of pattern and shows some degree of variability, it even becomes highly aesthetic, but the consistency of the design pattern may not be disturbed.

- ***Flow*** – Flow is the way viewers move their eyes in an interface design. All viewers will scan through the interface design in their own fashion or according to their own priorities but if the design is aesthetic, then their gazes can be directed by controlling their scanning pattern. Artists, designers or creative directors of any visual medium such as books, movies, paintings, magazines, advertisements, web pages, etc, ensure that it is viewed in the right way and for that they carefully plan

out a path to direct viewer's eye. Accordingly the design is composed and laid out such that it tends to influence viewers' eyes for following that path [179]. An aesthetic design will have excellent story-telling in its content, with good continuation and breaks (verbal flow) and employ effective visuals to make its content more inviting to read (visual flow).

- ***Scale*** – Scale is about the relative size and proportion of different visual elements [86]. The size of visual elements relative to one another is important for creating harmonies balance, aesthetic contrast and emphasis. However the size of same visual elements in relation to the format of the design and the size of the format itself are also worth considering. Likewise, typographic scale needs to be legible and readable at different sizes. Typographic scale also creates hierarchy in information. Scaling the space between lines of type creates a vertical rhythm through flow of text. Similarly, when scale is in harmony, it considered to be in proportion, means the relative size of elements work and different sizes of our elements are in agreement and balance. The overall unity in design can be realized.

- ***Depth*** – Depth provides interface design with a sense of reality as opposed to making it dreary and boring one [50]. It is created by using illusion of two or three dimensional shapes, sizes, value, color, and space and texture techniques. There is a definite sense of three dimensions in "Hedges," despite the fact that we our frame of reference is two dimensional. There are a couple of techniques used to create this illusion. First, the imagery is drawn in perspective using two points in space to establish the angles at which all of the elements are aligned. Second, a good amount of value differentiation is used to establish highlights and shadows and to make the title text appear to be sitting on the ground [179]. Finally, the use of the small figures helps to establish a sense of environment, making the overall illusion more believable. The figures are interacting with the forms, standing on top of them or digging holes in them, which helps to extend the sense of space in the composition. For example, loud and soft or big and small project relative quality measurement on some scale. Therefore, scale is an important tool for creating illusion of depth, since elements that are larger in size register

prominently by attracting viewer's attention first, while smaller elements tend to recede into the background.

- ***Movement*** – Graduation of size, and repeated shapes and size of related elements subtly leads the eye as well. Lines imply motion and suggest direction or orientation. Use of lines provide both length and direction and also create contour and form, perspective and continuance. Together, it can establish a sense of density or value. It is an excellent way to provide senses of unity in the design. Likewise, movement can also be created with such optical effects as linear repetition, action, and rhythm [86]. Used deliberately, suggested movement can have a marked emotional and physical impact on a viewer.

- ***Unity*** – Unity refers to an ordering of all elements in an image so that each contributes to a unified aesthetic effect and the image is seen as a whole [179]. Failing to accomplish this results in the premature termination of the viewer's experience - they look away. There are a number of ways to achieve unity to attract and keep the viewers attention. For example, color can unify a design, as can a grid, visuals that represent related subjects or a consistent style of imagery. Coherence refers to the belonging together or the various parts of the artwork. In reality these parts may be unrelated, but within the confines of the image their color, shapes, and size form a sense of unity. Visual coherence can be achieved through the use of analogous color and color tonality. It can also be achieve through similarity of shape, color size or texture. However too much similarity can lead to boredom - we need some variety to add "spice" to the image.

Aesthetic designing guidelines reviewed in this section will serve as a basis to measure LAPs in F&IVEs for developing learners' mental models in the proposed aesthetic perception and motivation model.

2.6 Learners Learning Motivation (LLM)

The third variable of the conceptualized model is called *Learners Learning Motivation*, which is an outcome variable of the proposed model.

Motivation is an emotion or a sense of feeling that captivates positive senses in our brain by employing extrinsic and intrinsic factors [180]. This eventually is responsible for stimulating learning process. Today researchers are increasingly interested in finding out factors that are critical for enhancing or preventing learners' involvement in a FLVE [181] and one such factor is Learning Motivation (LM). Learning is found to be the most effective when an individual is ready to learn, or in other words, when one wants to know something, without any compulsion or extrinsic rewards. Motivation theorists assume that all learned activities or behaviors occur due to LM. It is said that "*a learned behavior will not occur unless it is energized*" [182]. At the same time, motivation remains a major area of concern among educational psychologists [183] who continue to probe into the question; "whether motivation is a primary or secondary influence on learning behavior?", since it essentially energizes learners' learning behavior to achieve instructional goals [184].

Motivation psychologists classify motivation to be intrinsic and extrinsic in nature. Extrinsic motivation refers to motivation that comes from outside an individual. The motivating factors are external, or outside, rewards such as money or grades. These rewards provide satisfaction and pleasure that the task itself may not provide. An extrinsically motivated person will work on a task even when they have little interest in it because of the anticipated satisfaction they will get from some reward. Intrinsic motivation refers to motivation that comes from inside an individual rather than from any external or outside rewards, such as money or grades. The motivation comes from the pleasure one gets from the task itself or from the sense of satisfaction in completing or even working on a task. Psychological research distinguishes between intrinsic and extrinsic motivation too. Intrinsic motivation reflects activities undertaken by individuals for their own sake or for personal interest. This means intrinsic motivation is what is felt by an individual, when he/she is inspired by his/her own attitudes, skills, and interests. Extrinsic motivation, on the contrary, reflects activities undertaken for instrumental assessment or external reasons [180]. Of the two, intrinsic motivation is more influential because intrinsically motivating activities are those in which learners' choose to participate for no external reward or pressure.

2.6.1 Learning Motivation in FLVEs

LLM is said to have a phenomenal impact on the entire learning process as it has been reported that LM in WBLE accounts for more than one fourth of student achievements [185] and in another study LM was found to be the best predictor of student achievement and learning Japanese language through the medium of Satellite Television [186].

Likewise, research has shown that unless learners' are not intrinsically motivated; they are likely to have less constructive experiences when interacting with E-Learning systems [187]. The worldwide dropout rate for WBL in 2007-08 was recorded as high as 64% [18], resultantly giving negative impression of WBL and its potential, which are said to a powerful asset only if they are designed and executed well [19]. WBLEs if are able to sustain LLM and retention, they act as a powerful skill transformation medium where learners can master *"new skills and transfer those skills back into the working environment"* [188]. Although, there are various reasons why a learner may drop out of a course, lack of LM is the most critical factor in keeping them in [20]. Frankola [21], in her widely cited article concerning dropout rates in corporate eLearning courses, states that learners most frequently reported lack of time, lack of learning motivation, poorly designed courses and incompetent instructors as the reasons for their attrition. To resolve attrition issues in FLVEs, researchers have emphasized upon motivational designing for FLVEs from different perspectives. For instance, Zvacek [189] argues to explore aspects of instructional designing, beyond the cognitive domain to optimise LLM, while Kurse [190] stressed upon instigating learners intrinsic motivation and stated without a desire to learn on part of the student, retention is unlikely. Favouring this stance, Weller [191] suggests that an effective WBLE should promote learning atmosphere, favourable attitude towards learning, and at the same time provide high levels of self-efficacy and self-motivation [192]. Smith [55] referred to lack of LLM in FLVEs to be the result of a learner's inability to identify issues underlying increased levels of anxiety about engaging with e-learning.

Unfortunately, instigating LLM through effective Learner-Interface Interaction and aesthetic designing of FLVEs is not much researched. It is said [189] that any sophisticatedly designed FLVE, either face-to-face or web-based, will eventually fail,

if learners' are not intrinsically motivated to interact with it [189]. Internationally, substantial research has been carried out to investigate Learning Motivation Factors (LMFs) within WBLEs that can ensure effective interaction between a learner and the learning environment. For instance, Hanrahan [181] conducted a survey on the effect of learning environment factors on students' motivation and learning in WBL, and reported that for higher cognitive engagement in WBLEs, instructional control and a learning context are two important interaction design factors. Poon et al [193] conducted a study on eight Malaysian Universities offering WBL facility. Results indicated that students' grades are highly correlated with student perception of the WBLE, self-efficacy and interactivity provided by WBLE. Tsai [194] conducted a survey by developing a CILES-S scale to investigate student preferences in constructivist Internet-based science learning environments. Study results showed that LLM was strongly correlated with WBLE that could provide a contextual relevance in connecting with scientific knowledge. This study particularly developed a scale to measure learners' LM and identified eight aspects (ease of use, relevance, multiple sources, student negotiation, cognitive apprenticeship, reflective thinking, critical judgment and epistemological awareness) that instructional designers should check upon when designing a WBLE meant for scientific studies. Vuorela [195] examined what emotions are experienced by learners in a WBLE and reported that interface designing based on emotion regulation strategies and computer self-efficacy may be collaborated with instructional designing practices to provide a more gratifying learning experience. Dikshet *et al.* [196] investigated learning attitude, motivation and preferences of online learners in two top Indian Universities and their results showed that LM of learners' with greater self-efficacy and technocrat skills differed significantly from learners with lesser or no technocracy skills. The study reported LLM is a strong predictor of online learners' attitude and learning preferences and emphasized upon improving motivational designing of E-Learning systems by introducing more learner centric designs.

Despite all these, it is believed in reality the reasons of experiencing lack of LM or early withdrawal from WBL are likely to be deeper and far more complex than originally thought [56]. One such relatively unidentified, deeper and complex reason may possibly be associated with learners' perceptual limitation, developed due to their

interaction with IVEs. It has already been stated by researchers [44] that IVEs are producing learners' with a new profile of cognitive skills which include sophisticated enhancement of their visual-spatial skills and aesthetic perceptions. This indicates that enhancement in learners' aesthetic perceptions due to their interaction with IVEs is a new cognitive skill that learners' of FLVEs are equipped with today. This cognitive skill is developed due the influence of media aesthetics of IVEs on LST altering their perceptual process and making them selective in judging aesthetics in a contextual frame of reference [48]. This has resultantly formed *learners' new schema* (set of aesthetic expectations) on aesthetics of digital environments. Learners' new schema becomes their perceptual filter or act as a perceptual limitation in FLVEs. Learners' experience visual gaps or cognitive fatigue due to difference between what they aesthetically expect and what they see, which lowers their LM in FLVE.

This argument requires empirical support, and no study was identified that had empirically embedded FLVEs with IVEs or examined the influence of Informal Motivational Factors (IMFs) on FLVEs or how Formal and Informal Motivational Factors (F&IMFs) jointly determine LLM in FLVEs. The aesthetic perception and motivation model proposed in this research will examine learners' new schema based on their aesthetic perceptions in IVEs and investigate how their LM is influenced in FLVE. Since the proposed model looks at two different environments, formal and informal in nature, this requires integration of two motivational models into the research framework, one focusing upon characteristics of FLVEs, while other on IVEs. The next section will therefore review literature on formal and informal motivational models deemed relevant for incorporation in the proposed aesthetic perception and motivation model for F&IVEs.

2.6.2 Formal & Informal Motivational Models

Learner's intrinsic motivation is an area of interest for instructional designers and both are critical for the success of F&IVEs. In Web-based Environments, formal and informal may not be considered as completely distinct entities, but rather as being part of a continuum. In order to develop aesthetic perception and motivation model for F&IVEs, this research uses two motivational models namely given by, (1) John Keller

and (2) Malone & Lepper. The two models are unique in their own perspectives and adopt different approaches towards sustaining motivation in F&IVEs.

Keller's ARCS model is a problem solving approach in designing motivational aspects of FLVEs to stimulate and sustain LLM [58], [197], [198]. The model is grounded in expectancy-value theory, reinforcement theory, cognitive evaluation theory and explains relationship between effort, performance and satisfaction [199]. It is predominately applied in FLVEs because it can essentially facilitate in identifying and solving specific motivational problems related to the appeal of instruction. The Keller's model is thus appropriate for incorporation in the proposed model for F&IVEs as it has been validated by numerous studies, at different educational levels across different cultures and also meets characteristics of FLVEs. It has following four categories of motivational variables (Table 2.6).

Table 2.6: Keller's Motivational Model

1. **Attention**: Attention is grabbed in a learning environment by using colors, creating novelty, providing interaction, generating participation, wittiness and sound effects.
2. **Relevance**: By providing realistic scenario, a meaningful Contextual Interpretation is created between the learner and the learning environment.
3. **Confidence:** Engagement provided by the learning environment tends to enhance learners' confidence level and proves to be a confidence-building experience for them.
4. **Satisfaction**: By accepting the benefits of learning environment and expressing aspiration to continue pursuing similar goals through it, indicates satisfaction on part of learners.

Likewise, Malone and Lepper's research [59] indicated that intrinsic motivation is more successful than extrinsic motivation in terms of reinforcing desired learning behavior. Malone and Lepper proposed a model based on causal motivational variables, exclusively meant for multimedia based learning environments, such as games and other interactive visual environments. Wilson *et al.* [200] integrated Malone & Leppers' model in their study to investigate relationships between game attributes and learning outcomes. They referred to its IMFs as casual dimensions for designing intrinsically motivating media technologies meant for education purposes. In another study conducted by Habgood *et al.* [201], the Malone & Leppers model was found to have strong positive correlations with LLM associated with digital

games. Since, IVEs provide flexible learning-space, empower learners' and are casual in nature, therefore, Malone & Lepper's model is relevant to address informal characteristics of IVEs. This model has the following four variables (Table 2.7).

Table 2.7: Malone and Lepper's Motivational Model

1. **Challenging:** The difficulty of the activities to be performed by learners should be kept at an optimal level, otherwise they will get bored or frustrated.
2. **Curiosity:** To enhance sensory and cognitive curiosity in activities to be performed by learners, the environment may be designed as such to make learners believe that their current knowledge structure is incomplete, incompatible, or vague.
3. **Control:** The learning environment should promote a positive sense of control in learners, so that they are aware of the fact that their learning outcomes are dependent upon their own actions.
4. **Fantasy:** Cognitive engagement to be provided by learners by making them experience situations in fantasy contexts that are not actually present, but intrinsically motivating.

Keller's and Malone & Lepper's model share a certain degree of overlap as well in terms of their motivational variables. E.g., attention and curiosity are related concepts and motivational critiques Hardré [202] suggests that an integration of the two may provide an optimal instructional design model. No study was found in the literature that integrated these two models [203] highlighting a potential research gap.

2.6.3 Integrating LAPs and LLM in F&IVEs

Emotions associated with our daily life experiences reflect our state-of-mind or feelings. This also indicates our involvement and appreciation from motivational perspective. But that does not mean Emotion = Aesthetic Perception or Emotion = Motivation. Emotions are considered as complex experiences, hard to quantify. They occur in response to certain thoughts or stimuli due to our excited state of mind, reaction or feeling. This section reviews literature on use of emotions to reflect upon LAPs and LLM in F&IVEs.

Measuring an aesthetic perception can be cumbersome and difficult since it is largely believed to be a subjective judgment that is not rooted in any preconceived notion of purpose [35]. According to Hume & Krant [204], noteworthy researchers in

modern aesthetic approach and psychology of art, for an aesthetic perception and experience, formal characteristics of objects are important to the extent that they evoke an inner knowledge or feeling associated with the idea or emotion. Higgens [205] also argues that there is lack of research on role of emotions in aesthetic perceptions, which extensively requires integration of psychology of emotions so as to do justice to the emotions so prized in aesthetic realm. Thus, aesthetics is associated with affect, mood, emotion, and feeling [26] and aesthetic perceptions instigate affective/emotional connection and essentially act as a bridge between the system (user interacts with) and the user's emotion and feelings (towards the system). This has also been the finding of Thüring and Mahike [206] that aesthetic perceptions have a major effect on users' emotional valence and physiological arousal. Research on computer interface designing considers aesthetics to be a strong determinant of users' satisfaction and pleasure [207] which are emotional states. These emotional states are based on physiological arousal, expressive behaviors, and conscious experience [96]. This explains why emotional aesthetic experiences vary as per users' respective mood, temperament, personality and motivation. This is also endorsed by appraisal theory, which is an advocate of the fact that users appraisal is based upon emotions build due to their personality relevant information [208]. Emotions are useful to measure affective perceptions [209] and aesthetic critiques establish a strong relationship between emotion and aesthetic value, calling them emotional state [210].

Abraham Maslow, known for "Maslow's hierarchy of needs", had refined his famous model to include a new need level *need for aesthetics and knowledge* between esteem needs and self-actualization. This indicates that humans are naturally motivated by their aesthetic needs as some form of aesthetic appreciation is universal to human nature [177]. Research in aesthetics also shows that people are motivated to resolve inconsistence, vagueness or imbalances that they encounter in their environment. A study [211] examined the role of emotions in the dynamics of different shapes and found that unusual shapes that were obscure or imbalance, strongly correlated with pessimistic or negative feelings like suffering or fear. Just like aesthetic perception, motivation too is a form of emotion or a sense of feeling that captivates positive/negative senses in our brain [19].

Swiss Center for Affective Sciences [212] defines 'aesthetic-emotions' as an emotional experience that one goes through during an aesthetic activity or appreciation. This experience can be expressed in variety of emotional states (such as fear, wonder or sympathy) or may be quite specific to aesthetic contexts. Neurologists [213] suggest that emotion plays an important role in human memory and emotional responses are a reflection of the situations humans are in, influencing upon their interpretation of the environment and to make it worth remembering and recalling. This means in addition to emotions being a reflection of aesthetic perception and motivation, they are also a reflection of schematic thinking. This makes learners' aesthetic-emotions appropriate for incorporation in the proposed aesthetic perception and motivation model, as by this way LAPs in IVEs and LLM in FLVEs can be integrated to determine learners' new schema on aesthetics of digital environments.

To examine how learners' aesthetic-emotions can be implemented in the proposed model, literature was reviewed and related work was found. Mahlke [76] studied the influence of perceived usability and visual aesthetics on users' emotional reactions and examined the effect of user characteristics and contextual parameters on these relations. Lavie & Tractinsky [207] conducted a study to determine dimensions of perceived visual aesthetic of websites by developing aesthetic-emotions measuring scale, using exploratory and confirmatory factor analyses. Mehrabian & Russell [214] environmental psychologists measured people's emotional responses in different environments and experimented with hundreds of environments, asking subjects to put their emotional responses on a continuum between two adjectives. Their findings were also based on factor analysis and revealed that much of the variance in descriptions of emotions can be boiled down to 2 dimensions, (1) *pleasure*, and (2) *arousal*. The studies reviewed examined users' aesthetic perceptions or aesthetic evaluation through their aesthetic-emotions. However, no study was found where aesthetic perceptions in context of aesthetic-emotions associated with motivational variables were investigated. This highlighted research gap, as no existing scale from literature was identified that measure aesthetic perception and motivation in F&IVEs.

As discussed above, aesthetic perception and motivation can be expressed through emotions and integrated through aesthetic-emotions. Therefore, by examining

learners' aesthetic-emotions associated with F&IMFs of Keller and Malone & Lepper's models, the LAPs and LLM can be incorporated in the proposed aesthetic perception and motivation model for F&IVEs (see Figure 2.3).

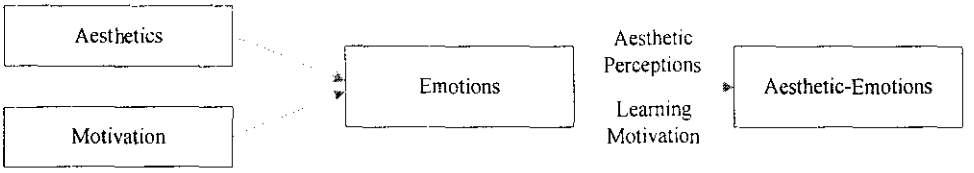


Figure 2.3: Integrating Aesthetic Perceptions and Motivation in F&IVEs

2.7 Chapter Summary

In Chapter 2 literature has been reviewed to underline significance of Learner-Interface Interaction in aesthetic-motivational designing of F&IVEs. Substantial arguments are presented to emphasize upon the influence of IVEs that are producing learners' with a new profile of cognitive skills which include formation of new schemas on aesthetic of digital environments. This highlights potential research gap as existing literature covers LAPs in FLVEs only. Learners' new schema on aesthetics of digital environments are argued to act as their perceptual filters for judging aesthetics in a contextual frame of reference and formed prejudiced aesthetic perceptions. Moreover, literature has been reviewed to examine how the difference between what is visually expected and what is actually shown creates visual gap. This visual gap according to control theory of self-regulation can instigate cognitive fatigue and also lower LLM in FLVEs. To address research gaps an aesthetic perception and motivation model for F&IVEs is proposed. The proposed model has three research variables (1) LST, (2) LAPs and (3) LLM. Accordingly, literature on three research variables and their sub-measuring constructs is reviewed to facilitate model conceptualization, testing and validation.

CHAPTER 3

MODEL DEVELOPMENT FRAMEWORK

3.0 Chapter Overview

This Chapter introduces the Model Development Framework (MDF) designed in accordance with Groot's empirical research cycle. The MDF explicitly addresses research questions defined in Chapter 1 and research gaps identified in Chapter 2.

3.1 Empirical Research Cycle

Empirical research is defined as *"research based on experimentation or observation (evidence) to test a hypothesis"* [215]. The widely tested and applied Groot's empirical research cycle consists of following five stages [216]:

1. *Observation* - collecting and organizing empirical facts to form hypothesis.
2. *Induction* - reasoning process where a small observation is used to infer a larger theory, without necessarily proving it.
3. *Deducting* – deducing consequences with newly gained empirical data.
4. *Testing* – testing the hypothesis with new empirical material.
5. *Evaluating* – evaluating the outcome of testing on new empirical data.

Since this research was empirical, explorative and experimental, therefore both quantitative and qualitative methods were applied for hypothesis testing. The research framework was designed with a phase-wise approach and was based on the five stages of empirical research cycle. Section 3.2 will further elaborate upon each stage.

3.2 Model Development Framework (MDF)

The five phases of the Model Development Framework are shown in Figure 3.1.

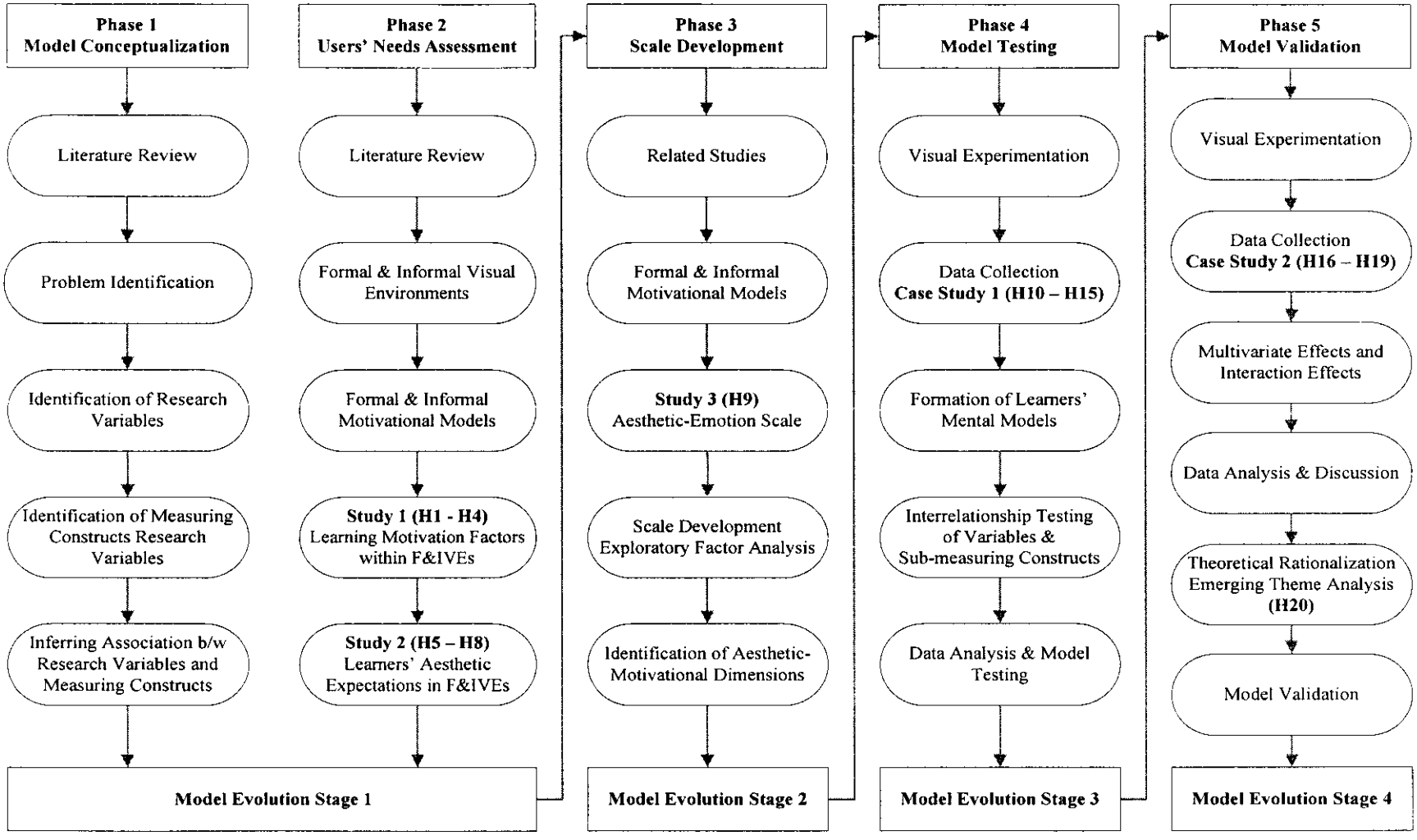


Figure 3.1: Model Development Framework

Table 3.1: Research Questions and Hypotheses

Research Questions (RQ)	Hypotheses
Induction Stage - Users' Needs Assessment	
RQ1: How learners' learning motivation and aesthetic needs are associated with F&IMFs in F&IVEs?	H^1: FLMFs will correlate with LLM.
	H^2: IMFs will not correlate with LLM in WBL.
	H^3: LLM for WBL will be different across FLMFs *(attention, relevance, confidence, satisfaction).*
	H^4: LLM for WBL will be same across four IMFs *(challenge, curiosity, fantasy, control).*
	H^5: Learners' aesthetic expectations in FLVEs will be different across three IVEs *(video-games, motion-pictures, SNWs).*
	H^6: Learners' aesthetic expectations in FLVEs will be different across four IMFs *(challenge, control, curiosity, fantasy).*
	H^7: Learners' aesthetic expectations from FLVEs will be different across three IVEs *(video-games, motion-pictures, SNWs)* by choice of IMFs *(challenge, control, curiosity, fantasy).*
	H^8: FLMFs *(attention, relevance, confidence, satisfaction)* and IMFs *(challenge, control, curiosity, fantasy)* will correlate to jointly predict learners' aesthetic expectations in FLVEs.
Deduction Stage - Scale Development	
RQ2: How to develop a scale based on F&IMFs to measure LAPs and LLM in F&IVEs?	H^9: Learners' aesthetic-emotions associated with FLMFs (*attention*, *relevance*, *confidence*, *satisfaction*) and IMFs (*fantasy*, *challenge*, *curiosity*, *control*) will be correlated .
Testing Stage - Model Testing	
RQ3: How do the preliminary empirical analyses result in formation of learners mental models and infer relationships among research variables?	H^{10}: LAPs can be classified (high, medium, low).
	H^{11}: LAPs in IVE and LLM in a FLVE will be correlated.
	H^{12}: LST will be correlated with CI and GU.
	H^{13}: LAPs, LST, CI and GU will be correlated.

Table 3.1: Research Questions and Hypotheses (Continue)

Research Questions (RQ)	Hypotheses
	H^{14}: LLM in FLVE will be different across LAPs (high, medium, low) in IVE after adjusting for the effect of LST as a covariate.
	H^{15}: LAPs in IVE and LST (CI + GU) will jointly predict significant variance in LLM in FLVEs than LAPs in IVE and LST (CI + GU) alone.
Evaluation Stage - Model Validation	
RQ4: How to validate results of aesthetic perception and motivation model for F&IVEs?	H^{16}: There will be significant multivariate effect of LAPs in IVE (high, medium, low) on four aesthetic motivational dimensions *(usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction)* of FLVE.
	H^{17}: There will be significant multivariate effect of LAPs in IVE (high, medium, low) on four aesthetic motivational dimensions *(usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction)* of FLVE, after adjusting for the effect of LST as a covariate.
	H^{18}: Usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction in FLVE will be lowest for LAPs (high) in IVE.
	H^{19}: The relationship between four aesthetic-motivational dimensions and the covariate (LST) will be same across LAPs (high, medium, low) in IVE.
	H^{20}: LAPs components in IVEs will be associated with LM components in FLVEs for derivation of emerging themes.

3.2.1 Phase 1 - Model Conceptualization

The Phase 1 of the MDF was designed as an *observation* stage of empirical research cycle. It is mostly covered in Chapter 1 and Chapter 2 of this thesis, where literature review, empirical studies and arguments have been extensively discussed to identify research gaps and to provide basis for hypothesis testing. Model Evolution Stage 1 as shown in Figure 3.4 was achieved at the end of this Phase.

3.2.1.1 Identification of Variables

The proposed model is conceptualized with three variables, (1) LST, (2) LAPs, and (3) LLM. Table 3.2 indicates how each variable is theoretically defined in literatures.

3.2.1.2 Measuring Constructs of Variables

The measuring constructs of three variables are identified from literature review and are shown in Table 3.3 for Model Conceptualization.

3.2.1.3 Variables Association

The association between LST and LAPs is inferred from Table 3.4 and shown in Figure 3.2.

Figure 3.2: Association between LST and LAPs

Association between LAPs and LLM is interpreted from Table 3.5 and shown in Figure 3.3.

Figure 3.3: Association between LAPs and LLM

Table 3.2: Theoretical Explanations of Variables

Research Variables	Explanation	Referred Articles (adopted/adapted)
Learners' Schematic Thinking	It is an information processing strategy of human brain for reducing the amount of information to be stored, based on prior and familiar knowledge.	[176]
	Schematic Thinking helps in recalling appropriate details.	[50]
	It is a cognitive model that humans unconsciously use to organize and interpret information.	[217]
Learners' Aesthetic Perceptions	It is based on viewers experiences, where formal characteristics of objects evoke an inner knowledge or feeling associated with the idea or emotion.	[204]
	Aesthetic perceptions are a reflection of our affective state, mood, emotions, and feelings.	[26]
	Our perceptions instigate affective emotional connection and essentially act as a bridge between the system and the user.	[206]
	It is an emotional experience that one goes through during an aesthetic activity or appreciation.	[212]
Learners' Learning Motivation	It energizes our behavior by inclining us towards learning.	[182]
	When learners' choose to participate and learn from the learning environment for no external reward, they are said to intrinsically motivated	[185]
	It determines focus of learners' attention and what needs to be learned.	[191]

Table 3.3: Measuring Constructs Definitions of Research Variables

Research Variables	Measuring Construct	Explanation	Referred Articles (adopted/adapted)
Learners' Schematic Thinking	Contextual Interpretation (CI)	Research has shown that human perceptual processes exhibit sufficient consistency in making accurate predictions as to how people will respond to a specific aesthetic stimuli and contextual patterns	[49]
		Humans are constantly engaged in judging one aspect of the event with another aspect or another event and contextualistic aesthetics provides a convenient frame of reference for applying media aesthetics	[134]
		The contextual interpretation of any event or scene is determined by contextual factors that reinforce viewers' schemas, formulate characteristics of the surrounding environment and ensure effective collaboration between the two.	[217]
		Contextual interpretation is influenced by situational variables such as environmental contexts.	[147]
	Gestalt Understanding (GU)	Gestalt principles of organization provide perceptual shorthand for quickly processing and interpreting basic shapes, allowing a pattern to emerge as a whole.	[155]
		Gestalt principles form a basic building block in understanding how context influences our perception.	[156]
		It is the rule our brain follows for reducing the overwhelming complexity of the perceptual world.	[154]
Learners' Aesthetic Perceptions	Aesthetic Designing Principles	The designing principles (appropriate images, choice of colors, size, font and placement of bars) when incorporated in designing of online learning material positively influenced upon LAPs and LLM.	[154]
		Principles of designing can create an aesthetic environment which is said to have a persuasive role in intensifying LLM.	[24]
		Interface designing principles are all about setting priorities for quick orientation by users.	[176]

Table 3.3: Measuring Constructs Definitions of Research Variables (Continue)

Research Variables	Measuring Construct	Explanation	Referred Articles (adopted/adapted)
		Aesthetics of a learning environment refer to the consistency of design pattern and layout in interior pages and how that tends to sustain the feel and visual interest of the learners in learning environment.	[218]
		An aesthetic environment influences upon viewers aesthetic perceptions through maintaining visual flow in its interaction design and verbal flow in its layout design.	[30]
		An aesthetic design has an emotional impact beyond decoration.	[7]
Learners' Learning Motivation	Aesthetic-Emotions	It is an emotional state based on physiological arousal, expressive behaviors, and conscious experience.	[96]

Table 3.4: Association between Learners' Schematic Thinking and Learners' Aesthetic Perceptions

Research Variable	Association with Learners' Aesthetic Perceptions	Referred Articles (adopted/adapted)
Learners' Schematic Thinking	Our perceptions in aesthetics are sabotaged by what our brain already possesses.	[219]
	We guess what is there from our past-experiences (based on schemas) rather than having to buildup visual images in our mind, each time from scratch.	[112]
	What we see when we are looking at a picture is modified by what we have seen in the past, and what our brains wants us to see.	[220]

Table 3.5: Association between Learners' Aesthetic Perceptions and Learners' Learning Motivation

Research Variable	Association with Learners' Learning Motivation	Referred Articles (adopted/adapted)
Learners' Aesthetic Perceptions	Visual aesthetics are a strong determinant of users' satisfaction, pleasure and motivation in a digital environment.	[207]
	Aesthetic experiences influence upon users' mood, temperament, personality and motivation.	[208]
	If the learner-interface interaction is not engaging and visually appealing, it will also influence upon learners' others types of interactions as well as LLM.	[8]

Aesthetic Perception and Motivation Model for Formal & Informal Visual Environments

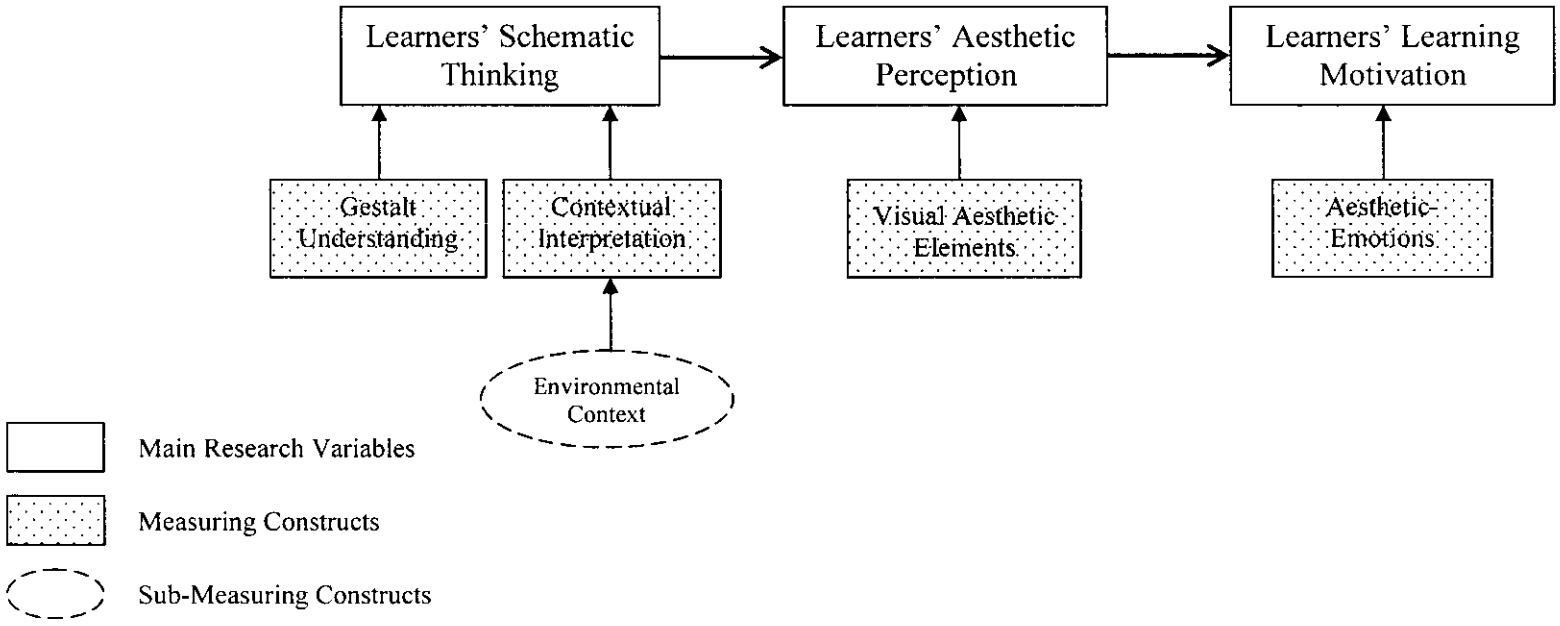


Figure 3.4: Model Evolution Stage 1

3.2.2 Phase 2 - Users' Needs Assessment

The Phase 2 of MDF was designed as an *induction* stage of empirical research cycle to address RQ1 as defined in Chapter 1.

From literature review in Chapter 2, it was identified that no study, either empirical or theoretical existed that examined influence of LAPs in IVEs and if that influenced upon LLM in FLVE. Lack of research on implication and influences of IVEs on learners' motivation and aesthetic needs in FLVEs were important research considerations. To induct basis for reasoning whether IVEs should be inculcated within the proposed model or not, two pilot studies were conducted to investigate influence of IVEs and IMFs on learners' motivation and aesthetic needs in F&IVEs. Data analysis results were used to infer larger assumptions for developing the proposed model for F&IVEs based on F&IMFs. Both studies used self-reporting questionnaires, a method that *"involves asking a participant about their feelings, attitudes, and self-beliefs"* [221]. Since this form of data collection is often seen as incredible due to respondents' ability to exaggerate problems that may result in over-rating or under-estimation of the mean, therefore, content and concurrent validity measures were applied. Moreover, the number of respondents or size of the *n* was relatively large [Study 1, n = 343], [Study 2, n = 289] so as to overcome the problem of mean overrating. Motivational variables in models given by Keller and Malone & Lepper were used as measuring constructs. Hypotheses tested during this phase are shown in Table 3.1. Further details on research methodology adopted during this phase will be discussed in Chapter 4.

3.2.3 Phase 3 - Scale Development

The Phase 3 of MDF was designed as a *deduction* stage of the empirical research cycle to address RQ2 as defined in Chapter 1.

From literature review in Chapter 2, it was identified that no scale could be identified that embedded LAPs in IVEs and LLM in FLVEs. For this empirical research, it was essential to develop such a scale that could club together LAPs in

IVEs with LLM in FLVE and measure effect of differences between LAPs in IVEs and LLM in FLVEs. For this reason, a study based on visual screening of IVEs was conducted to develop a scale by examining LAPs and LLM through their aesthetic-emotions (treated as adjectives) associated with formal and informal motivational variables given by Keller and Malone & Lepper. The integration of these two models is recommended by researchers and in Phase 1, a predicting model based on motivational variables of these two models immensely improved model's ability to predict learners' aesthetic expectations. Exploratory Factor Analysis on the initial and revised lists of aesthetic-emotions was performed. The study used a blend of both, qualitative and quantitative reporting and the scale's fitness was ensured through factoral validity and reliability check measures.

The analysis resulted in identification of scale's four aesthetic-motivational dimensions embedding LAPs in IVEs and LLM in FLVEs, namely (1) Usability Perception, (2) Cognitive Engagement, (3) Visual & Aesthetic Appeal, and (4) Satisfaction. The four aesthetic-motivational dimensions are implied to be where learners' experience visual gaps, due to the difference between what they aesthetically expect and what they see in F&IVEs. Results of this study helped in deducing consequences of integrating LAPs and IVEs in the proposed model and further strengthened research arguments based on newly gained empirical data. Hypothesis tested during this phase is shown in Table 3.1. Further details on research methodology adopted during this phase will be discussed in Chapter 4.

3.2.4 Phase 4 - Model Testing

The Phase 4 of MDF was designed as a *testing* stage of the empirical research cycle to address RQ3 as defined in Chapter 1.

From literature review in Chapter 2, it was argued to develop and aesthetic perception and motivation model that can examine the influence of LAPs in IVEs on LLM in FLVEs and determine existence of visual gaps between what learners' aesthetically expect and what they see. In Phase 1, a conceptualized model based on literature review was developed (Figure 3.3), in this Phase model testing was

performed by a *true experimental design* of F&IVEs, involving learners participating in visual screening and filling out pre-posttesting questionnaires. True experimental designs are a preferred method in empirical studies that are required *"to compare participant groups and measure the degree of change occurring as a result of treatments or interventions"* [222]. The experimental design included formation of learners' mental models by making classification of LAPs in IVE (High, Medium, Low), investigating interrelationships among LAPs, LST and LLM in F&IVEs and assessing how a model based on measuring constructs of LAPs in IVE and LST (CI + GU) predicted LLM in a FLVE. For the formation of learners' mental models, item discrimination validity, based on expert judgment scoring, was applied and mental models were segregated on the basis of LAPs classified as high, medium, and low. Likewise, interrelationship testing of variables in a FLVE was conducted on classified LAPs in IVE to infer causal relationships and association between variables and their measuring constructs. The study also employed Hierarchal Regression Modeling (HRM) as a simple form of quasi-experimental research design as it is believed to be a *"good way to obtain a general overview and then follow up with a another case study or quantitative experiment, to focus on the underlying reasons for the results generated"* [222]. Results of HRM tested and compared models based on measuring constructs of LAPs in IVEs and LST (CI + GU) predicted variance in LLM in FLVE. Hypotheses testing are shown in Table 3.1 and for more details on research methodology adopted during this phase see Chapter 4.

3.2.5 Phase 5 - Model Validation

The Phase 4 of MDF was designed as an *evaluation* stage of the empirical research cycle to address RQ4 as defined in Chapter 1.

Empirical testing of the proposed model conducted in Phase 4 required evaluation for validation purpose. Therefore, in Phase 5 case study based on a *true experimental design* of F&IVEs involving actual learners' participating in visual screening and filling out pre-posttesting questionnaires was conducted. The experimental design used four aesthetic-motivational dimensions of the developed scale as dependent/outcome variable. The study investigated proposed model's multivariate

effects of LAPs in IVE on LLM in FLVE, influence of LAPs in IVE on LLM in FLVE and interaction effects of LAPs in IVE with LST in predicting LLM in FLVE. Hypotheses tested during this phase are shown in Table 3.1. Further details on research methodology adopted during this phase will be discussed in Chapter 4.

The study applied a blend of quantitative and qualitative reporting methods. Empirical results were used to develop, test, evaluate and validate model, while qualitative reporting results were based on grounded theory and produced emerging themes in support of empirical findings. Eisenhardt [223] in her highly cited research work "Building Theories From Case Study Research" has emphasized upon using empirical data to build grounded theory due to its three major strengths, firstly, *"theory building from case studies is likely to produce novel theory"*, as it will be less dependent on researcher's biasness and more on significance of empirical findings. Second, the emergent theory *"is likely to be testable with constructs that can be readily measured and hypotheses that can be proven false"*, due to the close connection between theory and data and the theory can be further tested and expanded by subsequent studies. Thirdly, the *"resultant theory is likely to be empirically valid"*, because of high level of validation which is performed implicitly by constant comparison, questioning the data from the start of the process. Further details on research methodology adopted for qualitative reporting will be discussed in Chapter 4.

3.3 Chapter Summary

In this Chapter five phases of the MDF are briefly introduced and based on literatures a model has been conceptualized for testing and evaluation. Phase 1 of the MDF has been extensively covered in this Chapter along with hypotheses to be tested during the other four phases of the MDF are formulated. Detailed methods/statistical procedures to be applied during each phase of the MDF will be discussed in the next chapter.

CHAPTER 4

METHODS AND PROCEDURES

4.0 Chapter Overview

This Chapter is organized to elaborate upon methodology, validity techniques, and rationale behind statistical procedures applied for hypotheses testing during MDF. Sections 4.1, 4.2, 4.3 and 4.4 further elaborate each phase of the MDF individually. Section 4.1 describes users' needs assessment and two studies that were conducted to assess learners' motivation and aesthetic needs in F&IVEs. Section 4.2 is devoted to scale development to embed LAPs and LLM in F&IVEs. Section 4.3 elaborates upon model testing based on true experimental designs using pre-posttesing of F&IVEs and formation of learners' mental models for interrelationship testing of variables. Section 4.4 explains model validation based on another true experimental design to examine model's multivariate effects, prognostication abilities and interaction effects. Finally, this Chapter is closed with its summary presented in Section 4.5.

4.1 Users' Needs Assessment

This phase of the MDF was introduced as an induction stage of empirical research cycle. Two studies were conducted to assess learners' motivation and aesthetic needs in F&IVEs.

4.1.1 Study 1: Assessing Learners' Motivation Needs in F&IVEs

This study was conducted with the following research methodology.

4.1.1.1 Methodology

The study was performed with quantitative research methodology, based on hypotheses testing, for the following research model (Figure 4.1).

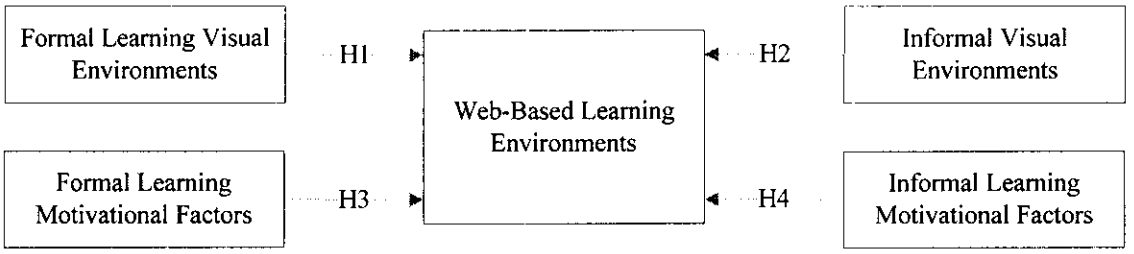


Figure 4.1: Research Model (Study 1)

4.1.1.2 Hypotheses

Hypotheses H^1 to H^4 were tested in Study 1 and it was hypothesized that FLMFs based on Kellers' Model will correlate significantly while IMFs based on Malone and Leppers' Model will not correlate significantly with LLM in FLVEs.

4.1.1.3 Validity

Burns & Grove [224] have emphasized upon content validity in self-reporting questionnaires, especially when literature does not provide much support in building hypotheses. According to the Neilson [262], content validity is obtained from three sources: literature, representatives of the relevant populations, and experts. To attain Content Validity Index (CVI), five HCI graduates (Ph.D students with HCI background and knowledge) rated each item of the questionnaire based on *relevance*, *clarity*, *simplicity* and *ambiguity* on the four-point scale as suggested by Waltz and Bausell [225]. Items scoring over 0.75 remained and rest discarded.

4.1.1.4 Sample size

The questionnaire used in this study is shown in Appendix A which was developed after extensive literature review. Keller and Malone & Leppers' Motivational Models

served as baseline constructs. After ensuring CVI of the questionnaire, it was hand-distributed and emailed to 500 undergraduate and postgraduate students at Universiti Teknologi PETRONAS (UTP) and Universiti of Malaya (UM).

4.1.1.5 Response rate

The overall response rate of the questionnaire was 343 (68.6%) of which, 304 (88.6%) were usable as most items were adequately answered.

4.1.1.6 Scale

Each construct included questions presented in a five-point Likert mode, ranging from "strongly agree" to "strongly disagree." Respondents' responses were scored as: a score of 1 was assigned to the "strongly agree" response, while for the "strongly disagree" response a score of 5 was assigned. Consequently, respondents gaining lower scores on a certain scale showed stronger preferences toward the specific scale.

4.1.1.7 Learners' Analysis

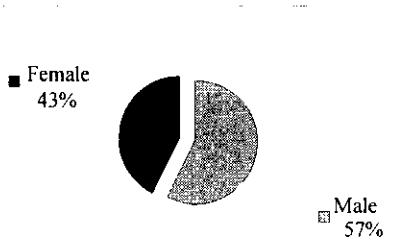


FIGURE 4.2: Gender (Study 1)

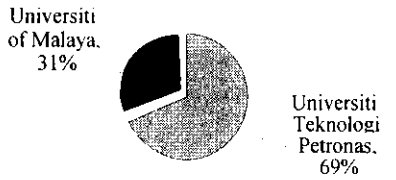


FIGURE 4.3: Institution (Study 1)

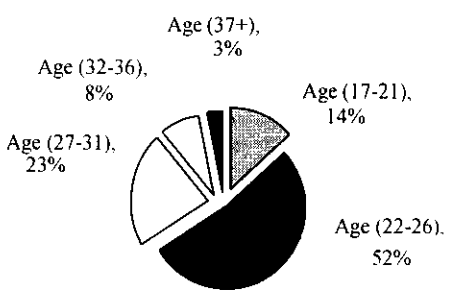


FIGURE 4.4: Age (Study 1)

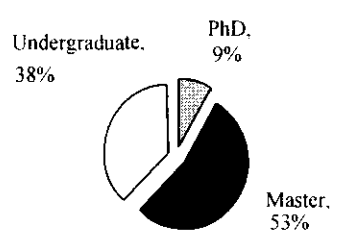


FIGURE 4.5: Qualification (Study 1)

4.1.1.8 Applied Statistical Procedures

H^1 investigated positive influence of LMFs of FLVEs upon WBL. Pearson Correlation Coefficients was computed to test H^1 (FLMFs by Keller and LLM in WBL) since it is the most familiar measure of examining dependence between two quantities. The Pearson Correlation Coefficient indicates the strength of a linear relationship between two variables, but its value generally does not completely characterize their relationship [226]. The same procedure was applied to test H^2 (IMFs by Malone & Lepper and LLM in WBL).

H^3 & H^4 were investigated by computing One-way Analysis of Variance (ANOVA) to determine how the motivational mean of LM for WBL differed across groups. Learners' were requested to make a pick of their favorite motivational factor (grouping variable) from Keller's FLMFs (attention, relevance, confidence, satisfaction) and Malone & Lepper's IMFs (challenge, curiosity, fantasy, control), and to also rate their level of LM for WBL (dependent variable). ANOVA is a statistical method used to compare the means of two or more groups [227]. One of the basis assumptions before performing any analysis of variance is to check for normality of sampling distribution of mean. The sample size for this study (n) was 304, and according to Central Limit Theorem, *"if a random sample of size n is > 30 and it is derived from an infinite population with finite standard deviation, then the standardized sample mean converges to a standard normal distribution"* [228]. The ANOVA results were interpreted using F-statistic and significance value associated with it. F-ratio is a ratio of the explained variability to the unexplained variability (taking into account the degrees of freedom). A larger F-statistic indicates that more of the total variability is accounted for by the model [229].

Results of ANOVA were significant for H^3 ($F(3, 249) = 40.377$, $p = .000$) and H^4 ($F(3, 249) = 34.034$, $p = .002$). When F-test, with a factor that consists of three or more means, and additional exploration of the differences among means is needed to provide specific information on which means are significantly different from each other, Post hoc tests should be performed [230]. ANOVA results of H^3 & H^4 were further investigated by performing Post-hoc Scheffe's tests. Scheffe's procedure is the most popular of the post hoc procedures, the most flexible, and the most conservative

[231]. Scheffe's procedure corrects alpha for all pair-wise or simple comparisons of means, but also for all complex comparisons of means as well [232]. Effect sizes for H^3 and H^4 were also estimated to interpret the effect of differences created by Kellers' and Malone & Leppers' Motivational Models.

4.1.2 Study 2: Assessing Learners' Aesthetic Needs in F&IVEs

4.1.2.1 Methodology

The study was performed with quantitative research methodology through self-reporting questionnaire (Appendix B). A self-report study is a type of survey, questionnaire, or poll in which respondents read the question and select a response by themselves without researcher interference. It also invloves asking a participant about their feelings, attitudes and beliefs. This method was particularly useful during the induction stage for assessing learners' aesthetic and motivation needs in F&IVEs since it is often used as a way of gaining participants responses in observational studies and experiments based on less complex testing.

4.1.2.2 Hypotheses

Hypotheses H^5 to H^8 were tested in Study 2 (Chapter 3, Table 3.1). It was hypothesized that FLMFs based on Kellers' Model and IMFs based on Malone and Leppers' Model will predict learners' aesthetic expectations in FLVEs.

4.1.2.3 Validity

In psychometrics, criterion validity is a measure of how well one variable or set of variables predicts an outcome based on information from other variables [233]. Criterion validity in this study was checked through concurrent validity of the measuring constructs by taking feedback of 26 randomly selected respondents. It was particularly useful to demonstrate when a test correlated with a measure has previously been validated [234]. In Study 1 a strong correlation between IVEs and

LLM in WBL was ascertained and results for Study 2 showed a positive correlation of $r = 0.466$, $p < 0.05$ between learners' IVEs interaction and LLM in FLVEs, indicating LLM can be predicted by learners' aesthetic expectations in F&IVEs.

4.1.2.4 Sample Size

Keller and Malone & Leppers' Motivational Models served as baseline constructs for this Study. After ensuring CVI of the questionnaire, 400 copies of questionnaire were hand-distributed and emailed to undergraduate and postgraduate students at Universiti Teknologi PETRONAS (UTP) and Universiti Sains Malaysia (USM).

4.1.2.5 Response Rate

The overall response rate of the questionnaire was 289 (72.25%) of which, 221 (76.4%) were usable as most items were adequately answered.

4.1.2.6 Scale

Each construct included questions presented in a five-point Likert scale, ranging from "highly essential" to "highly non-essential". For the "highly essential" a score of 1 while for the "highly non-essential" a score of 5 was assigned. Less score on an aespect showed higher aesthetic expectations on that specific scale or dimension.

4.1.2.7 Learners' Analysis

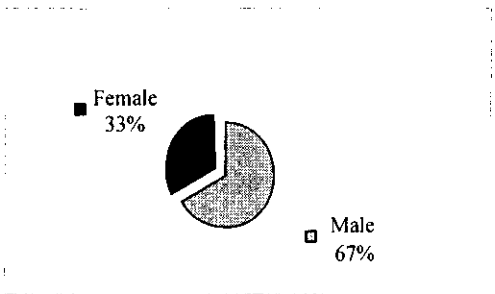


Figure 4.6: Institution (Study 2)

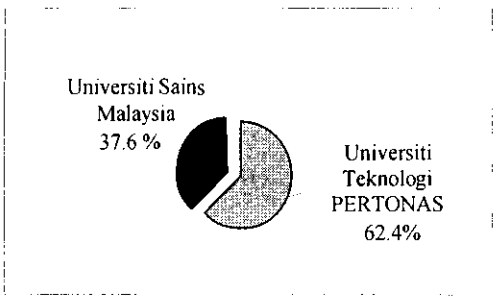


Figure 4.7: Gender (Study 2)

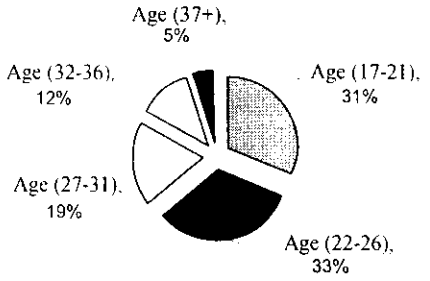


Figure 4.8: Age (Study 2)

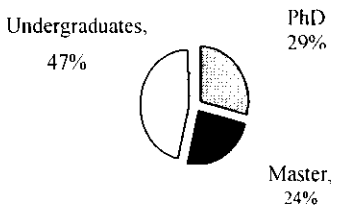


Figure 4.9: Qualification (Study 2)

4.1.2.8 Applied Statistical Procedures

H^5, H^6 and H^7 were investigated by performing Two-way Analysis of Variance, which is an extension to the One-Way Analysis of Variance. It is used when there is one outcome variable (LAPs reflected in their aesthetic expectations) and two independent variables, (1) Favorite IVEs (SNWs, video-games, motion-pictures)/Favorite IMF (challenge, curiosity, fantasy and control) and (2) LLM in FLVEs. The two independent variables in a two-way ANOVA are called factors. The idea is that there are two variables, factors, which affect the dependent variable.

H^8 was investigated by performing Multiple Regression Analysis, which is a statistical procedure used to predict values on a quantitative outcome variable, using several other predicting variables [235].

At the end of Phase 1 and 2 of the MDF, Model Evolution Stage 1 as shown in Figure 3.4 of Chapter 3 was achieved.

4.2 Scale Development

This phase of the MDF was introduced as a deduction stage of empirical research cycle.

4.2.1 Study 3: Study to Develop Scale Embedding LAPs and LLM in F&IVEs

4.2.1.1 Methodology

The study used a blend of both quantitative and qualitative research methodology but primarily it was based on visual screening. It was conducted as part of an observational study to draw inferences about the possible effect of a treatment on learners participating in visual screening. This method for data collection is particularly useful where the assignment of subjects into a treated group versus a control group is outside the control of the investigator.

4.2.1.2 Hypotheses

Hypothesis H^9 was tested in Study 3 that was formulated using Kellers' and Malone & Leppers' motivational models as research constructs. Moreover, since the scale development phase was meant to be deduction stage therefore emperical results obtained from testing H^1 to H^8 were further confirmed and validated through H^9.

4.2.1.3 Validity

Content Validity – Motivational factors in Keller's model (attention, relevance, confidence, and satisfaction) and Malone & Lepper's model (challenge, curiosity, control, and fantasy) were used as baseline to acquire adjectives that represented certain form of aesthetic-emotional responses. To ensure that aesthetic-emotion items on the questionnaire were related to motivational constructs being measured, content validity of the questionnaire was ascertained. Burns and Grove [224] suggest that content validity is obtained from three sources: literature, representatives of the relevant populations, and experts. Therefore, three sources were used to ensure content validity of aesthetic-emotion items.

1. Reviewing literature on use of emotions to measure aesthetic perception and motivation.

2. 42 undergraduate business and cyber law students were assigned the task to provide lists of aesthetic-emotions that are adequately inculcated by Keller and Malone & Lepper's motivational variables. The students worked in groups and provided the initial lists.

3. Expert recommendation of 1 web-designer, 2 HCI researchers and 1 Media Psychologist was also obtained in the initial list of variables.

The lists of variables were carefully examined, checked, cleared for duplication or opposite words and a comprehensive list of 54 aesthetic-emotion items was compiled.

Factorial Validity – This validity refers to whether the factor structure of the questionnaire makes intuitive sense. Factorial validity is checked through factor analysis which examines whether the items tied onto factors make intuitive sense or not. This means if the clusters of aesthetic-emotion items used in this study, *"correlated highly and could be interpreted into meaningful groups"* factorial validity is attainted [236].

4.2.1.4 Sample Size / Response Rate

Thirty-eight (38) undergraduate business and cyber law students (with an average age of 21) participated in the first visual test (VT1), while thirty-four (34) undergraduate business and cyber law students (with an average age 21) participated in the second visual test (VT2) to secure a class participation point.

4.2.1.5 Scale

Each aesthetic-emotion item included a question presented in a five-point Likert scale mode, ranging from "strongly disagee" to "strongly agree". Respondents' responses were scored as: for the "strongly disagree" response a score of 1 was assigned, while for the "strongly agree" response a score of 5 was assigned. Consequently, a high scoring on a particular aesthetic-emotion item denoted its stronger presence.

4.2.1.6 Learners' Analysis

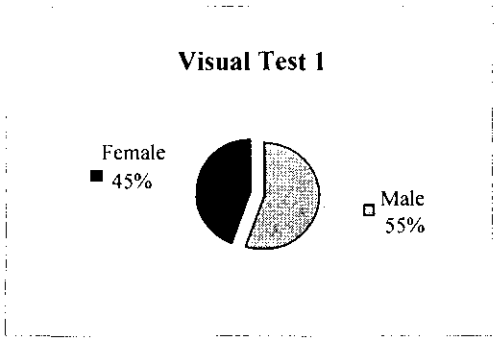


Figure 4.10: Gender (Study 3)

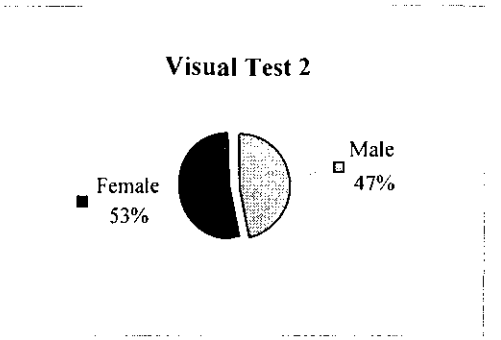


Figure 4.11: Gender (Study 3)

4.2.1.7 Applied Statistical Procedures

Factor analysis is a statistical method used to describe variability among observed variables in terms of a potentially lower number of unobserved variables called factors [236]. In other words, it is possible, for example, that variations in three or four observed variables mainly reflect the variations in a single unobserved variable, or in a reduced number of unobserved variables. Exploratory Factor Analysis (EFA) was based on data collected through VT1 and VT2. Methodology and analysis performed in each visual test are discussed below.

Visual Test 1 – The purpose of VT1 was to assess aesthetic-emotion items (Appendix C) by checking for duplications, discovering confusing items, and refining the list after the preliminary visual screening and EFA. The eigenvalues > 1 were scrutinized, while un-rotated factor solution and Cattell's Scree Plot recommendation was also examined before moving on the next explorative phase.

Selection of Website – According to Education and Research Association for Consumers, Malaysia, 30% Malaysian teenagers watch over eight hours of television a day during holidays, and are exposed to over two and half hours of advertisements a day [237]. Television or advertisements run on an IVEs, and fast food companies in Malaysia generate about US$ 28 million revenue a year by way of advertising through TV, newspapers and billboards [237]. Therefore, for the first visual screening test, websites of two popular fast food brands in Malaysia were selected.

Procedure – All participants were individually supervised in a computer laboratory and were randomly instructed to visit one of the two websites under

assessment, (1) McDonalds Malaysia http://www.mcdonalds.com.my/ (Figure 4.12), (2) Burger King Malaysia http://www.burgerking.com.my/ (Figure 4.13). Respondents were provided a hardcopy of the questionnaire (Appendix C) for indicating their response by evaluating the website on each aesthetic-emotion by using a 5 point scale ranging from (1) "strongly disagree" to (5) "strongly agree". After the rating, the participants were asked to indicate their views on the set of aesthetic-emotion items and recommend additional aesthetic-emotions, if they thought were missing from the initial list.

Figure 4.12: McDonald's' Malaysia Website (Visual Test 1)
Source: http://www.mcdonalds.com.my/

Figure 4.13: Burger Kings' Malaysia Website (Visual Test 1)
Source: http://www.burgerking.com.my/

Initial Solution: Out of 54, thirteen (13) aesthetic-emotion items emerged with eigenvalues greater than 1.00, explaining 66.3% of the total variance. Cattell's Scree Plot (a line graph of eigen values that depicts amount of variance explained by each factor) indicated a cutt-off at a five factor solution. This was because sixth factor onwards had failed to add appreciably to the cumulative explained variance.

Learners' Qualitative feedback: On the basis of initial solution, the list was thoroughly reviewed and modified by keeping in view loadings of items that were less than 0.5, as well as items that depicted either high cross-loadings or did not load high at all. 17 additions were also made as per the following (underlined) qualitative feedback of the respondents on the list of aesthetic-emotions (Chapter 5, Section 5.2.1.2).

Qualitative feedback of the respondents on Burger King's website is reproduced below:

"... sudden appearance of things in the main menu is quite mysterious"

"... 'have fun with the King' phrase reminds me of my childhood memories"

"advertisements are striking"

"Well-informed website"

"Color-combination of red background with yellow text is in harmony with the logo of BK"

"Very arousing!!"

"The website lacks in depicting the true eminence of Burger King"

Qualitative feedback of the respondents on McDonald's website is reproduced below:

"Reminds me of guilty pleasures that I have had at McDonalds with my friends"

"The image of joker standing (in the main menu) is very gimmicky"

"I feel happy to see this website"

"the website isn't interactive, it is important to intensify user's involvement"

"the kid's zone section needs a more realistic or a personalized touch "

"I feel like a resourceful person after reading all these nutritional facts"

"the website isn't stimulating at all"

"Extremely colorful website, with good combination of design, pattern and content."

The revised list of 59 aesthetic-emotion items was prepared.

Visual Test 2 – The purpose of VT2 was to develop/derive a scale by further reducing 59 aesthetic-emotion items and classifying them into aesthetic-motivational dimensions. This time Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were computed, eigenvalues > 1 were requested, factor loadings < 0.2 were

suppressed and unrotated factor solution along with Cattell's Scree Plot were also examined.

Selection of the Website – For the second screening test, it was decided to select a website that adequately reflected on aspirations of younger generation and at the same time association of an average Malaysian. According to a survey done by the Statistic Department for the Economic Planning Unit [238], a typical family in Malaysia earns only RM 3686/month. This amount is sufficient to pay for a new car because the local automotives such as Proton & Pordua are economical, e.g., around 546,000 cars were sold in 2009 and the forecasted number substantially exceeded 568,000 in 2010 [239]. Moreover, this sector is also very competitive as YB Tan Sri Nor Mohamed Yakcop, in PVA International Conference held at Kuala Lumpur in 2006 said that "*Malaysia is the only developing country in the world to have its own full automotive design and engineering capability*" [240]. For the second visual screening test, Malaysian local automotive sector was selected, since it has significantly contributed towards Malaysian economic growth and progress. Malaysians are generally said to take great pride in their automotive sector's development [241] and their true aspirations are reflected in it.

Figure 4.14: Proton Malaysia's Website (Visual Test 2)
Source: http://www.proton.com/

Procedure – All participants were individually supervised in a computer laboratory and were instructed to visit one of the two websites (1) Proton Malaysia http://www.proton.com/ (Figure 4.14) (2) Perodua Malaysia http://www.perodua.com.my/ (Figure 4.15). The participants were provided a

hardcopy of the questionnaire (Appendix D) for indicating their response by evaluating the website on each aesthetic-emotion by using a 5 point scale ranging from (1) "strongly disagree" to (5) "strongly agree".

Figure 4.15: Perodua Malaysia's Website (Visual Test 2)

Source: http://www.perodua.com.my/

Initial Solution – Out of 59, twenty-eight (28) aesthetic-emotion items emerged with eigenvalues greater than 1.00. The cumulative % of variance explained by the first four factors was 74.4%, indicating that about 74% of the common variance as shared by 28 aesthetic-emotions can be predicted by four factors alone. The recommended four factor solution was preferred because even on the Cattell's Scree Plot eigen values had immensely experienced a 'leveling off' situation after the fourth factor. Moreover, inadequate primary loadings and complexity in deducing the fifth and subsequent factors also supported the four factor suggestion.

Degree of common variance among 28 aesthetic-emotions, as indicated by Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.743. The KMO value is always between 0 and 1 and the closer the value is to 1, better it is considered for factorization, while values below 0.6 are considered unacceptable for factorization [242]. Its value was > than 0.6 and when referred to the interpretation table, it depicted "middling" adequacy for factorization (Table 4.1). Tabachnick and Fidell [243] stated that "*Bartlett's (1954) test of sphericity is a notoriously sensitive test of the hypothesis that the correlations in a correlation matrix are zero.*" The test is critized by researchers due to its sensitivity and its dependence on n, the test is likely to be significant with samples of substantial size even if correlations are very low. This test is recommended by researchers for a small sample of data, as it tends to often show significant results for larger population. This study too involved a small

sample data (n = 34) so the test was appropriate. Bartlett's test of sphericity also showed significant result, ($\chi 2$ (55) = 496.536, $p < .05$). Taken together, the results of KMO measure of sampling adequacy and Bartlett's test of sphericity *"provide a minimum standard which should be passed before a principal components analysis (or a factor analysis) should be conducted"* [245].

Table 4.1: KMO Interpretation Table

KMO Value	Degree of Common Variance
0.90 to 1.00	Marvelous
0.80 to 0.89	Meritorious
0.70 to 0.79	Middling
0.60 to 0.69	Mediocre
0.50 to 0.59	Miserable
0.00 to 0.49	Don't Factor

Based on initial solution and Cattell's Scree Plot which indicated a higher likelihood of a four factor solution, four factors were extracted and rotated using the Direct Oblimin method. Rotation serves to make the output more understandable and is usually necessary to facilitate the interpretation of factors [246]. Oblimin Direct rotation (non-orthogonal, oblique solution) method was chosen over more popular Varimax rotation (orthogonal solution) because from literature it was already establishd that aesthetic-emotion items were interrelated, and Oblimin Direct rotation is chosen when factors are allowed to be correlated. Tabachnick and Fiddell [247] argue that *"Perhaps the best way to decide between orthogonal and oblique rotation is to use oblique rotation (e.g., direct oblimin) with the desired number of factors and look at the correlations among factors. If factor correlations are not driven by the data, the solution remains nearly orthogonal, otherwise there are compleling reasons for it to be non-orthogonal"*.

In the final output (Chapter 5, Section 5.2.1.4), 9 aesthetic-emotion items had high cross loadings and 22 aesthetic-emotion items did not load high on any of the four factors, and were dropped from grouping consideration. The remaining aesthetic-emotion items that loaded high on each factor were grouped together to identify four aesthetic-motivational dimensions of the scale which were (1) *usability perception*, (2) *cognitive engagement*, (3) *visual & aesthetic appeal*, and (4) *satisfaction*. The four

dimensions highlight aesthetic aspects of FLVEs are assumed to be where learners' experience visual gaps due to difference between LAPs in IVEs and LLM in FLVEs.

Model Evolution Stage 2 at the end of Phase 3 is shown in Figure 4.16.

Aesthetic Perception and Motivation Model for F&IVEs

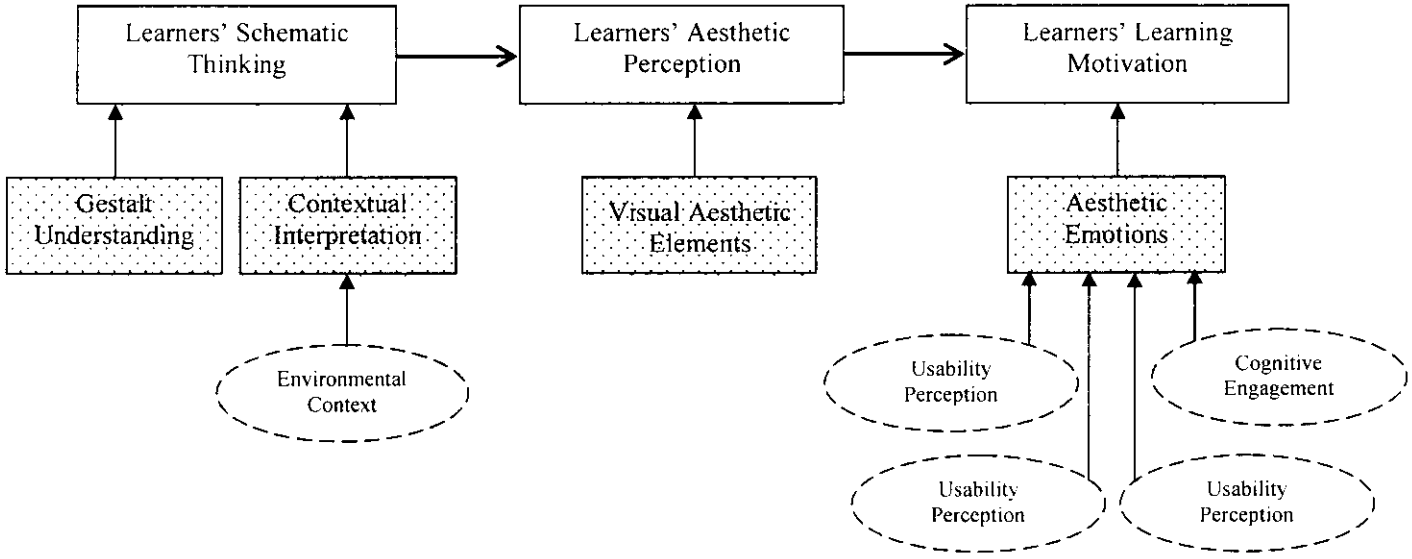
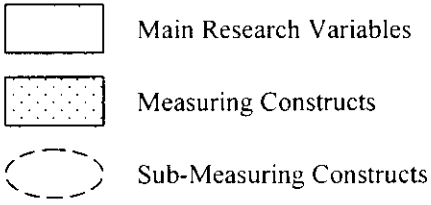


Figure 4.16: Model Evolution Stage 2



4.3 Model Testing

This phase of the MDF was introduced as testing stage of empirical research cycle.

4.3.1 Case Study 1: Formation of Learners' Mental Models and Interrelationship Testing of Variables

4.3.1.1 Methodology

The methodology was based on a true experimental design of F&IVEs involving learners participating in visual screening and filling out pretest-posttest questionnaires. For many researchers it is a preferred method to *"to compare participant groups and measure the degree of change occurring as a result of treatments or interventions"* [222]. Based on literature review, research model for Case Study 1 as shown in Figure 4.17 was developed.

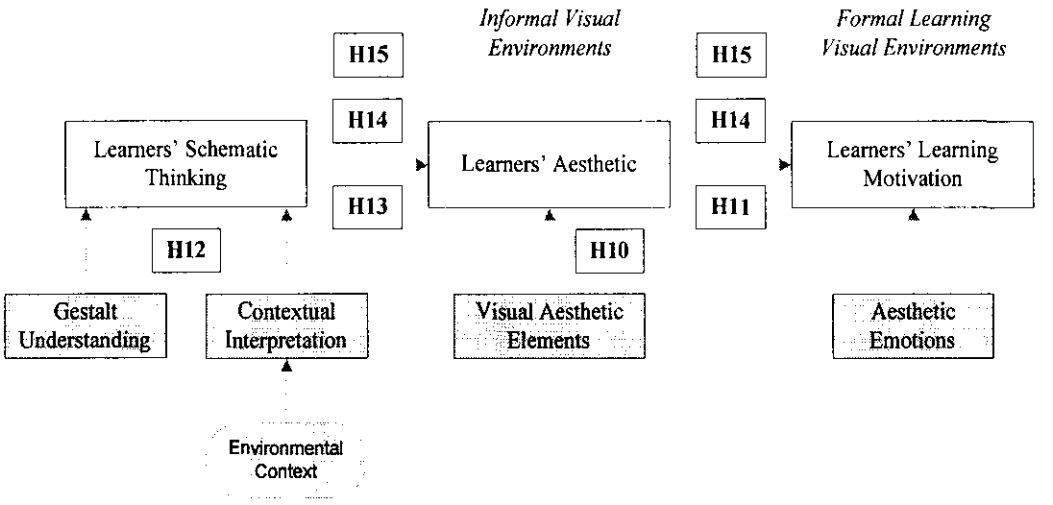


Figure 4.17: Research Model (Case Study 1)

4.3.1.2 Hypotheses

Hypotheses H^{10} to H^{15} were tested in Case Study 1. The hypotheses were formulated using results of the Study 1 and Study 2 that were conducting during the induction

stage (users' needs assessment) to infer strength of association between/among research variables.

4.3.1.3 Selection of the Websites

Informal Visual Environment: Alpine Meadows' website (Figure 4.18) was selected for visual screening and experimentation in Case Study 1, as it is an aesthetic website placed among top 5 visually appealing websites by Galleries [248], a celebrated online review magazine. For more details on selection of websites see Section 3.5.1.2. Alpine Meadows' website uses creative mix and blend of colors, images, captioning and eye catching visual tactics to win over satisfaction and immense popularity among its visitors. The website falls within tourism/recreation genere and provides detailed information on snow-sports, tourim and leisure activities.

Figure 4.18: Alpine Meadows' Website (Case Study 1)
Source: http://www.skialpine.com/

Formal Learning Visul Environment: Universiti Teknologi PETRONAS (UTP) E-learning environment as shown in Figure 4.19 was selected for visual screening and experimentation in Case Study 1.

Figure 4.19: E-Learning System of UTP (Case Study 1)

Source: www.utp.com.my/elearning

4.3.1.4 Procedure

The visual screening test was performed using pre and post session questionnaires, which learners' completed before and during visual screening of Alpine Meadows' and UTP's E-Learning Websites. Questionnaires for the visual screening test were designed using psychometric scales, as used in psychological research [139]. This technique was employed because psychometric scales tend to prompt an individual to respond to various questions that pertain to a given context and according to Davis [137] *"responses of individuals are an indication of their internal belief"*.

The questionnaire developed for this study had four sections. Section 1 consisted of questions on general demographics, interests and hobbies of the respondents, while Section 2 examined LAPs in IVEs. All participants were individually supervised in a computer laboratory and were instructed to visit Alpine Meadows' website. The participants were provided a hardcopy of the questionnaire (Appendix E) for indicating their response by evaluating the website on 11 aesthetic designing construct by using a 5 point Likert scale ranging from (1) "highly disaesthetic" to (5) "highly aesthetic". Time allocated for visual screening was 5 minutes. Section 2, also had 2 additional questions to assess LLM in F&IVEs. Section 3 consisted of questions on CI (Appendix F), while Section 4 consisted of questions on GU (Appendix G). Section 3 and 4 together measured LST as a compount of (CI + GU) in F&IVEs.

4.3.1.5 Validity

Two types of validity measures were applied.

(1) Comparable Validity of F&IVEs: Both F&IVEs were evaluated for their aesthetics and motivation before conducting visual experimentation. For aesthetic evaluation, 2 HCI researchers with expertise in graphic designing and usability, served as expert evaluators for UTP and Alpine Meadows' websites.

Table 4.2: Quanitifying Users's Aesthetic and Usability Perceptions (Testing)

Scoring	Universiti Teknologi PETRONAS (Formal Learning Visual Environment)	Alpine Meadows Website (Informal Visual Environment)
Aesthetics	51	64
Functionality	32	65
Usability	46	55
Content	37	46

Quantifying user's aesthetic and usability perceptions is a shareware excel program (Appendix L) designed by a researchers [249] for evaluating four aspects of websites, (1) Aesthetics, (2) Content, (3) Funtionality and (4) Usability. Each of the four constructs have 5 questions and takes scoring on a scale of 1-20. The scoring of of both websites was compared in a Spider Chart (Figure 4.20). From Spider Comparison Chart in Figure 4.20, it is evident that IVE of Alpine Meadows' has outdone FLVE of UTP in terms of both, aesthetic and usability perceptions.

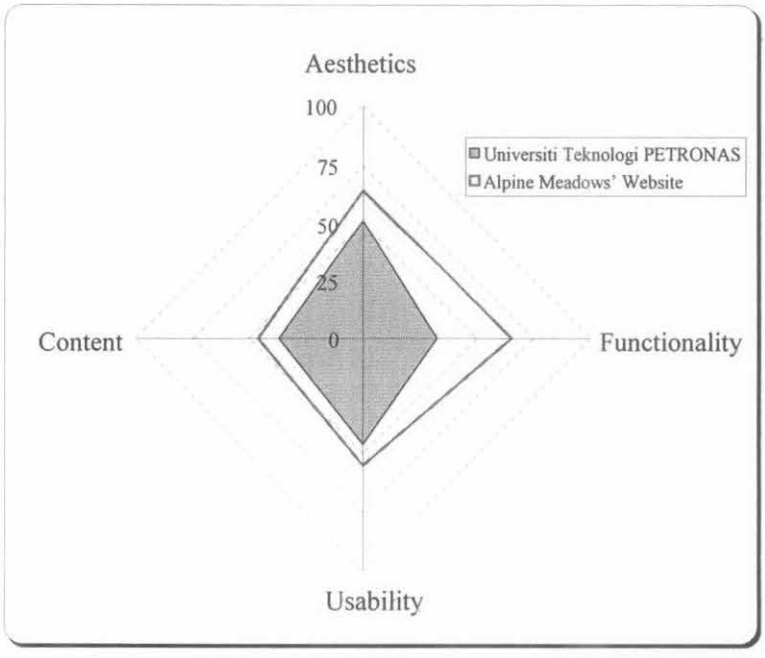


Figure 4.20: Spider Comparison Chart of F&IVEs (Case Study 1)

To quantify motivational appeal, two faculty members from Management and Humanities Department, majored in Instructional Design rated motivation level of the F&IVEs based on Website Motivational Analysis Checklist (WebMac) [250]. WebMac is a research tool, used by researchers worldwide and is based upon expectancy-value theory [251] and Keller's model. It essentially facilitates by using its eight instruments to assess the motivational quality of websites. In this study, the share wear version of WebMac Professional 2.0 (Appendix M) was used. The instrument is consisted of 32 items, 8 items for each motivation criteria, Stimulating (S), Meaningful (M), Organized (O) and Easy-to-use (E). Each item has a statement regarding the Webpage. The evaluators were asked to rate on a four-point Likert scale from 0 (strongly disagree) to 3 (strongly agree), or NA (not applicable).

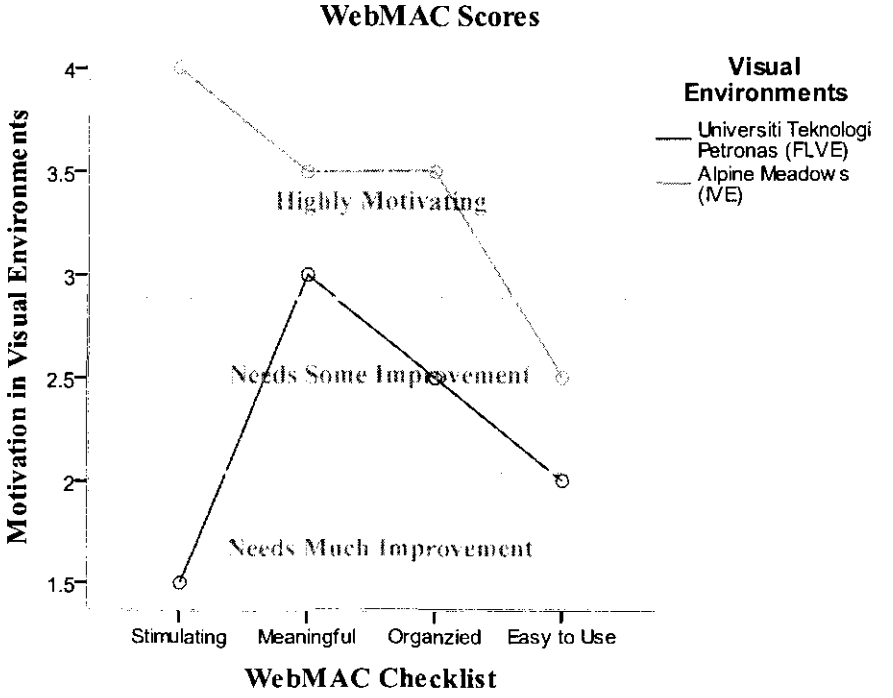


Figure 4.21: WebMAC Evaluation Results (Case Study 1)

The WebMAC evaluation results (Fig. 4.21) indicated that the motivation features of IVE (Alpine Meadows) were more inspiring when compared with FLVE (UTP).

(2) Item Discrimination Validity: Validity technique known as Item Discrimination Index (IDI) [252] indicates how adequately an item separates or discriminates between high scorers and low scorers on an entire test. It is a measure of

difference between the proportion of high scorers answering an item correctly and the proportion of low scorers answering the item correctly. Field [253] argues that item discrimination means that respondents with different score on a visual test should also differ in the construct of researchers' interest. Kelley [254] suggested item discrimination should be based upon following two corollaries and proposed inclusion of expert judgment to draw comparisons with, and to ensure Item Discrimination Validity (IDV).

1. Respondents with same score should be equal to each other along the measured construct

2. Respondents with different score should be different to each other along the measured construct

Therefore, experts' rating (1 HCI Expert and 1 Media Psychologist) were used as a classification baseline to ensure IDV and learners' with similar scores (falling within a common range) in a visual screening test were assigned same classification of aesthetic perception (High, Medium, Low) in IVE.

4.3.1.6 Learners' Analysis

43 undergraduate (20 male, 23 female) and 29 post-graduate (21 male, 8 female) IT students from Universiti Teknologi PETRONAS participated in the visual screening test. All participants were screened for color deficiency using online Dvorine Pseudo-Isochromatic Plates [255].

4.3.1.7 Applied Statistical Procedures

Section 2 of the questionnaire was analyzed to test H^{10} which was based on learners' rating of eleven aesthetic designing constructs for Alpine Meadows' website. It was important to transform those ratings into a single unit, product or score, for making comparisons and to classify LAPs (high, medium, low). This required adoption of a validated mechanism, whereby individual ratings of participants on 11 aesthetic

designing constructs could be transformed into singular unit, product or score. In a study [207] conducted on aesthetic appraisal of 5 most popular aviation websites in the world, a similar methodology based on transformation of ratings into a product score, has been used. Respondents in the study evaluated websites on given parameters by assigning 1 (Very Low) to 5 (Very High). These ratings were transformed into a product score, by examining frequency of occuring of each rating (1, 2, 3, 4, 5) and multiplying that frequency (e.g., 1 occurs two times, 2 occurs zero times, 3 occurs four times, 4 occurs three times, 5 occurs zero times) with that of transformation scale. The final total is added to obtain a unique product score, which in this case, e.g., is -1 (Table 4.3).

Table 4.3: Transformation Scale (Worked Example)

Rating	**VL**	**L**	**N**	**H**	**VH**
	1	**2**	**3**	**4**	**5**
Transformation Scale	-2	-1	0	+1	+2
Rating Frequency	2	0	4	3	0
Product (*Rating Frequency * Scale)*	-4	0	0	3	0
Product Score	-1				

Aesthetic Rating Transformation Scale – The transformation scale was accordingly adapted in this study to meet IDV. The results shown in the worked example (Table 4.3) is adapted in Table 4.4.

Table 4.4: Aesthetic Rating Transformation Scale (adapted by author)

Aesthetic Rating	**VL**	**L**	**N**	**H**	**VH**
	1	**2**	**3**	**4**	**5**
Transformation Scale	-2	-1	0	+1	+2
Aesthetic Rating Frequency	2	0	4	3	0
Product (*Aesthetic Rating Frequency * Scale)*	-4	0	0	3	0
Aesthetic Judgment Score (AJS)	-1				

The participants ratings on Section 2 of the questionnaire were transformed using Table 3.6, to obtain their Aesthetic Judgment Scores (AJS). Rating of Alpine Meadows' website on eleven (11) aesthetic designing constructs by one HCI expert and one Media Psychologist (MP) was obtained, see Table 4.5.

By using Aesthetic Rating Transformation Scale (Table 3.5), expert evaluators AJS (Table 4.6 for HCI graduates and Table 4.7 for Media Psychologist) were obtained.

Table 4.5: Expert Aesthetic Rating of Alpine Meadows' Website

Aesthetic Designing Constructs	**Case Study 1** Alpine Meadows	
	HCI	**MP**
Hierarchy	4	4
Emphasis	4	4
Contrast	5	4
Tension	4	5
Balance	4	4
Rhythm	4	4
Flow	5	4
Depth	5	4
Scale	4	4
Movement	4	5
Unity	5	5

Table 4.6: Tranforming Expert Aesthetic Rating to AJS (HCI)

Aesthetic Rating	**VL**	**L**	**N**	**H**	**VH**
	1	**2**	**3**	**4**	**5**
Transformation Scale	-2	-1	0	+1	+2
Aesthetic Rating Frequency	0	0	0	7	4
Product (*Aesthetic Rating Frequency * Scale)*	0	0	0	7	8
Aesthetic Judgment Score (AJS)	15				

Table 4.7: Tranforming Expert Aesthetic Rating to AJS (MP)

Aesthetic Rating	**VL**	**L**	**N**	**H**	**VH**
	1	**2**	**3**	**4**	**5**
Transformation Scale	-2	-1	0	+1	+2
Aesthetic Rating Frequency	0	0	0	8	3
Product (*Aesthetic Rating Frequency * Scale)*	0	0	0	8	6
Aesthetic Judgment Score (AJS)	14				

Experts (HCI, Media Pyschologist) AJS was used as a *baseline* to meet IDV and to also *identify* aesthetic perception classification range (Table 4.8).

By using similar approach, 72 learners' aesthetic rating on Alpine Meadows' website was transformed into their AJS. Extensive filteration of results was carried

out and 52 cases were retained of those learners' only who had adequately answered in all 5 sections of the questionnaire (Appendix J).

Table 4.8: Experts Aesthetic Rating and AJS for Alpine Meadow's Website

Aesthetic Designing Constructs	**Case Study 1** Alpine Meadows	
	HCI	**MP**
Hierarchy	4	4
Emphasis	4	4
Contrast	5	4
Tension	4	5
Balance	4	4
Rhythm	4	4
Flow	5	4
Depth	5	4
Scale	4	4
Movement	4	5
Unity	5	5
Aesthetic Judgment Score (AJS)	15	14

Data Distribution: In Figure 4.22, respondents AJS is plotted against LLM in IVE. Two types of evaluators (Experts and learners' of FLVE) evaluated the Alpine Meadows' website on the basis of 11 aesthetic designing constructs. Expert evaluation is shown in black bars, while learners' evaluation is shown in grey bars. Expert AJS evaluation ranges between + 14 ~ +15 and motivation between 3 ~ 4, while learners' AJS evaluation falls between - 4 ~ + 18 and motivation ranges between 2 ~ 5.

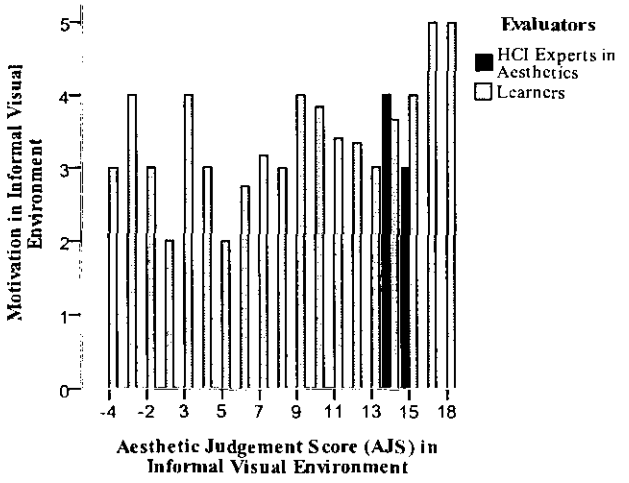


Figure 4.22: Bar Chart of Aesthetic Judgment Scoring Distribution (Case Study 1)

Scatterplot of the same data was also plotted to examine presence outliers in data, which were identified as none (Figure 4.23).

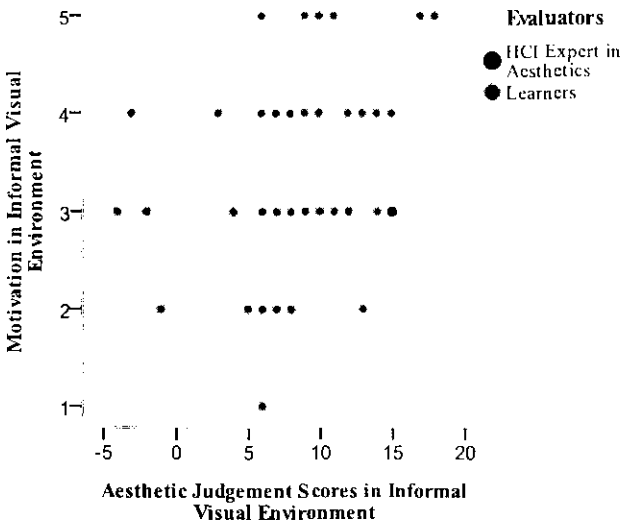


Figure 4.23: Scatter Plot of Aesthetic Judgment Scoring Distribution (Case Study 1)

Range: As seen in data distribution, the range (minmum to maximum) to classify respondents on the basis of their AJS is - 4 ~ +18. This range has 22 digits in between inclusive of the extreme two ends. When the range is divided among three groups, following classifications (Table 4.9) to be assigned to learners' on the basis of their AJS is determined and hypothesis testing H^{10} is performed.

Table 4.9: Range for Classification of Learners' Aesthetic Perceptions

	Classification	Range
1	Low in Aesthetic Perceptions	- 04 to + 04
2	Medium in Aesthetic Perceptions	+ 05 to + 11
3	High in Aesthetic Perceptions	+ 12 to + 18

H^{11} investigated interrelationship between LAPs in IVE and their LLM in a FLVE. For this investigation, Kendall's Tau method for examining Bivariate Correlations was selected because it essentially met the nonparametric conditions of the study. First, study used a small data set of 52 learners' reporting their learning motivation in FLVE. Second, learners' were classified into three categories of aesthetic perceptions (high, medium, low) on the basis of their AJS in IVE. This caused many learners' to have similar AJS resulting in a relatively a larger number of them classified as with medium aesthetic perceptions. Although, Spearman's statistic

is more popular, there are much to suggest that Kendall's statistic is conservative and actually a better estimate of the correlation in such kind of population distribution [256] and makes more accurate generalizations [257]. The correlation analysis was performed and significance level was checked and interpreted.

H^{12} investigated interrelationships among CI, GU, and LST. Before performing any kind of correlation analysis it is good to plot a scatter plot and look at the shape of data. A scatter plot is a line graph that indicates some important things about the data, such as whether there seems to be a relationship between the variables, what kind of relationship it might be and whether there are any cases that are markedly different from the others. For this investigation, first scatter plots of the two independent variables CI and GU were plotted against the outcome variable, LST. Pearson Correlation Coefficient is an extremely robust method that requires parametric data, since it is based upon the average deviation from the mean. Data for this research question was parametric, so Pearson Correlation Coefficient were computed, significance level was check and interpreted. To understand causality of interrelationships between LST, CI and GU, R square (R^2) of each variable was drawn by squaring its Correlation Coefficients, to make conclusions about variability. In statistics, the coefficient of determination R^2 is used in the context of statistical models whose main purpose is the prediction of future outcomes on the basis of other related information [258]. By squaring the Correlation Coefficient, a measure of how much of the variability in one variable is predicted by the other can be derived.

H^{13} investigated interrelationship among LAPs, LST, CI and GU. Again for this investigation, scatter plot of LAPs was plotted against LST. Pearson Correlation Coefficients were computed (LAPs, LST, CI and GU), significance level was checked and direction of casuality using R^2 was interpreted.

H^{14} investigated interrelationship between LAPs in IVE and LLM in FLVE by accounting for the effect of LST, as a covariate. ANOVA includes one or two continuous variables that predict the outcome or dependent variable. However, continuous variables such the once that are not part of the main experimental manipulation but may have an influence on dependent variable are known as covariate in the Analysis of Covariance (ANCOVA). ANCOVA [259] or the analysis of

covariance takes into account confounding variables to give a clear measure of effect of the experimental manipulation, and the analysis is performed as such to examine influence of independent or fixed factor (LAPs) on dependent variable (LLM) and the same influence of independent variable after the effect of covariate (LST) is included in the analysis. Two assumptions were met before performing ANCOVA (i) Independence of the Covariate and Treatment Effect, and (2) Homogeneity of Variances [260]. The first assumption was checked by performing One Way Independent ANOVA on groups as independent variables (LLM in FLVE) and covariate (LST) as an outcome variable. The second assumption was met by performing Levene's Test [261].

H^{15} investigated if a model based on measuring constructs of LAPs in IVE and LST can predict variance in LLM in a FLVE. The hypothesis testing was based on Hierarchal Regression Modelling (HRM), which is the practice of building successive Linear Regression Models, each adding more predictors [262], employed as a simple form of quasi-experimental research design, as it is said to provide *"a less-biased estimate of the causal relationship of variables with one another by controlling confounding variables or set of variables"* [263]. The idea of the quasi-Experiment is to use observational data, non-experimental or non-randomly assigned data for estimating *how big the effect of a true experiment would be*. This is important because observational data tends to have a very biased outcome and may suggest that things make much bigger difference than they actually do. However, it is not always possible to do a true randomized experiment, therefore, quasi-experimental method can be very handy. HRM works by start adding chunks or blocks of predictors (control variables) to the model in one step. Later, more predictors of interest are added in chunks or blocks, to see if they predict the dependent variable above and beyond the effect of the controls. To test H^{15}, Pearson Correlation Coefficients were computed to determine individual strength and association of each measuring construct with LLM. Then a fixed entry order of variables in the form of Order 1 (consisted of measuring constructs for LAPs), Order 2 (consisted of measuring constructs for CI) and Order 3 (consisted of measuring constructs for GU) were specified to control for the effects of covariates and to test the effects of certain predictors independent of the influence of others on LLM in FLVE. Results were analyzed by examining *b*eta Coefficients of

each measuring construct in Model 1 (consisted of Order 1), Model 2 (Order 1 + Order 2) and Model 3 (Order 1 + Order 2 + Order 3) on predicting LLM. The *b*eta Coefficients or *b* value signifies relationship between LLM and each measuring construct, by indicating, individual contribution of each measuring construct towards predicting LLM and to which degree each measuring construct affects it, if the effect of all other constructs is held constant [264]. The standardized *b*eta values (SBVs) indicate the number of standard deviations that the outcome will change as a result of one standard deviation change in the predictor [264]. The standardized *b*eta values are all measured in standard deviation units and so are directly comparable to provide a better insight into the importance of a predictor into the model. This was followed by interpretation of R^2 for Model 1-2-3 and interpretation of R^2 Change for Model 1-2-3.

Model Evolution Stage 3 at the end of Phase 4 is shown in Figure 4.24.

Aesthetic Perception and Motivation Model for F&IVEs

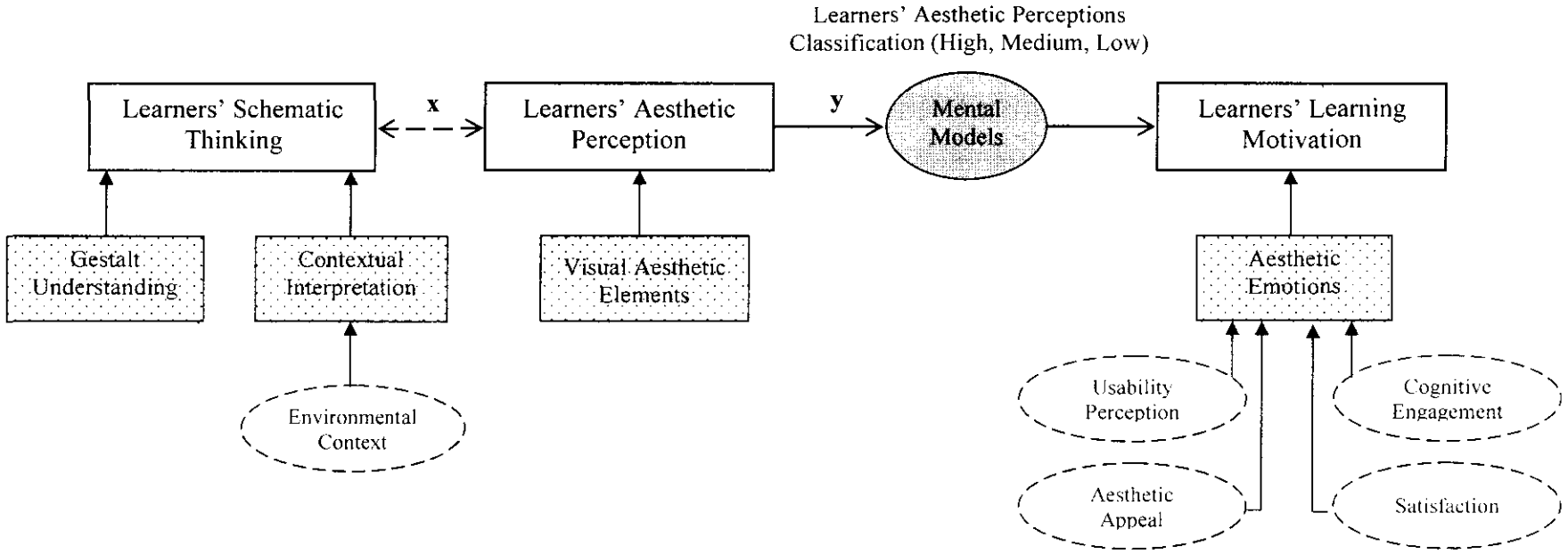
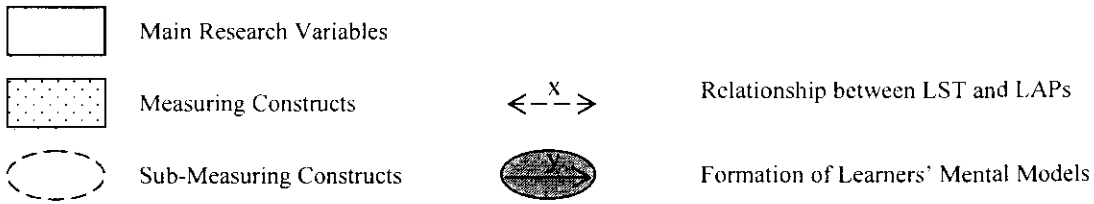


Figure 4.24: Model Evolution Stage 3



4.4 Model Validation

This phase of the MDF was introduced as an evaluation stage of empirical research cycle.

4.4.1 Case Study 2: Model's Multivariate Effects and Interaction Effects

4.4.1.1 Quantitative Methodology

This phase also involved a true experimental design based on pretest-posttest questionnaires. Both, quantitative and qualitative research methods were applied to collect data. The purpose was to solidify empirical findings and develop a theoretical justification of the proposed model. The quantitative methodology of the experimental design is discussed from Section 4.4.1.2 to 4.4.1.8, while the qualitative methodology is presented in Section 4.4.2.

4.4.1.2 Hypotheses

Hypotheses H^{16} to H^{20} were tested in Case Study 2 (Chapter 3, Table 3.5).

4.4.1.3 Selection of Websites

Informal Visual Environment: For this experimental research design, it was important to choose an IVE that was web-based and also aesthetic. Galleries [248] is a celebrated online review magazine which frequently showcases examples of well-designed and aesthetic websites in various industries. It is reviewed by top-notch industry experts and aesthetic professionals working at multinational organizations that also provide ideas on creative arts and designing. The magazine in its April, 2011 edition presented a collection of community-oriented aesthetic websites for inspiration of designers and five websites were critically appreciated (Figure 4.25 to 4.29).

Figure 4.25: Ernest Hemingway
Source: www.ernesthemingwaycollection.com/

Figure 4.26: Destination Organic
Source: http://www.organicexpress.co.nz/

Figure 4.27: Project Vino
Source: ttp://www.projectvino.com.au

Figure 4.28: Dara's Garden
Source: www.darasgarden.com

Figure 4.29: Alpine Meadows
Source: www.skialpine.com

Four HCI researchers, with expertise in graphic and creative designing assisted in selection of aesthetic websites for the two case studies by nominating 3 out of 5 websites as their 'favourite most', in terms of their visual and aesthetic appeal. The

evaluators browsed through each website for less than 2 minutes and made a pick. HCI evaluators rating of each website is summarized in Table 4.10. The websites of Destination Organic and Alpine Meadows received the highest number of votes (4 each) and were selected for inclusion in the true experimental designs.

Table 4.10: HCI Evaluators rating of the 5 selected IVEs

	The Ernest Hemingway Collection	**Destination Organic**	**Project Vino**	**Alpine Meadows**	**Dara's Garden**
Genre	Autobiography	Health Care	Social Networking Website	Tourism	Gardening
HCI Evaluator	✓	✓		✓	
HCI Evaluator		✓	✓	✓	
HCI Evaluator		✓		✓	✓
HCI Evaluator		✓	✓	✓	
Votes	1	4	2	4	1

Formal Learning Visual Environment: For Case Study 2, E-Learning systems of Universiti Malaysia PAHANG (UMP), Open Universiti Malaysia (OUM), and Universiti Tun Abdul Razak (UniTAR) were among initial choices. Finally, after much consideration, E-Learning system of Universiti Malaysia PAHANG (UMP) was selected (see Figure 4.30 to Figure 4.34).

Figure 4.30: E-Learning System of UMP (Case Study 2)
Source: www.moodle.ump.edu.my/

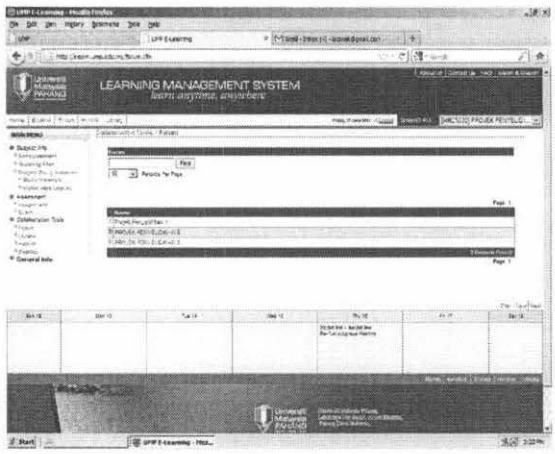


Figure 4.31: E-Learning System of UMP (Case Study 2)
Source: www.moodle.ump.edu.my/

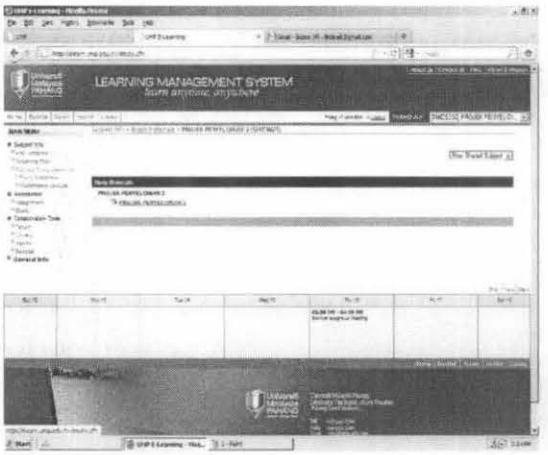


Figure 4.32: E-Learning System of UMP (Case Study 2)
Source: www.moodle.ump.edu.my/

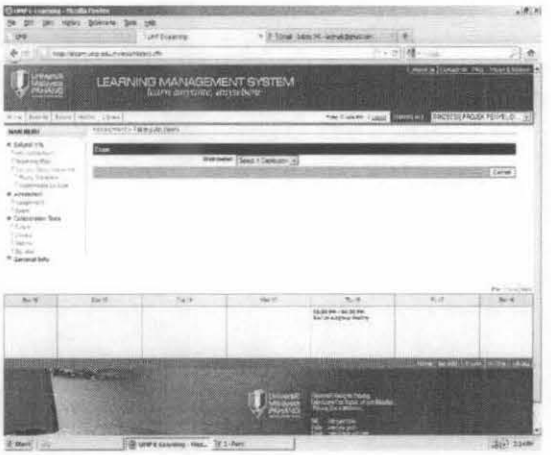


Figure 4.33: E-Learning System of UMP (Case Study 2)
Source: www.moodle.ump.edu.my/

4.4.1.4 Procedure

Every participant of visual experimentation filled in self-reporting questionnaires and appeared for visual screening of F&IVEs. However, selective participants (who voluntarily agreed) appeared for qualitative reporting session in Phase 5. In order to encourage maximum number of learners' to participate in experimentation, flyers/posters were emailed and also displayed at the campus main gathering areas 14 days before making actual visit. Experimentation took place from 26-30th June, 2011 at Universiti Malaysia PAHANG's main campus. Participants were given energy drinks, sweet candies, and souvenirs including key chains and cups with UTP's logo, in acknowledgement of their participation. Figure 3.22 shows experiment design steps that were used in Case Study 2.

4.4.1.5 True Experimental Design Steps

Step 1 (Self-reporting): In the first step, participating learners' had to complete questionnaire's Section 1 (Appendix F) based on CI factors to reflect upon their visual media interaction behaviour and Section 2 (Appendix G) on paper based visual test of their GU.

Step 2 (Visual Screening of an IVE): Learners' appeared for a visual screening of an IVE (Destination Organic) to reflect upon their aesthetic perceptions based on 11 aesthetic designing constructs. Each participant was allocated 3 minutes to browse through the website and accordingly rate (1- least aesthetic to 5 - highly aesthetic) the website in Section 3 (Appendix E) of the questionnaire.

Step 3 (Visual Screening of a FLVE): Learners' appeared for a visual screening of a FLVE (E-Learning System of UMP) to reflect upon LLM in FLVE and accordingly completed questionnaire's Section 4 (Appendix N). Each participant was allocated 3 minutes to browse through and accordingly rate (1- least motivating to 5 – highly motivating) the website.

Step 4 (Qualitative Reporting): Learners' who voluntarily agreed also appeared for qualitative reporting in Section 5 (Appendix H) and Section 6 (Appendix I) of the questionnaire in which they had to choose appropriate words (adjectives) to indicate (i) what in terms of aesthetics attracts them the most in IVEs and (ii) choose appropriate words (adjectives) to indicate their motivation in FLVEs. This was followed by short interviews.

4.4.1.6 Validity

In order to ascertain validity of F&IVEs used for visual screenig in Case Study 2, following two measures were ensured:

(i) The selected F&IVEs should be comparable in terms of their aesthetic and motivation appeal (see Section 4.3.1.5).

(ii) The constructs used in questionnaire should be equitable and justify classification of LAPs as high, medium and low in IVEs (see Section 4.3.1.5).

(1) Comparable Validity of F&IVEs: For aesthetic comparison, 2 HCI researchers with expertise in graphic designing and usability, served as evaluators for aesthetic evaluation of IVE, Destination Organic and FLVE, E-Learning Systems of UMP. Results are shown in Table 4.11.

Table 4.11: Quanitifying Users's Aesthetic and Usability Perceptions (Validation)

Scoring	Universiti Malaysia Pahang (Formal Learning Visual Environment)	Destination Organic (Informal Visual Environment)
Aesthetics	51	75
Functionality	49	60
Usability	67	69
Content	34	74

The scores obtained in Table 4.11 were plotted in a Spider Comparison Chart Figure 4.34, which shows that Destination Organics website (IVE) is superior to UMP's E-Learning System (FLVE), in terms of Aesthetic, Functionality and Content. However, in terms of Usability, the two visual environments were rated *almost* equally by experts.

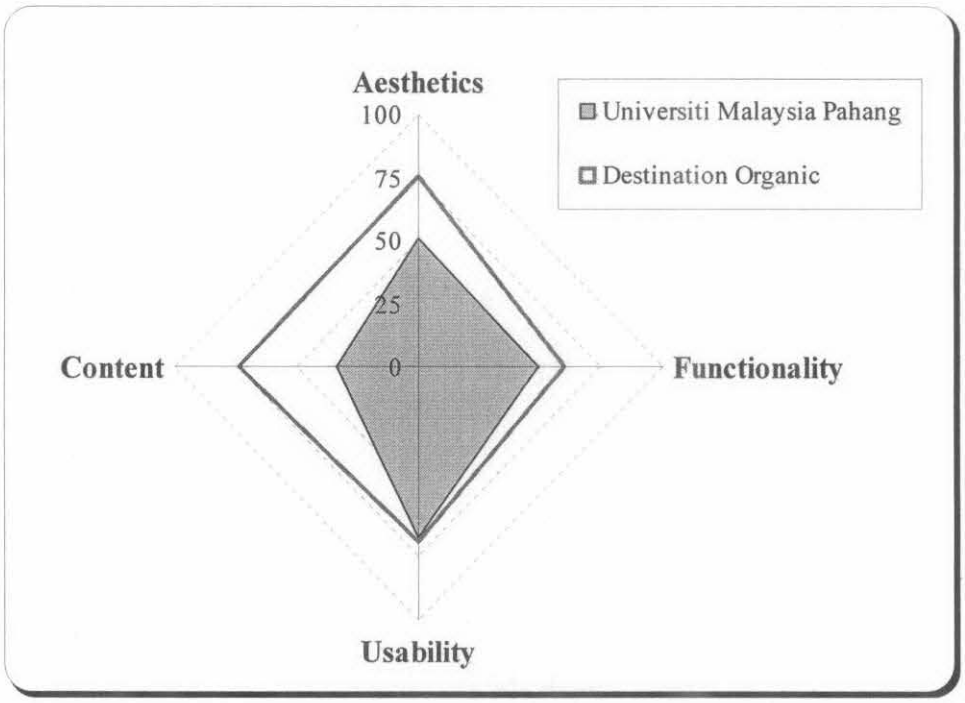


Figure 4.34: Spider Comparison Chart of F&IVEs (Case Study 2)

To quantify motivational appeal, two faculty members from Management and Humanities Department, majored in Instructional Design rated motivation level of Destination Organic and E-Learning System of UMP based on WebMac (Appendix M) The WebMAC evaluation results (Figure 4.35) indicated that the motivation features Destination Organic (IVE) were more inspiring when compared with UMP's E-Learning System (FLVE).

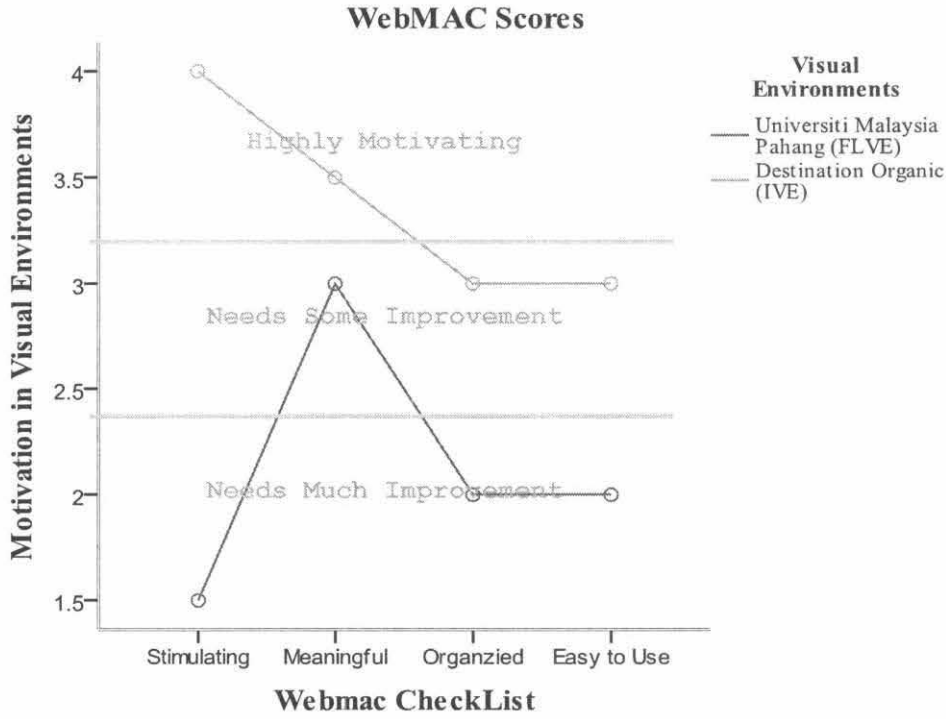


Figure 4.35: WebMAC Evaluation Results (Case Study 2)

(2) Item Discrimination Validity: Expert's aesthetic rating and transformation into AJS is shown in Table 4.12 for Case Study 2.

Table 4.12: Expert Aesthetic Ranking and AJS for Destination Organic's Website

Aesthetic Designing Constructs	**Case Study 2** Destination Organic	
	HCI	**MP**
Hierarchy	4	4
Emphasis	3	4
Contrast	4	4
Tension	3	4
Balance	4	5
Rhythm	4	4
Flow	4	3
Depth	5	4
Scale	5	4
Movement	4	4
Unity	5	4
Aesthetic Judgment Score (AJS)	12	11

Aesthetic rating of Destination Organic's website by 176 learners' was transformed into AJS and was compared with that of expert's AJS. Following learners' classifications emerged for Case Study 2 (Figure 4.36).

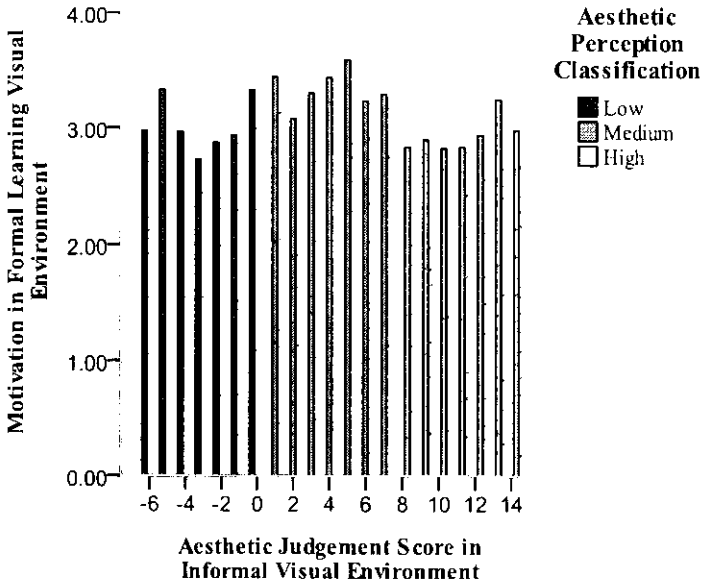


Figure 4.36: Bar Chart of Aesthetic Judgment Scoring Distribution (Case Study 2)

4.4.1.7 Learners' Analysis

A total number of 176 respondent participated in visual experimentation of F&IVEs, of which 56.82% were male respondents, while 43.18% were female respondents. Participants were screened for color deficiency using online Dvorine Pseudo-Isochromatic Plates [255]. The majority fell within 21-24 years age group (55.68%).

4.4.1.8 Applied Statistical Procedures

To test hypothesis H^{16}, Multivariate Analysis of Variance (MANOVA) was performed since the study involved four aesthetic-motivational dimensions (usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction) as dependent variables. MANOVA is a way to test the hypothesis that has one or more independent variables, or factors, have an effect on a set of two or more dependent variables [265]. MANOVA is better than performing a series of one-at-a-time ANOVAs, for two main reasons, (1) the procedure reduces experiment-wise level of Type I error, i.e., rejecting the null hypothesis when it is in fact true. The so-called overall test or omnibus test protects against this inflated error probability only when the null hypothesis is true and (2) none of the individual ANOVAs may produce a

significant main effect on the DV., but in combination they might, which suggests that *"the variables are more meaningful taken together than considered separately"* [265]. MANOVA takes into account the inter-correlations among the DVs.

For model validation, three assumptions of MANOVA were checked (i) Multivariate Normality of all four aesthetic-motivational dimensions (ii) Homogeneity of the Covariance Matrices and (iii) Homogeneity of Regression Slopes. While the (i) and (ii) assumptions were checked before performing MANOVA, assumption (iii) was checked to test hypothesis H^{19}. The first assumption was checked by visualizing histograms of the four aesthetic-motivational dimensions and by plotting their pair-wise scatter plots to confirm their linear. The second assumption required holding of equal variances for each aesthetic-motivational dimension. This assumption was met by examining Box's M, which tests the hypothesis that the covariance matrices of the dependent variables are significantly different across levels of the independent variable [265].

Once two basic assumptions were met, MANOVA was performed to test hypothesis H^{16}, which was done by interpreting Wilks' lambda (λ) and the F value associated. Wilks' lambda performs, in the multivariate setting, with a combination of dependent variables, the same role as the F-test performs in one-way analysis of variance [266]. Wilks' lambda is a direct measure of the proportion of variance in the combination of dependent variables that is unaccounted for by the independent variable (the grouping variable or factor). There are a number of alternative statistics that can be calculated to perform a similar task to that of Wilks' lambda, such as Pillai's trace criterion and Roy's gcr criterion; however, Wilks' lambda is the most widely used [267]. For significant overall F test results, individual dependent variables with separate ANOVA tests were later examined. Since MANOVA provides an experiment wise alpha protection known as the overall or omnibus F-test, *"it cannot be applied to the univariate tests, without making an alpha correction"* [268]. Therefore, alpha correction was made by dividing confidence levels (.05) with the number of F-tests to be performed. H^{16} involved four aesthetic-motivational dimensions and four subsequent F-Tests, therefore, p at $< .013$ (.05/4) was adjusted. Levene's Test showed non-significant results for the three dependent variables that

had significant ANOVAs, so post-hoc multiple comparisons with Sheffé Tests was performed and results interpreted.

To test hypothesis H^{17}, Multivariate Analysis of Covariance (MANCOVA) was performed to test mean differences among LAPs groups (high, medium, low) for a linear combination of four aesthetic-motivational dimensions (usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction) after adjusting for the effect of the covariate (LST) in the model (Chapter 5, Section 5.4.3). This was followed by assessment of Univariate ANOVAs and post-hoc multiple comparisons to test hypothesis H^{18}.

Hypothesis H^{19} was based on testing an additional assumption of MANCOVA which is known as Homogeneity of Regression Slopes. This assumption is tested because when analysis of covariance is computed, the overall relationship between four aesthetic-motivational dimensions and the covariate (LST) is considered to be true for all groups of LAPs (high, medium, low) in IVE. This is done by *"fitting a regression line into the entire data set, assuming that this overall relationship is true for all groups of participants"* [269]. If, however, the relationship between dependent variables and covariate is different in any one of the groups, then overall aesthetic perception and motivation model is inaccurate and void, since it does not represent all of the groups [269]. This assumption validates the relationships of measuring constructs used in proposed model and was checked by computing Interaction Effect of LAPs (high, medium, low) and the covariate, LST against four aesthetic-motivational dimensions (LLM in FLVE).

At the end of Phase 5, Model Evolution Stage 4 as shown in Figure 4.37 was achieved.

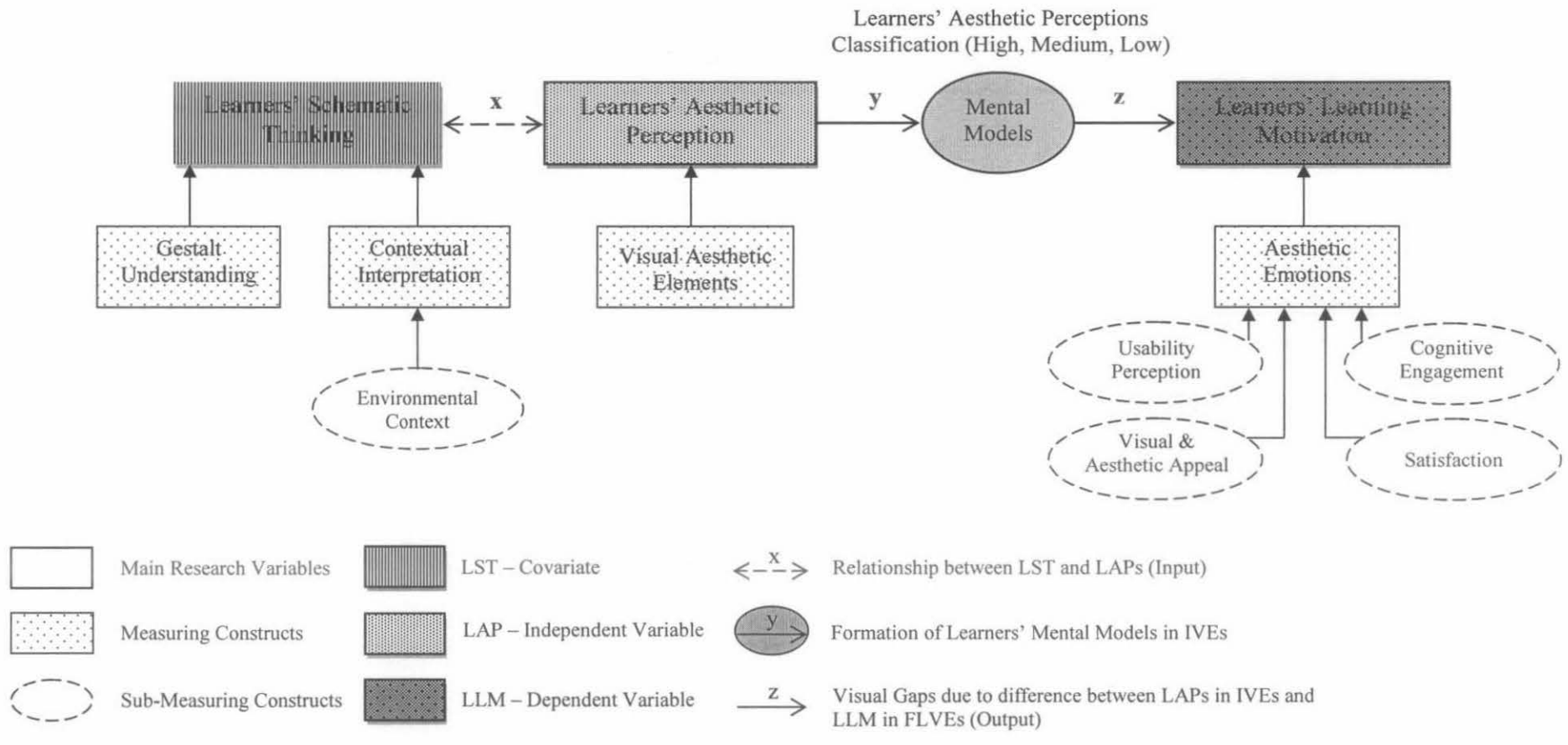


Figure 4.37: Model Evolution Stage 4

4.4.2 Case Study 2: Model's Theoretical Rationalization

4.4.2.1 Qualitative Methodology

Hypothesis H^{20} meant to gather an in-depth understanding of LAPs in IVEs and their LLM in FLVE. It was formulated to be tested with a qualitative method based on Grounded Theory Approach. Grounded Theory is a research method in which the theory is developed from the data, rather than the other way around [270], since it is an appropriate way to research a previously little studied area in IS research. According to Strauss [271], *"A grounded theory is one that is inductively derived from the study of the phenomenon it represents. That is, it is discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon"*. This methodology provides an ideal guideline to analyze qualitative data and equips researchers with necessary understanding of underlying concepts to build theories through successive levels of data analysis [272]. Researchers [273], [274] have recognized this method as an authentic research tool in qualitative data analysis due to its procedural credibility. The population of this study consisted of learners' of FLVEs and analysis of data transcripts was based on an inductive approach which is meant to identify emerging patterns in the data by using Thematic Codes. Inductive analysis looks for emerging patterns, themes and categories through analysis of data and opposes imposition of the same, prior to data collection and analysis [275].

4.4.2.2 Research Questions

Following questions were particularly and repeatedly asked to prompt respondents to reflect upon their schematic thinking, aesthetic perception and motivation in F&IVEs.

1. What is your most favorite IVE and why do you like it so much?
2. What makes your Informal Visual Media interaction so likeable/dislikeable?

3. Has your personality been influenced (in terms of attitude/behavior/selection /judging/ opinion) due to your frequent interaction with Informal Visual Environments?
4. Appreciate/criticize aesthetics of Formal Learning Visual Environment that you interact with.

4.4.2.3 Validity

In order to ensure study's trustworthiness and validity, two methods were employed, (1) Triangulation, and (2) Negative Case Analysis.

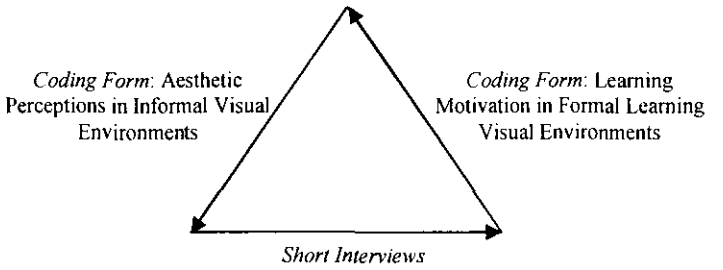


Figure 4.38: Triangulation Process

Triangulation: The purpose of triangulation in qualitative research is to increase the credibility and validity of the results [276]. For triangulation it is important to analyze and see that findings converge on something similar, or at least do not oppose each other [277]. Therefore, short interactive discussion of less than 3 minutes was held with every participant in qualitative reporting session so as to build deeper understanding of LAPs in IVEs and LLM in FLVEs. This information was crucial to complete the process of triangulation (Figure 4.38) and could not be obtained through the coding form alone. Moreover, in short interviews, researcher is in a position to pick up non verbal cues and even rephrase questions to personalize them and make respondents feel at ease to answer them.

Negative Case Analysis: Ne gative cas e analysis was performed on the initial derived emerging themes [271], [278]. The purpose was to see if the characteristics of the derived emerging theme sufficiently inculcated the true essence of whole research and were applicable to all cases. When it can be determined that there are no negative cases or disconfirming evidence, the analysis can be considered as complete.

4.4.2.4 Coding Form

Usability evaluation has been employed frequently for spotting strengths and weaknesses of an application's from user-friendliness point of view. Similarly, questionnaires have extensively been used to evaluate user interfaces of different applications. Microsoft's usability testing questionnaire, known as *"words"* is based on 118 words used by Microsoft in their product reaction cards [279]. In the questionnaire, 118 words are presented with a check-box and the users are asked to choose the words that best describe their interaction experience. They are free to choose as many or as few words as they wished. The same technique was adapted for the qualitative research to count frequency of selected words for coding purposes (Appendix H) and (Appendix I).

Three HCI graduates with sufficient knowledge of aesthetic and usability perception and three HCI graduates with apt background in instructional designing helped in identifying 26 words (treated as adjectives) to symbolize aesthetic experience and 26 words to represent disaesthetic experience in F&IVEs. Likewise, 26 words were selected to signify motivating experience and 26 words for demotivating experience in F&IVEs. Respondents were free to tick as many and as few words from both sections, and they were also requested to suggest additional words in case they were not provided or covered in the list.

4.4.2.5 Learners' Analysis

A total number 176 respondent participated in visual experimentation and 27 respondents voluntarily participated in qualitative reporting session, of which 12 (43.24 %) were female respondents, while 15 (56.76 %) were male respondents.

4.4.2.6 Emerging Themes Analysis

Grounded Theory is based on constant comparisons of literature, field notes, events and behavior. It requires naming and coding simultaneously to support an emerging theory [280]. Section 4.5.2.3 discusses the coding form and technique used in this

study. Moreover, short interviews were also conducted with respondents to compare and examine consistencies and differences in codes. Codes and short interviews were examined in parallel to look for consistencies in terms of similar meanings or pointing to a basic idea. This was followed by Emerging Themes Analysis (ETA) which is also known as Thematic Analysis [281]. This type of analysis is highly inductive and themes emerge from the data and are not imposed upon it by the researcher. For ETA data collection and analysis was done simultaneously. Background reading on formation of aesthetic perceptions and motivation was included in the analysis process since it could help to explain an emerging theme.

4.5 Chapter Summary

This Chapter presented detailed research methodology for model development, testing and validation applied through the MDF which was designed in alignment with the Groot's empirical research cycle. Based on self-reporting questionnaires, two pilot studies were conducted to assess learners' motivation and aesthetic needs in F&IVEs. A scale was developed to embed LAPs and LLM in F&IVEs for which EFA was performed on learners' aesthetic-emotions (treated as adjectives) associated with F&IMFs in models given by Keller (attention, relevance, confidence, satisfaction) and Malone & Lepper (challenge, control, curiosity, fantasy). Model testing was performed through true-experiment design on the conceptualized model. Model testing involved formation of learners' mental models or schemata models by using expert judgment scoring that led to the classification of LAPs into high, medium, low. Furthermore, interrelationship testing of variables and their sub-measuring constructs was also performed during this phase. Model validation was conducted through another true-experiment design by applying both quantitative and qualitative research methods. Model validation involved determining model's prognostication effect and multivariate interaction effects of LST (CI + GU) and LAPs (high, medium, low) across four aesthetic-motivational dimensions (usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction). Finally, using grounded theory approach ETA was performed to build model's theoretical rationalization.

CHAPTER 5

RESULTS

5.0 Chapter Overview

This Chapter is designed to report hypotheses testing results and has been organized as per the four phases of the MDF. Section 5.1 presents results of two preliminary studies conducted to assess users' motivation and aesthetic needs associated with F&IMFs in F&IVEs. Section 5.2 presents results of EFA performed for scale development to embed LAPs and LLM in F&IVEs. Section 5.3 is devoted to the results obtained through true experimental design on model testing and Section 5.4 is dedicated to results obtained through true experimental design on model validation. Section 5.5 presents summary of the Chapter.

5.1 Users' Needs Assessment

For research methodology adopted to assess users' motivation and aesthetic needs in F&IVEs may be referred in Chapter 4. In this Section, hypotheses testing results for Study 1 (H^1 to H^4) are presented from Sections 5.1.1 to 5.1.4, and for Study 2 (H^5 to H^8) are presented from Sections 5.1.5 to 5.1.8.

5.1.1 Hypothesis Testing (H^1)

FLMFs will correlate with LLM.

Table 5.1 shows that FLMFs associated with Keller's Model influence upon WBL, as the relationship has been found to be statistically significant at $p < .001$, with $r = 0.680$. Hence, *hypothesis H^1 is accepted.*

5.1.2 Hypothesis Testing (H^2)

IMFs will not correlate with LLM in WBL.

Table 5.1 shows that IMFs associated with Malone & Leppers' Motivational Model influence upon WBL as the relationship has been found to be statistically significant at $p < .001$ level, with $r = 0.519$. Hence, *hypothesis H^2 is rejected.*

Table 5.1: Pearson Correlation Coefficients (H^1 & H^2)

Learning Motivation Factors	Web-Based Learning (WBL), r	Significance (two tailed)
Formal Learning Visual Environment	0.680	0.000 **
Informal Visual Environment	0.519	0.000 **

**denotes significance at the $p < .001$
*denotes significance at the $p < .05$

5.1.3 Hypothesis Testing (H^3)

LLM for WBL will be different across FLMFs *(attention, relevance, confidence, satisfaction).*

5.1.3.1 One-way Analysis of Variance

Results showed (Table 5.2) statistically significant differences among LLM for WBL across four FLMFs associated with Keller's Motivational Model, $F(3, 249) = 40.377$, $p = .000 < .001$, thus, resulting in *acceptance of hypothesis H^3*.

Table 5.2: One-Way Analysis of Variance (H^3)

Dependent Variable: Learning Motivation for WBL

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	31.495	3	10.498	40.377	.000
Within Groups	63.505	246	.260		
Total	95.000	249			

5.1.3.2 Descriptive Statistics

Table 5.3 shows that respondents who picked FLMF c*onfidence* depicted highest level of LLM for WBL ($M = 1.10$, S.D. = .030).

This was followed by respondents who picked *attention* (M = 1.64, S.D. = 0.731) and *satisfaction* (M = 1.92, S.D, = 0.846). The respondents who picked *relevance* showed the least level of LLM for WBL (M = 2.68, S.D. = 0.894).

Table 5.3: Descriptive Statistics (H^3)

Formal Learning Motivational Factor	Mean	Standard Deviation
Attention	1.64	0.731
Relevance	2.68	0.894
Confidence	1.10	0.030
Satisfaction	1.92	0.846

5.1.3.3 Post-hoc Scheffé Tests

Post-hoc Scheffé Tests (Table 5 .4) showed that respondents who picked FLMFs *attention* and *confidence* differed significantly from respondents picking *relevance* and *satisfaction* on LLM for WBL.

Table 5.4: Post-hoc Scheffé Tests (H^3)

Informal Motivational Factor	Mean Difference		Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Relevance	Attention	-1.04(*)	.187	.000	-1.57	-.51
	Confidence	.64(*)	.197	.017	.08	1.20
	Satisfaction	-.28	.145	.305	-.69	.13
Attention	Relevance	1.04(*)	.187	.000	.51	1.57
	Confidence	1.68(*)	.235	.000	1.02	2.35
	Satisfaction	.77(*)	.194	.002	.22	1.31
Confidence	Relevance	-.64(*)	.197	.017	-1.20	-.08
	Attention	-1.68(*)	.235	.000	-2.35	-1.02
	Satisfaction	-.92(*)	.204	.000	-1.49	-.34
Satisfaction	Relevance	.28	.145	.305	-.13	.69
	Attention	-.77(*)	.194	.002	-1.31	-.22
	Confidence	.92(*)	.204	.000	.34	1.49

5.1.3.4 Effect Size for One-Way ANOVA

The size of the effect is 33% ($\eta^2 = 0.332$). This indicates that 33% of the total variance in LLM for WBL is accounted for by Keller's FLMFs.

5.1.4 Hypothesis Testing (H^4)

LLM for WBL will be same across four IMFs *(challenge, curiosity, fantasy, control).*

5.1.4.1 One-way Analysis of Variance

Results showed (Table 5.5) statistically significant differences among LLM for WBL across four IMFs associated with Malone & Lepper's Motivational Model, F (3, 249) = 34.034, p = .002, resulting in *rejection of hypothesis* H^4.

Table 5.5: One Way Analysis of Variance (H^4)

Dependent Variable: LLM in WBL

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	20.830	3	6.943	34.034	.002
Within Groups	50.172	246	.204		
Total	70.002	249			

5.1.4.2 Descriptive Statistics

Table 5.6 shows that respondents who picked IMF *curiosity* depicted highest level of LLM for WBL (M = 1.60, S.D. = 0.877), closely followed by respondents who picked *challenge* (M = 1.65, S.D. = 0.864) and *fantasy* (M = 1.87, S.D. = 0.955). Respondents picking *control* depicted least level of LLM for WBL (M = 2.53, S.D. = 0.515).

Table 5.6: Descriptive Statistics (H^4)

Informal Motivational Factor	Mean	Standard Deviation
Challenge	1.65	0.864
Control	2.53	0.515
Curiosity	1.60	0.877
Fantasy	1.87	0.955

5.1.4.3 Post-hoc Scheffé Tests

Post-hoc Scheffé Tests for H^4 (Table 5.7) showed that respondents who picked *curiosity* differed significantly in terms of LLM for WBL from respondents picking *challenge* (p = .002 < .05), *control* (p = .009 < .05) and *fantasy* (p =.004 < .05).

Table 5.7: Post-hoc Scheffé Tests (H^4)

IMFs	Mean Difference		Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Curiosity	Challenge	-.0.05(*)	.079	.002	-.48	-.57
	Control	-.0.93(*)	.086	.009	-1.60	-.16
	Fantasy	-.0.27(*)	.177	.004	-.72	-.28
Fantasy	Curiosity	-.0.27(*)	.177	.004	-.28	-.72
	Challenge	0.22 (*)	.141	.001	-.03	-1.36
	Control	-0.66	.093	.212	-.28	.72
Challenge	Curiosity	-.0.05(*)	.079	.002	-.57	-.48
	Fantasy	0.22 (*)	.141	.001	-1.36	-.03
	Control	-0.88	.086	.322	-.38	.82
Control	Curiosity	-.0.93(*)	.086	.009	-.16	-1.60
	Challenge	-0.88	.086	.322	.82	-.38
	Fantasy	-0.66	.093	.212	.72	-.28

5.1.4.4 Effect Size for One-Way ANOVA

From hypothesis testing H^4 it is known that the four groups are different, but this does not confer the strength or the magnitude of this effect. Effect size is measure of the strength of an effect and since hypothesis H^4 has been rejected, therefore, effect-size is calculated to determine the size of the effect. The size of the effect is 29% (η^2 = 0.2971), indicating that 29% of the total variance in LLM for WBL is accounted for by the Malone and Lepper's IMFs. This is suggestive of the fact that there is some meaningful difference among the groups, which cannot be ignored.

5.1.5 Hypothesis Testing (H^5)

Learners' aesthetic expectations in FLVEs will be different across three IVEs *(video-games, motion-pictures, SNWs).*

5.1.5.1 Two-Way Analysis of Variance

A Two-Way Analysis of Variance tested respondents aesthetic expectations who reported integration of IMFs will make FLVEs motivationally engaging or disengaging, and also indicated their choice of IVE. Respondents who indicated that

integration of IMFs will make FLVEs motivationally engaging, showed significantly higher aesthetic expectations from FLVEs ($F = 3.681$, $p = .010$, $\eta^2 = .029$) than those who reported otherwise. Aesthetic expectations from FLVEs also differed significantly ($F = 4.083$, $p = .002$, $\eta^2 = .038$) across respondents who indicated their choice of IVE, *confirming hypothesis* H^5.

5.1.5.2 Means Plot & Descriptive Statistics

Means plot in Figure 5.1 and descriptive statistics in Table 5.8 show that respondents who opted for *SNWs* (M = 2.00, S.D. = 0.894) as their favorite choice of IVE reported highest level of aesthetic expectation from FLVEs, followed by *video-games* (M = 2.49, S.D. = 1.147) and *motion-pictures* (M = 2.78, S.D. = 1.215) adopters.

Table 5.8: Descriptive Statistics (H^5)

Informal Motivational Factors will make WBL			**Motion-Pictures**	**Video-Games**	**Social Networking Websites**
	Engaging	Mean	2.78	2.49	2.00
		Standard. Dev.	1.215	1.147	0.894
	Disengaging	Mean	2.13	3.43	3.19
		Standard. Dev.	0.991	1.134	1.167

The aesthetic expectations pattern emerged similar across *video-games* and *SNWs* adopters. However for *motion-picture* adopters the pattern emerged in a reverse form.

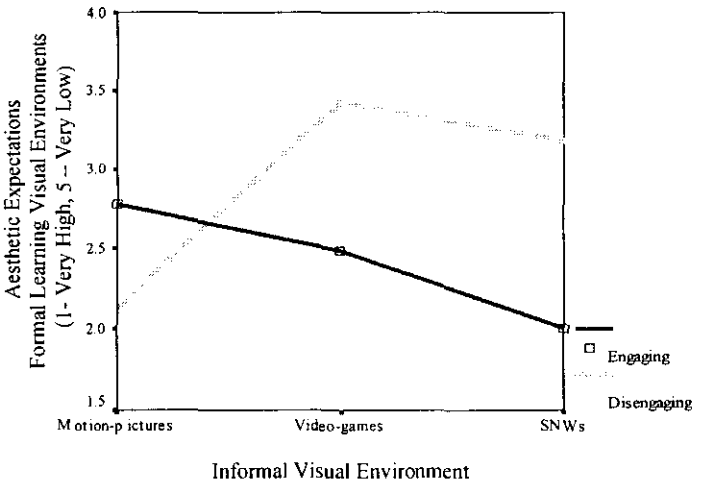


Figure 5.1: Means Plot of Learners' Aesthetic Expectations by choice of IVEs

This indicates respondents who reported integration of IMFs into FLVEs will make the later motivationally disengaging, reported higher level of aesthetic expectations than those who reported otherwise. The reverse interaction of *motion-pictures* with engagement also shared an Interaction Effect which was significant ($F = 6.880$, $p = .044$, $\eta^2 = .094$).

5.1.6 Hypothesis Testing (H^6)

Learners' aesthetic expectations in FLVEs will be different across four IMFs *(challenge, control, curiosity, fantasy).*

5.1.6.1 Two-Way Analysis of Variance

A Two-Way Analysis of Variance tested respondents' aesthetic expectations who indicated integration of IMFs will make FLVEs motivationally engaging or disengaging, and also rated their favorite IMF. Respondents who reported that integration of IMFs will make FLVEs motivationally engaging, depicted significantly higher aesthetic expectations from FLVEs ($F = 6.681$, $p = .054$, $\eta^2 = .017$) than those who reported otherwise. The aesthetic expectations pattern emerged similar across all four IMFs. Aesthetic expectations from FLVEs also differed significantly ($F = 3.553$, $p = .000$, $\eta^2 = .049$) across respondents who indicated their choice of IMFs, thus, *confirmed hypothesis* H^6.

5.1.6.2 Means Plot & Descriptive Statistics

Means plot in Figure 5.2 and descriptive statistics in Table 5.9 show that IMF *curiosity* ($M = 2.30$, $S.D. = 1.031$) is the vital factor for setting high aesthetic expectations in FLVEs.

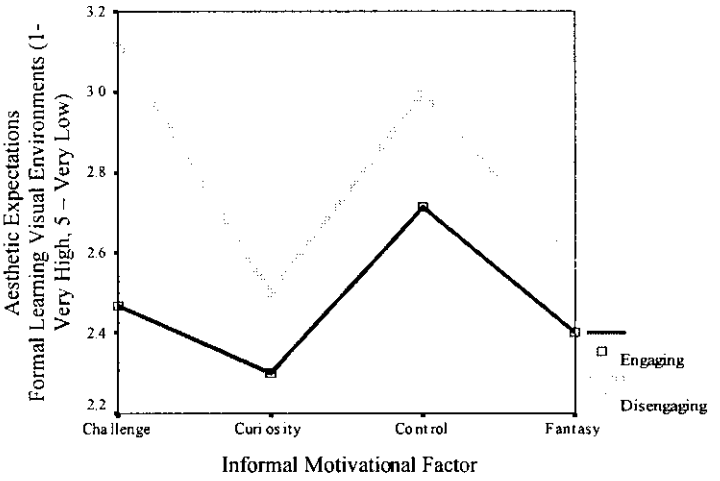


Figure 5.2: Means Plot of Learners' Aesthetic Expectations by choice of IMFs

This is closely followed by IMF *fantasy* (M = 2.40, S.D. = 1.188), while *challenge* (M = 2.47, S.D. = 1.125) and *control* (M = 2.71, S.D. = 1.267) have smaller influences upon setting high aesthetic expectations in FLVEs.

Table 5.9: Descriptive Statistics (H^6)

			Challenge	Curiosity	Control	Fantasy
Informal Motivational Factors will make WBL	Engaging	Mean	2.47	2.30	2.71	2.40
		Standard. Dev.	1.125	1.031	1.267	1.188
	Disengaging	Mean	3.13	2.50	3.00	2.57
		Standard. Dev.	0.835	1.732	0.707	0.514

5.1.7 Hypothesis Testing (H^7)

Learners' a esthetic expectations from FLVEs will be different across three IVEs *(video-games, motion-pictures, SNWs)* by choice of IMFs *(challenge, control, curiosity, fantasy).*

5.1.7.1 Two-Way Analysis of Variance

A Two-Way Analysis of Variance tested aesthetic expectations of the respondents who indicated their choice of IVE from the given three options of (1) Motion-pictures, (2) Video-games, (3) SNWs and also picked their choice of IMF from the given four options of (1) Fantasy, (2) Control, (3) Challenge, (4) Curiosity. Aesthetic

expectations from FLVEs differed significantly (F= 4.350, p=.038, η^2= .138) across respondents who indicated their choice of IVE and favorite IMF thus, *confirming hypothesis* H^7.

5.1.7.2 Means Plot & Descriptive Statistics

Means plot in Figure 5.3 and descriptive statistics in Table 5.10 show that aesthetic expectations from FLVEs were highest among respondents who picked *video-games* (M = 1.40, S.D. = 0.548) as their favorite IVE while IMF *challenge* led this derive and *fantasy* was found to be least tempting in the same IVE.

Table 5.10: Mean and Standard Deviation of IVEs and IMFs (H^7)

Informal Visual Environment (IVE)		**Informal Motivational Factor (IMF)**			
		Challenge	**Curiosity**	**Control**	**Fantasy**
Motion-Pictures	Mean	2.60	2.17	3.67	2.43
	SD.	1.265	1.169	1.155	0.976
Video-Games	Mean	1.40	2.64	2.80	2.94
	SD.	0.548	0.924	1.229	1.289
Social Networking Websites	Mean	2.75	2.00	2.33	3.00
	SD	0.886	1.414	0.816	1.342

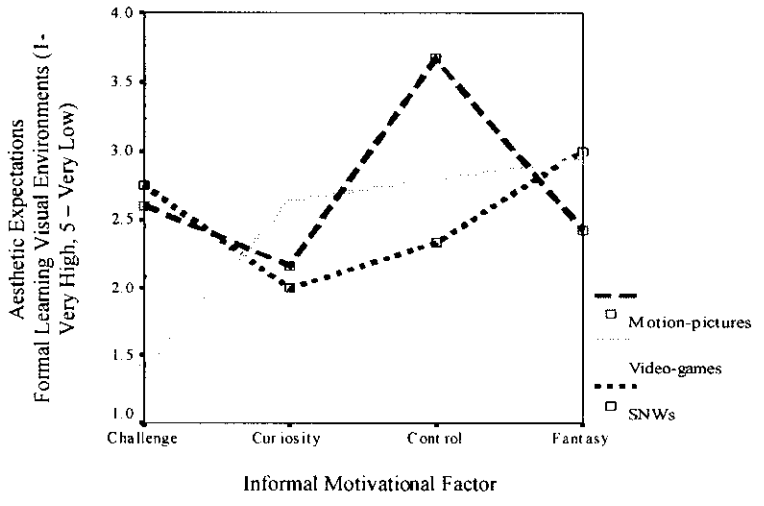


Figure 5.3: Means Plot of Learners' Aesthetic Expectations by choice of IVE/IMF

This was followed by respondents who picked *SNWs* (M = 2.00, S.D. = 1.414) as their favorite IVE, which was led by IMF *curiosity* while *fantasy* was found to be least motivating in the same IVE. Lastly, respondents picking *motion-pictures* (M =

2.17, S.D. = 1.169) over *video-games* and *SNWs* reported that IMF *curiosity* was the most tempting and *control* was least motivating in the same IVE.

5.1.8 Hypothesis Testing (H^8)

FLMFs *(attention, relevance, confidence, satisfaction)* and IMFs *(challenge, control, curiosity, fantasy)* will correlate to jointly predict learners' aesthetic expectations in FLVEs.

5.1.8.1 Pearson Correlation Coefficients

Pearson correlation coefficient of the eight motivational variables was computed to determine their association with learners' aesthetic expectations in F&IVEs and to also ascertain their individual range and strength of association (Table 5.11).

Table 5.11: Pearson Correlation Coefficients of F&IMFs (H^8)

Formal & Informal Motivational Factors	**Aesthetic Expectations, *r***	**Sig. (2 tailed), *p***
Fantasy	.352	.002 **
Control	-.077	.042 *
Curiosity	.452	.004 **
Challenge	-.275	.001 **
Attention	.413	.009 **
Relevance	.383	.000 **
Confidence	.458	.000 **
Satisfaction	.211	.011 *

**denotes significance at the $p < 0.01$
*denotes significance at the $p < .05$

FLMF *confidence* (ARCS) has a Pearson Correlation r = .458 which is a high positive value, depicts a strong correlation and indicates it positively determines learners' aesthetic expectations from F&IVEs. This is followed by IMF *curiosity* (Malone & Lepper) r = .452, FLMF *attention* (ARCS) r = .413, FLMF *relevance* (ARCS) r = .383, IMF *fantasy* (Malone & Lepper) r = .352. FLMF *satisfaction* (ARCS) has the smallest but positive correlation, r = .211, which is again significant at $p < .05$. IMF *control* (Malone & Lepper) and *challenge* (Malone & Lepper) have negative correlation coefficients, with r = -.077 and r = -.275, respectively. Although,

both of these correlations are negatively associated, they are still statistically significant at $p < .05$ and $p < .01$, respectively. This suggests that higher motivational influence of these two IMFs can lower learners' aesthetic expectations in FLVEs.

5.1.8.2 Multiple Regression Analysis

In Table 5.12, value of multiple correlation coefficient (R) among all eight predicting F&IMFs and aesthetic expectations from F&IVEs is 0.805. The maximum value of multiple correlation coefficients is 1 (positive or negative) and indicates correlation of all variables for predicting one single outcome, which in this case is 0.805. This suggests a strong relationship of FLMFs and IMFs in determining learners' aesthetic expectations from F&IVEs.

Table 5.12: Multiple Regression Analysis of F&IMFs (H^8)

R	R Square	Adjusted R Square	Std. Error of the Estimate
.805 (a)	.648	.634	.714

a Predictors: (Constant), Attention, Relevance, Confidence, Satisfaction, Challenge, Control, Curiosity, Fantasy

5.1.8.3 Analysis of Variance

Analysis of Variance tests whether the proposed model is significantly better at predicting the outcome, than using the mean as a best guess. The F-result, labeled as regression in Table 5.13, is the ratio of improvement in prediction relative to the inaccuracy that still exists in the model (labeled as residual). This model has an F-ratio = 68.350 which is highly significant at $p < .001$. It can be said that if the proposed aesthetic perception and motivation model will be based on F&IMFs its ability to determine learners' aesthetic expectations in F&IVEs will significantly improve. This results in *rejection of hypothesis* H^8.

Table 5.13: Analysis of Variance of F&IMFs (H^8)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	63.422	8	7.92	68.350	.000(a)
Residual	27.960	241	.116		
Total	91.382	249			

5.1.8.4 Model Parameters

For this model, significant model parameters to determine learners' aesthetic expectations in FLVEs are IMF *fantasy* t(241) = 5.477 at p < .001; IMF *curiosity* t(241) =3.497 at p <.01; FLMF *attention* t(241) = 7.260 at p < .05; and FLMF *confidence* t(241) = 2.667 at p < 0.01.

Table 5.14: Model Parameters for F&IMFs (H^8)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.866	.334		5.654	.000
Attention	.835	.115	.502	7.260	.015
Relevance	.027	.068	.030	.393	.695
Confidence	.318	.119	.217	2.667	.006
Satisfaction	.322	.132	.157	2.439	.075
Challenge	-.714	.119	-.488	-6.022	.000
Control	-.136	.118	-.079	-1.153	.251
Curiosity	.550	.157	.303	3.497	.007
Fantasy	.905	.165	.516	5.477	.000

FLMF *relevance*, t(241) = .393 at p > .05; IMF *control* t(241) = -1.153 at p > .05; and FLMF *satisfaction* t(241) = 2.439 at p > .05 do not essentially contribute towards predicting learners' aesthetic expectations and are found to be statistically insignificant (Table 5.14).

5.2 Scale Development

Research methodology based on EFA for scale development can be referred in Chapter 4, Section 4.2. Results are presented in this section for testing hypothesis H^9.

5.2.1 Hypothesis Testing (H^9)

Learners' aesthetic-emotions associated with FLMFs (*attention*, *relevance*, *confidence*, *satisfaction*) and IMFs (*fantasy*, *challenge*, *curiosity*, *control*) will be correlated.

5.2.1.1 Initial List of Aesthetic –Emotions Items

Table 5.15: Initial list of Aesthetic-Emotions 54 items (H^9)

Motivational Factor	Aesthetic- Emotion Items	Motivational Factor	Aesthetic- Emotion Items
Fantasy	1. Fancy 2. Imaginative 3. Successful 4. Reputation 5. Inspirational 6. Elegant 7. Mesmerizing 8. Pride 9. Impressive	**Attention**	1. Spontaneous 2. Creative 3. Original 4. Thoughtful 5. Interesting 6. Affective
Control	10. Organized 11. Structured 12. Contingency 13. Firmness 14. Supportive 15. Determined 16. Decisiveness	**Relevance**	7. Natural 8. Meaningful 9. Knowledgeable 10. Familiar 11. Conversant 12. Expertise 13. Proficiency
Curiosity	17. Excitement 18. Surprising 19. Incompleteness 20. Extraordinary 21. Sensitive 22. Secrecy 23. Paradoxes 24. Bizarre	**Confidence**	14. Easiness 15. Effective 16. Efficient 17. Energized 18. Competence
Challenge	25. Orientation 26. Focused 27. Alertness 28. Vigilant 29. Innovative 30. Randomness 31. Predictability	**Satisfaction**	19. Contented 20. Pleased 21. Ego-Gratification 22. Relaxed 23. Reliable

5.2.1.2 Revision in the Initial List of Aesthetic –Emotions Items

Table 5.16: Revisions in the Initial List of Aesthetic-Emotions: 54 items (H^9)

Motivational Factor	Aesthetic- Emotion Items	Motivational Factor	Aesthetic- Emotion Items
Fantasy	1. Fancy (x) 2. Imaginative 3. Successful 4. Reputation 5. Inspirational 6. Elegant 7. Mesmerizing 8. Pride (x) 9. Impressive (x) ▪ Eminence (+) ▪ Harmonic (+) ▪ Guilty Pleasures (+) ▪ Colorful (+)	**Attention**	1. Spontaneous 2. Creative 3. Original 4. Thoughtful 5. Interesting 6. Affective ▪ Striking (+) ▪ Gimmick (+)
Control	10. Organized 11. Structured 12. Contingency (x) 13. Firmness (x) 14. Supportive 15. Determined (x) 16. Decisiveness ▪ Informed (+)	**Relevance**	7. Natural (x) 8. Meaningful 9. Knowledgeable 10. Familiar 11. Conversant (x) 12. Expertise 13. Proficiency ▪ Memorable (+) ▪ Realistic (+) ▪ Personalized (+)
Curiosity	17. Excitement 18. Surprising 19. Incompleteness 20. Extraordinary 21. Sensitive (x) 22. Secrecy (x) 23. Paradoxes 24. Bizarre ▪ Arousal (+) ▪ Stimulating (+) ▪ Mysterious (+)	**Confidence**	14. Easiness 15. Effective 16. Efficient 17. Energized 18. Competence ▪ Resourceful (+)
Challenge	25. Orientation 26. Focused 27. Alertness (x) 28. Vigilant 29. Innovative 30. Randomness 31. Predictability (x) ▪ Interactive (+) ▪ Intensified (+)	**Satisfaction**	19. Contented 20. Pleased 21. Ego-Gratification 22. Relaxed 23. Reliable ▪ Happy (+)

(x) Aesthetic-Emotion items dropped from the Initial List after conducting VT 1
(+) Aesthetic-Emotion items added after receiving qualitative feedback of respondents during VT 1

5.2.1.3 Revised List of Aesthetic –Emotions Items

Table 5.17: Revised List of Aesthetic-Emotions: 59 items (H^9)

Motivational Factor	Aesthetic- Emotion Items	Motivational Factor	Aesthetic-Emotion Items
Fantasy	1. Imaginative 2. Successful 3. Reputation 4. Inspirational 5. Elegant 6. Mesmerizing 7. Eminence 8. Harmonic 9. Guilty Pleasures 10. Colorful	**Attention**	1. Spontaneous 2. Creative 3. Original 4. Thoughtful 5. Interesting 6. Affective 7. Striking 8. Gimmick
Control	11. Organized 12. Structured 13. Supportive 14. Decisiveness 15. Informed	**Relevance**	9. Meaningful 10. Knowledgeable 11. Familiar 12. Expertise 13. Proficiency 14. Memorable 15. Realistic 16. Personalized
Curiosity	16. Excitement 17. Surprising 18. Incompleteness 19. Extraordinary 20. Paradoxes 21. Bizarre 22. Arousal 23. Stimulating 24. Mysterious	**Confidence**	17. Easiness 18. Effective 19. Efficient 20. Energized 21. Competence 22. Resourceful
Challenge	25. Orientation 26. Focused 27. Vigilant 28. Innovative 29. Randomness 30. Interactive 31. Intensified	**Satisfaction**	23. Contented 24. Pleased 25. Ego-Gratification 26. Relaxed 27. Reliable 28. Happy

5.2.1.4 Factor Loadings Ouput

Table 5.18: Factor Loadings Output (H^9)

	Aesthetic – Emotion Items	Factor 1	Factor 2	Factor 3	Factor 4
1	Imaginative		.652		.239
2	Successful	.352		-.547	-.595
3	Reputation		.297		-.353
4	Inspirational		.771	-.429	-.230
5	Elegant		.825		
6	Harmonic*	-.418			
7	Guilty Pleasures*				.208
8	Eminence*		.356		.722
9	Mesmerizing*		.745	-.241	
10	Colorful*		.782		.238
11	Organized	.923			.203
12	Structured		.470		
13	Supportive		-.409	-.336	-.142
14	Decisiveness	.625		.154	
15	Informed*	.770			.325
16	Excitement	.297	-.341	.377	
17	Surprising		.396	.568	.282
18	Incompleteness		.758	.325	.548
19	Extraordinary	.674	.556		.241
20	Paradoxes	-.347		-.249	
21	Bizarre			.313	
22	Arousal*	-.396	.281		-.422
23	Stimulating*		-.241	.868	
24	Orientation	.644			-.436
25	Focused		.218	-.419	
26	Vigilance	-.575	-.521		.484
27	Innovative		-.288	.615	
28	Randomness			.279	
29	Interactive*	-.421		.811	.254
30	Intensification*	.503	.600	-.407	
31	Spontaneous	-.333	.780	-.325	.724
32	Creative		-.294		
33	Original			-.457	
34	Thoughtful		.522		
35	Interesting			.936	
36	Affective		.548		
37	Striking*		.733	-.742	.514
38	Gimmick*	-.322			
39	Evocative		.277	-.294	
40	Knowledgeable		.348		
41	Familiar	.341	.423		
42	Expertise	-.470			-.245
43	Proficient			.621	
44	Memorable*				.705
45	Realistic*	.846			
46	Personalized*	.926			
47	Easiness	.835			
48	Effective	.583	.533		-.554
49	Efficient		.398	-.731	-.692
50	Energized				.625
51	Competence		.277	-.294	.317

Table 5.18: Factor Loadings Output (H^9) (Continue)

	Aesthetic – Emotion Items	Factor 1	Factor 2	Factor 3	Factor 4
52	Resourceful*	.913			.252
53	Contented		.263		
54	Pleased				-.211
55	Gratified				.218
56	Relaxed		.416		.671
57	Reliable				.657
58	Ego Gratification			.216	.751
59	Happy*		-.242		.855

9 Aesthetic-Emotion items had *high cross-loadings.*

22 Aesthetic-Emotion items *not loaded higher* on any of the Four Factors.

5.2.1.5 Identification of Aesthetic-Motivational Dimensions

Table 5.19: Factor Grouping (H^9)

Factor 1: Usability Perception	Easiness	.835							
	Resourceful	.913							
	Organized	.923							
	Decisiveness	.625							
	Informed	.770							
	Orientation	.644							
	Realistic	.846							
	Personalized	.926							
Factor 2: Visual & Aesthetic Appeal			Elegant	.825					
			Inspirational	.771					
			Imaginative	.652					
			Mesmerizing	.745					
			Thoughtful	.522					
			Colorful	.782					
			Affective	.548					
Factor 3: Cognitive Engagement					Innovative	.615			
					Interesting	.936			
					Interactive	.811			
					Stimulating	.868			
					Surprising	.568			
					Proficient	.621			
Factor 4: Satisfaction							Ego Gratification	.751	
							Happy	.855	
							Energized	.625	
							Eminence	.722	
							Reliable	.657	
							Memorable	.705	
							Relaxed	.671	

Note. Factor loadings < .2 are suppressed

5.2.1.6 Descriptive Statistics & Reliability Analysis

The four aesthetic-motivational dimensions of the developed scale exceeded the acceptable standard of Reliability Analysis of 0.70 [282], indicating that measurement constructs of the four aesthetic-motivational dimensions have met the acceptable standard of reliability (Table 5.20). *This confirmed hypothesis H^9.*

Table 5.20: Descriptive Statistics & Reliability Analysis (H^9)

Aesthetic-Motivational Dimensions	No. of items	M (SD)	Alpha
Usability Perception	8	3.69 (.64)	0.74
Visual & Aesthetic Appeal	7	3.78 (.75)	0.77
Cognitive Engagement	6	3.32 (.62)	0.72
Satisfaction	7	3.51 (.88)	0.71

The composite scores of four categorized factor groups were also computed on the basis of mean score of aesthetic-emotions, with major loadings on each aesthetic-motivational dimension (Table 5.20). High mean score suggests that users' experienced a higher level of motivation on that particular aesthetic-motivational dimension. Out of the four aesthetic-motivational dimensions, *visual & aesthetic appeal* received a notable high mean score (M = 3.78) as well as the highest α score of 0.77. Followed by *usability perception* (M = 3.69, α score 0.74), *satisfaction* (M = 3.51, α score 0.71) and *cognitive engagement* (M = 3.32, α score 0.72). These findings suggest that LLM is immensely driven by *visual & aesthetic appeal* and *usability perception* of the IVE.

5.3 Model Testing (Case Study 1)

Model conceptualized in Phase 1 and 2 of the MDF was tested in the Phase 4. Results for model testing (H^{10} to H^{15}) are presented from Section 5.3.1 to 5.3.6.

5.3.1 Hypothesis Testing (H^{10})

LAPs can be classified (high, medium, low).

Based on classification range (Chapter 4, Table 4.9) identified from data distribution (Chapter 4, Figure 4.15) and transformation scale adapted from literature

(Chapter 4, Table 4.4), LAPs classification were made based on expert AJS serving as a baseline. Learners' whose AJS evaluation fell closest to that of evaluation by HCI experts, were classified as LAP (high), indicating they were 'as good as expert evaluators'. LAP (high) in IVE was assigned Code 1, LAP (medium) was assigned Code 2, and LAP (low) was assigned Code 3 (Appendix K). This led to data distribution as shown in Figure 5.4 which shows that LAPs (high, medium, low) in IVEs have different motivation levels, thus *confirming hypothesis* H^{10}.

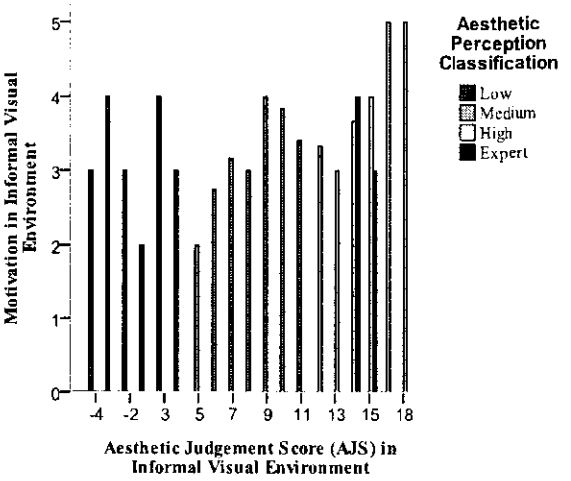


Figure 5.4: Bar Chart of AJS Distribution by LAPs (High, Medium, Low)

5.3.2 Hypothesis Testing (H^{11})

LAPs in IVE and LLM in FLVE will be correlated.

5.3.2.1 Scatter Plots

The scatter plot in Figure 5.5 shows that the majority of learners' AJS falls within 5 to 15 range (remains fairly close to expert AJS) and mainly curtails LAP (high) and LAP (medium) in IVE. LAP (low) in IVE are though a little isolated from rest of the data in scatter plot, this still does not designate presence of any outliers. There is also a very general trend in the data which indicates that LAPs (high and medium) in IVE have experienced a lower level of LM in a FLVE, compared to LAPs (low) in IVE, who have rather reported greater level of LLM in FLVE. LAP (medium) in IVE dominate the scatter plot as they are fairly large in data set when compared to LAPs (high and low) in IVE.

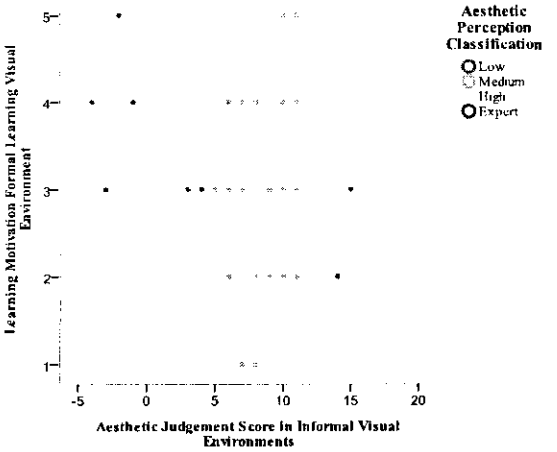


Figure 5.5: Scatter Plot of LLM in FLVE and AJS in IVE

5.3.2.2 Kendall's Tau Bivariate Correlation

To test hypothesis H^{11}, Kendall's Tau method of Bivariate Correlation was selected to meet the nonparametric conditions of the case study as discussed in Chapter 4, Section 4.3.1.7.

Table 5.21: Kendall's Tau Bivariate Correlation (H^{11})

Kendall's Tau_b		Learning Motivating FLVE	Aesthetic Perceptions IVE
Learning Motivating in FLVE	Correlation Coefficient	1.000	-.191(*)
	Sig. (2-tailed)	.	.049
	N	52	52
Learners' Aesthetic Perception s in IVE	Correlation Coefficient	-.191(*)	1.000
	Sig. (2-tailed)	.049	.
	N	52	52
* Correlation is significant at the .05 level (2-tailed)			

As shown in Table 5.21, LLM in FLVE is negatively associated with LAPs in IVE, correlation coefficient r = -.191, which is significant at $p < .05$, hence, *hypothesis H^{11} is confirmed.*

5.3.3 Hypothesis Testing (H^{12})

LST will be correlated with CI and GU.

5.3.3.1 Scatter Plots

The scatter plot of LST and GU is shown in Figure 5.6, which shows data distribution of LAP (high), LAP (medium) and LAP (low). Data shows that LST improves with the GU. With a few exceptions of outliers, majority of the data seem to fall within the vicinity of other points. There also seems to be some general trend in the data such that a higher level of LST is associated with higher levels of GU. An upward slopping line from zero can easily be imagined in the graph to conclude that there is a positive correlation between these two variables. An increase in one variable is correlated with increase in other variable. Similarly, decreases in one variable are correlated with decrease in other variable.

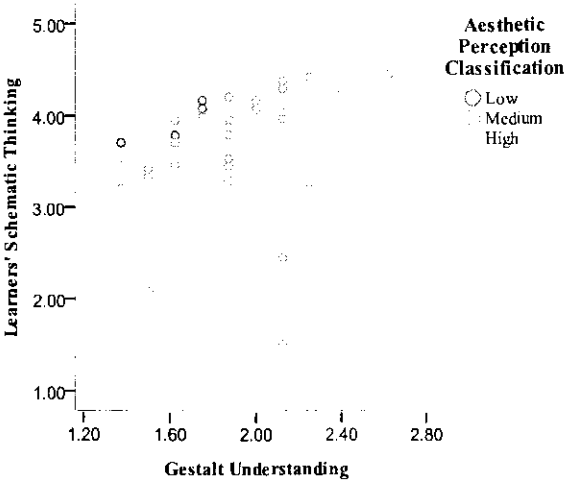


Figure 5.6: Scatter Plot of LST and GU

The scatter plot of LST and CI is shown in Figure 5.7 which shows data distribution of LAP (high), LAP (medium) and LAP (low). Data shows that LST depends upon viewers contextual interpretation of their visual media interaction behavior. With a few exceptions of outliers, majority of the data seem to fall within the vicinity of other points. There also seems to be some general trend in the data such that a higher level of LST is associated with higher levels of CI. An upward slopping line from zero can easily be imagined in the graph to conclude that there is a positive correlation between these two variables.

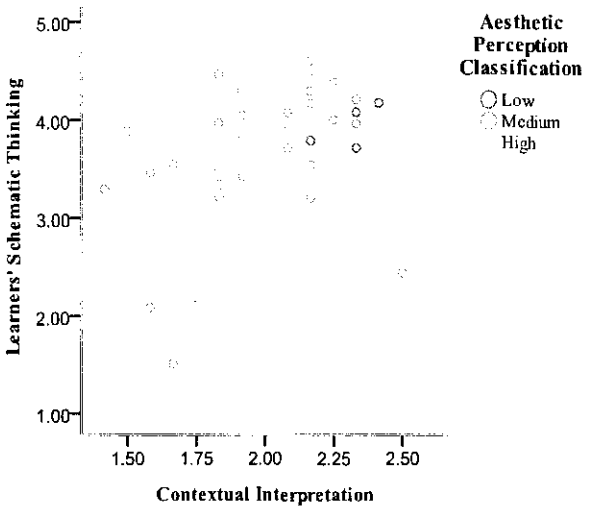


Figure 5.7: Scatter Plot of LST and CI

5.3.3.2 Pearson's Bivariate Correlation Coefficient

Table 5.22 provides a matrix of correlation coefficients for the three variables, i.e. LST, CI, and GU. It also displays a matrix of significance values for these coefficients. Each variable is perfectly correlated with itself, so r =1. CI is positively related to LST with a correlation coefficient of r = 0.689 significant at p < .001.

Table 5.22: Pearson Correlations Coefficients (H^{12})

		LST	CI	GU
Pearson Correlation	LST	1	.689(**)	.773(**)
	CI	.689(**)	1	.231(*)
	GU	.773(**)	.231(*)	1
Sig. (2-tailed)	LST	-	.000	.000
	CI	.000	-	.033
	GU	.000	.033	-
N	LST	51	51	51
	CI	51	51	51
	GU	51	51	51

GU is also positively related to LST, with a coefficient of r = 0.773, highly significant at p < .001.

CI too has a small but positive correlation with GU, r = 0.231, significant at p < .05. These significance values suggest that the probability of these three correlations

being a 'fluke' is very low (close to zero in fact). It can be interpreted that these relationships are genuine and not a chance result, hence *confirming hypothesis* $H^{12.}$

5.3.4 Hypothesis Testing (H^{13})

LAPs, LST, CI and GU will be correlated.

5.3.4.1 Scatter Plots

Figure 5.8 displays scatter plot of classified LAPs (high, medium, low) in IVEs and LST. The data is normally distributed, with no obvious outliers as most points seem to fall within the vicinity of other points. At the same time dots are scattered, making it hard to imagine a line connecting them. A line does seem to slop downwards apparently, but it is difficult to imagine it since some dots are densely positioned in one place and rest are scattered all over.

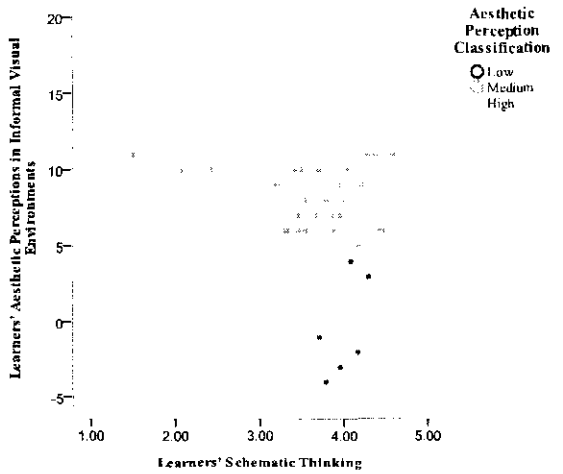


Figure 5.8: Scatter Plot of LAPs in IVE (High, Medium, Low) and LST (CI + GU)

It may indicate a not very strong or even zero relationship between LAPs and LST. That means the two variables are not related to one another or partially/weakly related. Increases or decreases in one variable have no effect on increases or decreases in second variable. However, without performing Bivariate Correlation Analysis it is not wise to jump to any conclusions, since LST is a combination of two sub-factors, CI and GU.

5.3.4.2 Pearson's Bivariate Correlation Coefficient

Table 5.23 provides a matrix of correlation coefficients for the two main variables, i.e. LAPs and LST, and also two sub-measuring factors of LST, i.e., CI and GU. It also displays a matrix of significance values for these coefficients. Each variable is perfectly correlated with itself, so r =1.

LAPs share a negative correlation coefficient with LST, r = -.273, with p = .053 > .05. Although, results do not reveal statistically significant correlation between these two variables, the significance value p, is close to p < .05.

LAPs share a non-significant and weak correlation coefficient with CI, r = .023, p = .870 > .05. This means that there is a weak relationship between these two variables and changes in one variable may not correlate with changes in the second variable.

LAPs share a strong positive correlation coefficient with Learners' GU, r = .456, significant at p < .05. Thus, based on mixed results, *hypothesis H^{13} is partially accepted.*

Table 5.23: Pearson Correlations Coefficients (H^{13})

		LAPs	**LST**	**CI**	**GU**
Pearson Correlation	LAPs	1	-.273	.023	.456(**)
	LST	-.273	1	.689(**)	.773(**)
	CI	.023	.689(**)	1	.231(*)
	GU	.456(**)	.773(**)	.231(*)	1
Sig. (2-tailed)	LAPs	-	.053	.870	.001
	LST	053	-	.000	.000
	CI	.870	.000	-	.033
	GU	.001	.000	.033	-
N	LAPs	51	51	51	51
	LST	51	51	51	51
	CI	51	51	51	51
	GU	51	51	51	51

5.3.5 Hypothesis Testing (H^{14})

LLM in FLVE will be different across LAPs (high, medium, low) in IVE after adjusting for the effect of LST as a covariate

5.3.5.1 Box-and-Whisker Plot

Figure 5.9 shows that respondents classified as with expert level aesthetic perceptions in IVE, have a median at 2.5 (black line). This represents a 'lesser to neutral' learning motivation (which is at 3).

LAP (high) in IVE have a median at 3 (black line), while 50% of the data is lesser than this value. Respondents with any lesser learning motivation in FLVE are represented everything below median black line, while learners' with higher learning motivation are represented everything above median black line. As shown by the top 'whisker', this group has maximum ranging value of 4. The data is normally distributed, without any presence of outliers.

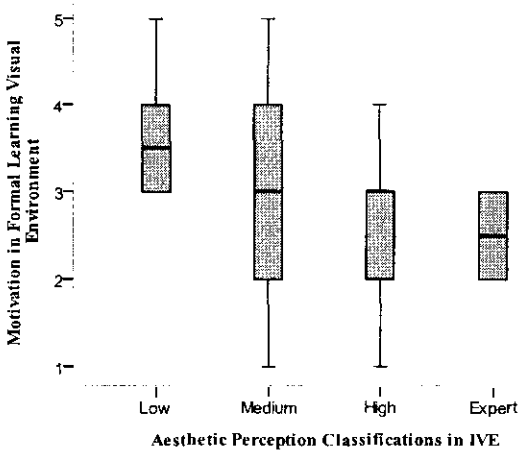


Figure 5.9: Box-and-Whisker Plot

LAP (medium) in IVE have a median at 3 (black line). While 50% of the data is lesser than this value, almost 50% is above it. As shown by the top 'whisker', this group has maximum ranging value of 5. The data is normally distributed, without any presence of outliers.

LAP (low) in IVE have a median at 3.5 (black line). While 50% of the data is lesser than this value, almost 50% is above it. As shown by the top 'whisker', this group has maximum ranging value of 5. The data is normally distributed, without any presence of outliers.

5.3.5.2 Means Plot & Error Bars

Figure 5.10 shows means plot, which apparently (due to SPSS scaling) indicates an enormous difference between LLM of the three groups of LAPs (high, medium, low) in IVE. This may not be the actual case, therefore as a follow-up, same data is reproduced in Error Bars (Figure 5.11) with 95 % Confidence Intervals, to have an idea of the variation in sample distribution.

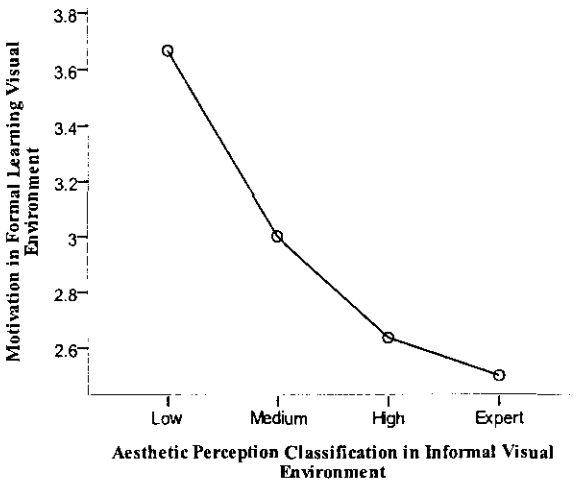


Figure 5.10: Means Plot of LAPs in IVE (High, Medium, Low) and LLM in FLVE

Confidence Intervals of the groups is closely related to the results of the Analysis of Variance for these groups and for each graph, it shows a linear pattern of the sample distribution which otherwise appeared to be showing huge variations in the simple means plot (Figure 5.10).

In Figure 5.11, group mean of LAPs (high, medium, low) in IVE share a degree of Confidence Interval overlap with one another. This indicates variances between the groups may not be significantly different from one another. But, this can only be confirmed with test of Homogeneity of Variance, which is an important assumption of Analysis of Variance.

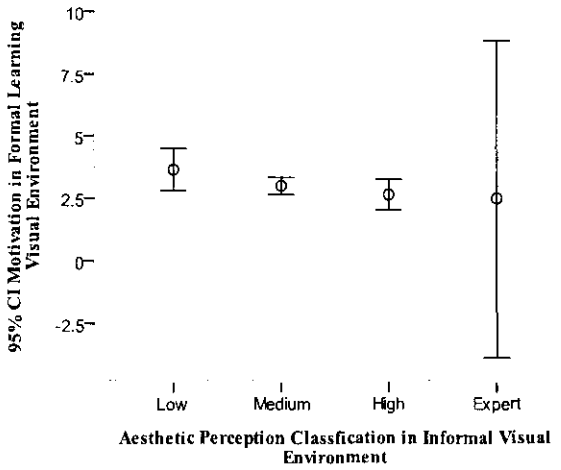


Figure 5.11: Error Bars of LAPs in IVE (High, Medium, Low) and LLM in FLVE

5.3.5.3 Assumptions in ANCOVA

Two assumptions were met before performing ANCOVA (i) Independence of the Covariate and Treatment Effect, and (ii) Homogeneity of Variances.

Table 5.24: Independence of the Covariate and Treatment Effect (ANOVA)

Dependent Variable: LST (CI + GU)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.539	4	.635	1.589	.193
Within Groups	18.372	46	.399		
Total	20.911	50			

The first assumption basically requires that covariate, LST should not be different across the three groups. To check this One Way Independent ANOVA was performed with LLM in FLVE taken as independent variable and covariate, LST as an outcome variable. This analysis should be non-significant to meet the first assumption and results showed non-significant effect, $F(4, 46) = 1.589$, $p = .193 > .05$ (Table 5.24).

The second assumption was checked by examining results of Levene's Test for Homogeneity of Variances, which tests null hypothesis that variances of the groups are same (LLM in FLVE as an outcome variable). Levene's Test showed non-significant results, $F(2, 49) = 1.197$, $p = 0.319 > .05$ (Table 5.25). This indicated variances of groups were equal and an important assumption of ANCOVA has not been violated.

Table 5.25: Levene's Test of Equality of Error Variances (H^{14})

Dependent Variable: LLM in FLVE

F	df1	df2	Sig.
1.197	2	49	.319

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a Design: Intercept+ Learners' Schematic Thinking+ Learners' Aesthetic Perceptions

5.3.5.4 Analysis of Variance

Table 5.26 presents ANOVA for H^{14}.

Table 5.26: Analysis of Variance (H^{14})

Dependent Variable: LLM in FLVE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16.844(a)	2	8.422	2.416	.047
Intercept	535.184	1	535.184	153.522	.000
Learners' Aesthetic Perception in IVE	16.844	2	8.422	2.416	.047
Error	94.123	49	1.921		
Total	683.000	52			
Corrected Total	110.967	51			

a R Squared = .152 (Adjusted R Squared = .089)

Sum of squares between groups for the corrected model is 16.844, which indicates total experimental effect while means square of the model is 8.422, which represents average experimental effect. Unexplained variance error is the sum of squares within groups, and it is 94.123, which explains unsystematic variation within data. The test of whether the group means are the same is represented by the F-ratio for the combined between group effect. The value of F-ratio is 2.416, which is significant at $p = .047 < .05$. It is reported after conducting ANOVA that there was a significant effect of LAPs in IVE on LLM in FLVE, $F(2, 52) = 2.416$, $p = 0.047 > .05$.

5.3.5.5 Analysis of Covariance

Looking first at the significance value in Table 5.27, it clear that the covariate, i.e., LST, significantly predicts LLM in FLVE, $F(1, 48) = 4.959$; $p = .035 < .05$. *Thus, confirming* H^{14} that there are differences among LLM in FLVE across LAPs (high, medium, low) in IVE, after adjusting for the effect of LST as a covariate in the model.

Table 5.27: Analysis of Covariance (H^{14})

Dependent Variable: LLM in FLVE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	31.920(a)	3	10.640	3.500	.030
Intercept	76.069	1	76.069	25.020	.000
LST	15.076	1	15.076	4.959	.035
Learners' Aesthetic Perception in IVE	25.185	2	12.593	4.142	.027
Error	79.047	48	3.040		
Total	683.000	52			
Corrected Total	110.967	51			

5.3.5.6 Scatter Plots

Although results of H^{13} testing revealed statistically non-significant correlation between LAPs and LST, the significance value $p = .053$ is close to $p < .05$. As the regression line in scatter plot (Figure 5.12) runs from the upper left to the lower right, it concludes a negative association ($r = -.273$) or direction between these two variables. This means increase in one variable is correlated with decrease in another variable.

Results of H^{13} testing also showed that CI (a sub-variable of LST) shared a non-significant correlation with LAPs ($r = .023$, $p = .870 > .05$), but GU (a sub-variable of LST) shared a strong positive and significant correlation with LAPs ($r = .456$, $p = .001 < .05$). The slope in regression line as shown in scatterplot (Figure 5.13) depicts a strong positive correlation between LAPs and GU.

In H^{14}, LST when included as a covariate in the proposed aesthetic perception and motivation model yielded significant results against predicting dependent variable (LLM in FLVE). As shown in Figure 5.14, regression line slopes upward from zero, therefore it can be concluded that LST has a positive correlation with LLM in FLVE, since increase in one variable is correlated with increase in other variable. Similarly, decrease in one variable are correlated with decrease in other variable.

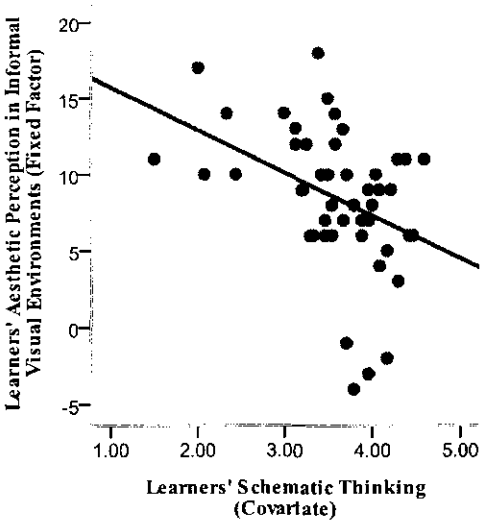


Figure 5.12: Scatter Plot of LST (CI + GU) and LAPs in IVE

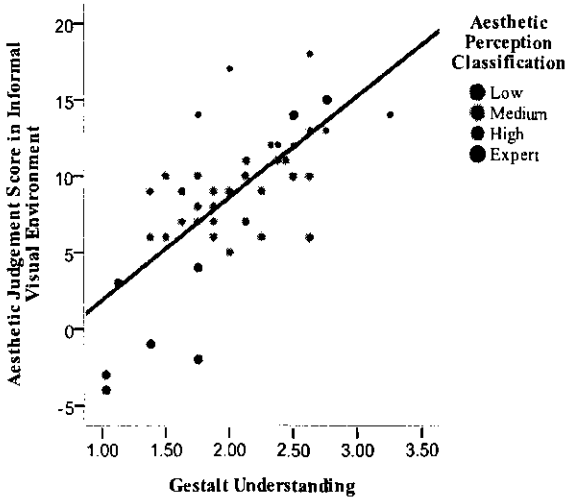


Figure 5.13: Scatter Plot of LAPs in IVE (High, Medium, Low) and GU

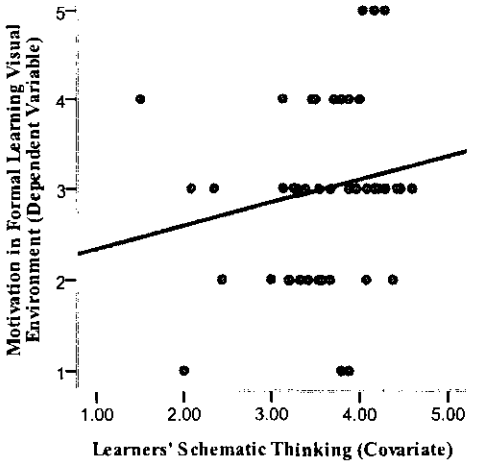


Figure 5.14: Scatter Plot of LLM in FLVE and LST (CI + GU)

5.3.6 Hypothesis Testing (H^{15})

LAPs in IVE and LST (CI + GU) will jointly predict significant variance in LLM in FLVEs than LAPs in IVE and LST (CI + GU) alone.

To test H^{15}, Hierarical Regression Modeling (HRM) was performed (see Chapter 3, Section 3.4.1.7)

5.3.6.1 Formulation of Models 1-2-3

Table 5.28 shows formulation of Model 1, Model 2, and Model 3 as entered in HRM for hypothesis testing H^{15}.

Table 5.28: Formulation of Models 1-2-3 (H^{15})

Model	Variables Entered	Variables Removed	Method
1	Hierarchy (ap1), VE Hierarchy (ap2), Emphasis (ap3), Contrast (ap4), Tension (ap5), Balance (ap6), Rhythm (ap7), Flow (ap8), Depth (ap9), Scale (ap10), Movement (ap11), Unity (ap12) (a)	.	Enter
2	Self-concept (ci 1), Self-efficacy (ci2), VM engagement (ci3), VM attribution (ci4), VM persuasion (ci5), Self-enhancement (ci6), VM Interaction attitude (ci7), VM innovativeness (ci8), VM salience (ci9), Environmental context (ci10) (a)	.	Enter
3	Proximity (gu1), Symmetry (gu2), Similarity (gu3), Common fate (gu4), Good continuation (gu5), Isomorphism (gu6), Closure (gu7), Figure ground (gu8), Focal point (gu9), Simplicity (gu10), Pregnanz (gu11), Unity (gu12) (a)	.	Enter

a All requested variables entered.
b Dependent Variable: Learning Motivation in FLVE

Model 1: Consists of block of 12 variables measuring Learners' Aesthetic Perception

Model 2: Consists of block of 10 variables measuring Contextual Interpretation

Model 3: Consists of block of 12 variables measuring Gestalt Understanding

5.3.6.2 Model Summary

Summary of Model 1, Model 2, and Model 3 is presented in Table 5.29.

Table 5.29: Model Summary (H^{15})

Model	R	R Square	Adjusted R Square	Std. Error of Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.491(a)	.241	.074	.943	.241	1.446	9	41	.184
2	.656(b)	.430	.110	.925	.430	1.180	9	32	.038
3	.852(c)	.726	.105	.927	.726	.985	11	21	.043

5.3.6.3 Hierarchal Regression Modeling

Table 5.30 shows results for HRM for Model 1, Model 2 and Model 3.

Table 5.30: Hierarical Regression Modeling (H^{15})

Dependent Variable: LLM in FLVE

Beta Coefficients for Models 1-2-3

	Models' Measuring Constructs	*R*	Model 1	Model 2	Model 3	*p*
1	Hierarchy	0.335**	0.348	0.256	0.146	0.110
2	Visual Expression of Hierarchy	0.169	0.121	0.105	-0.077	0.442
3	Emphasis	0.333*	0.417	0.311	0.318	0.010
4	Contrast	0.126	0.122	0.146	-0.127	0.354
5	Tension	0.254*	0.135	0.078	-0.101	0.284
6	Balance	0.556**	0.351	0.351	0.303	0.031
7	Rhythm	0.653**	0.581	0.466	0.342	0.000
8	Flow	0.261*	0.284	-0.084	-0.121	0.140
9	Depth	-0.343	-0.103	-0.103	-0.028	0.221
10	Scale	-0.161	-0.206	-0.206	-0.056	0.376
11	Movement	0.223*	0.394	0.394	0.318	0.026
12	Unity	0.712**	0.355	0.313	0.319	0.000
1	Self-Concept **	0.548**		0.268	0.325	0.000
2	Self-Efficacy**	0.731**		0.412	0.373	0.021
3	Visual Media Engagement	0.175		0.128	-0.027	0.205
4	Visual Media Attribution*	0.308*		0.141	0.232	0.014
5	Visual Media Persuasion	0.244		0.235	0.157	0.211
6	Self-Enhancement**	0.452**		0.181	0.184	0.076

Dependent Variable: LLM in FLVE

Models' Measuring Constructs		*R*
7	Media Interaction Attitude*	0.306*
8	Visual Media Innovativeness**	0.411**
9	Visual Media Salience	0.123
10	Environmental Context	0.136
1	Proximity *	0.271*
2	Symmetry **	0.396**
3	Similarity**	0.727**
4	Common Fate	0.018
5	Good Continuation*	0.118*
6	Isomorphism	-0.035
7	Closure **	0.226**
8	Figure Ground**	0.224**
9	Focal Point	-0.092
10	Simplicity**	0.289**
11	Pregnanz	0.179
12	Unity**	0.618**

Beta Coefficients for Models 1-2-3

Model 1	Model 2	Model 3	*p*
	0.273	-0.038	0.190
	0.384	0.325	0.000
	-0.010	-0.042	0.072
	0.106	0.117	0.066
		0.219	0.029
		0.321	0.022
		0.537	0.000
		-0.063	0.178
		0.101	0.224
		0.113	0.086
		0.386	0.030
		0.154	0.213
		-0.168	0.117
		0.316	0.000
		0.017	0.069
		0.466	0.016

Model	**1**	**2**	**3**
R^2	0.241	0.430	0.726
Change in R^2	------	0.189	0.296
Change Significance		0.038*	0.043*
* p < .05, ** p < .001			

5.3.6.4 Pearson Bivariate Correlation Coefficients for Model 1-2-3

The first column titled *'r'* consists of correlation coefficients of each measuring construct (independent variables) within LAPs and LST correlated on its own with LLM in FLVE (dependent variable).

Model 1 – LAPs in IVEs –The first block consists of 12 measuring constructs for LAPs in IVE. The statistically significant correlations of LAPs measuring constructs with LLM in FLVE at p < .001 level are of *hierarchy* r = 0.335, *balance* r = 0.556, *rhythm* r = 0.653 and *unity* r = 0.712. While, statistically significant correlations with LLM at p < .05 level are of *emphasis* r = 0.333, *tension* r = 0.254, *flow* r = 0.261 and *movement* r = 0.223.

Model 2 – LAPs in IVs and CI – The second block consists of 12 measuring constructs for LAPs in IVE and additional 10 variables measuring LST through CI. The statistically significant correlations of CI measuring constructs with LLM at $p < .001$ level are of *self-concept* r = 0.548, *self-efficacy* r = 0.731, *self-enhancement* r = 0.452 and *visual media innovativeness* r = 0.411. While, statistically significant correlations with LLM at $p < .05$ level are of *visual media attribution* r = 0.308 and *visual media interaction attitude* r = 0.306.

Model 3 – LAPs in IVEs, CI, GU – The third block consists of 12 measuring constructs for LAPs in IVE, 10 measuring constructs for CI and additional 12 measuring constructs related to GU. The statistically significant correlations of GU measuring constructs with LLM at $p < .001$ level are of *symmetry* r = 0.396, *similarity* r = 0.727, *closure* r = 0.226, *figure- ground* r = 0.224, *simplicity* r = 0.289 and *unity* r = 0.618. While, statistically significant correlations with LLM at $p < .05$ level are of *proximity* r = 0.271 and *good continuation* r = 0.118.

5.3.6.5 Beta Coefficients for Model 1-2-3

This part of analysis is concerned with Model Parameters which are measuring constructs of LAPs, CI and GU.

Model 1: The SBVs in Model 1 are high for *hierarchy* 0.348, *emphasis* 0.417, *balance* 0.351, *rhythm* 0.581, flow 0.284, *movement* 0.394 and *unity* 0.355. Thus, in Model 1, *emphasis* and *rhythm* have more impact on predicting LLM in FLVE due to their higher SBVs.

Model 2: The SBVs among measuring constructs for LAPs in Model 2 are high for *hierarchy* 0.256, *emphasis* 0.311, *balance* 0.351, *rhythm* 0.466, *movement* 0.319 and *unity* 0.313. The SBVs among measuring constructs for CI in Model 2 are high for *self-concept* 0.268, *self-efficacy* 0.412, *visual media interaction attitude* 0.273 and *visual media innovativeness* 0.384. In Model 2, *rhythm* and *self-efficacy* have more impact on predicting LLM in FLVE due to their higher SBVs.

Model 3: The SBVs among measuring constructs for LAPs in Model 3 are high for *emphasis* 0.318, *balance* 0.303, *rhythm* 0.342, *movement* 0.318 and *unity* 0.319. The SBVs among measuring constructs for CI in Model 3 are high for *self-concept* 0.325, *self-efficacy* 0.373, *visual media interaction attitude* 0.232 and *visual media innovativeness* 0.325. The SBVs among measuring constructs for GU in Model 3 are high for *proximity* 0.219, *symmetry* 0.321, *similarity* 0.537, *closure* 0.386, *simplicity* 0.316 and *unity* 0.466. In Model 3 *similarity*, *unity*, *closure*, *rhythm* and *self-efficacy* have more impact on predicting LLM in FLVE due to their higher SBVs.

5.3.6.6 Significant Model Parameters

Model 3, which is a combination of measuring constructs for LAPs, CI and GU, can predict about 73% variance in LLM for FLVE, which is significant at $p < .05$, therefore, *hypothesis* H^{15} *is accepted.* Significant Model Parameters of LAP measuring constructs accounting for 73% of variance in predicting LLM for FLVE are *emphasis* $p = 0.010 < .05$, *balance* $p = 0.031 < .05$, *rhythm* $p = 0.000 < .001$, *movement* $p = 0.026 < .05$ and *unity* $p = 0.000 < .001$.

Significant Model Parameters of CI measuring constructs accounting for 73% of variance in predicting LLM for FLVE are *self-concept* $p = 0.000 < .001$, *self-efficacy* $p = 0.021 < .05$, *visual media attribution* $p = 0.014 < .05$ and *visual media innovativeness* $p = 0.000 < .001$.

Significant Model Parameters of GU measuring constructs accounting for 73% of variance in predicting LLM for FLVE are *proximity* $p = 0.029 < .05$, *symmetry* $p = 0.022 < .05$, *similarity* $p = 0.000 < .001$, *closure* $p = 0.030 < .05$, *simplicity* $p = 0.000 < .001$ and *unity* $p = 0.016 < .05$.

5.4 Model Validation (Case Study 2)

For detailed methodology adopted for model validation Chapter 4, Section 4.4 may be referred. Model validation was performed through hypotheses testing (H^{16} to H^{20}) results of which are presented in this section.

5.4.1 Assumptions in MANOVA

Hypotheses H^{16} and H^{17} were tested by performing Multivariate Analysis of Variance (MANOVA) and Multivariate Analysis of Covariance (MANCOVA), respectively. This required following two assumptions to be checked.

5.4.1.1 Multivariate Normality

First assumption requires that all dependent variables must be distributed normally. This assumption was met by visualizing histograms of four aesthetic-motivational dimensions (1) usability perception, (2) cognitive engagement, (3) visual & aesthetic appeal, (4) satisfaction. A histogram is a vertical bar chart that depicts data distribution and makes it easy to see where the majority of values fall and variation in on a measurement scale. Histograms of four dependent variables are shown in Figures 5.15 to 5.18. A common pattern known as the *'bell-shaped curve'* indicates normality of distribution, the same pattern was observed in all cases.

Multivariate normality also requires that any linear combination of the dependent variables must be distributed normally. This assumption was checked by examining pair wise nonlinear relationships between aesthetic-motivational dimensions, using scatter plots. Figures 5.19 to 5.24 show wide dispersion of all data points around a straight line, indicating one variable can be predicted by the other with some degree of accuracy, but not with as much accuracy. In Figures 5.19, 5.21, 5.22, 5.24, it is observed that as one variable increases in value, the other variable tends to slightly increase in value, illustrating weak, positive, linear relationships. In Figures 5.20 and 5.23, it is observed that as one variable increases in value, the other variable tends to slightly decrease in value; illustrating weak, negative, linear relationships.

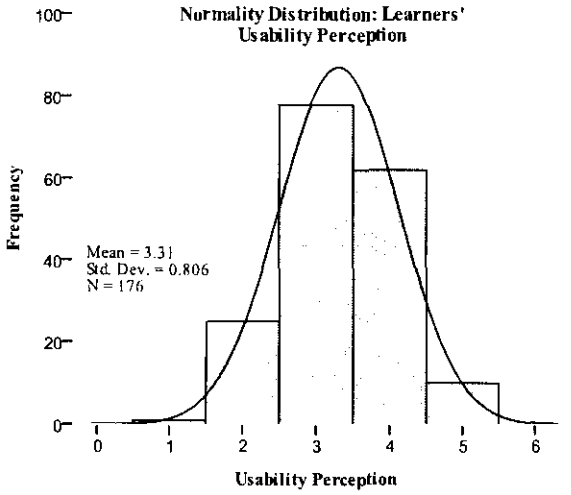


Figure 5.15: Usability Perception

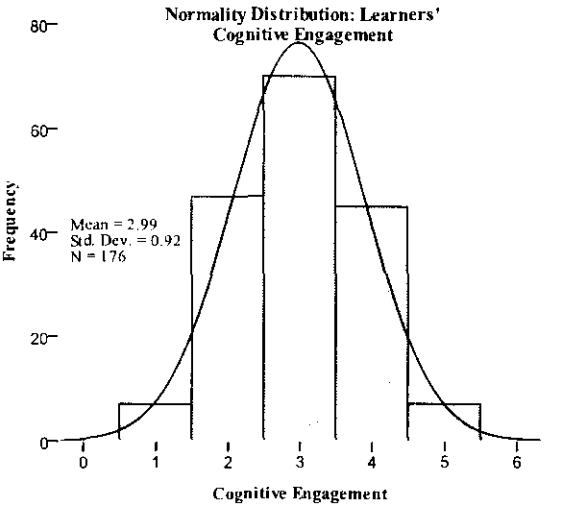


Figure 5.16: Cognitive Engagement

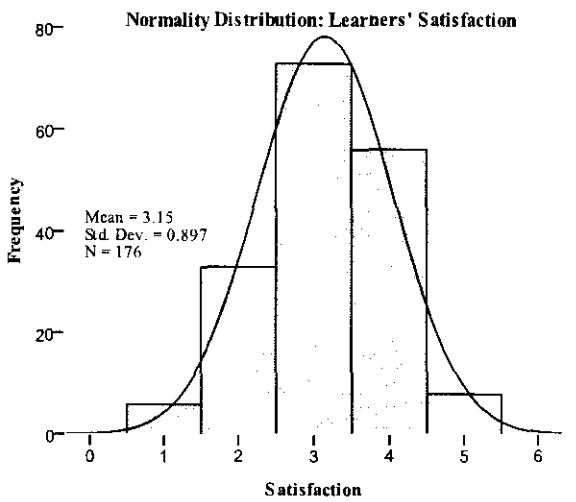


Figure 5.17: Satisfaction

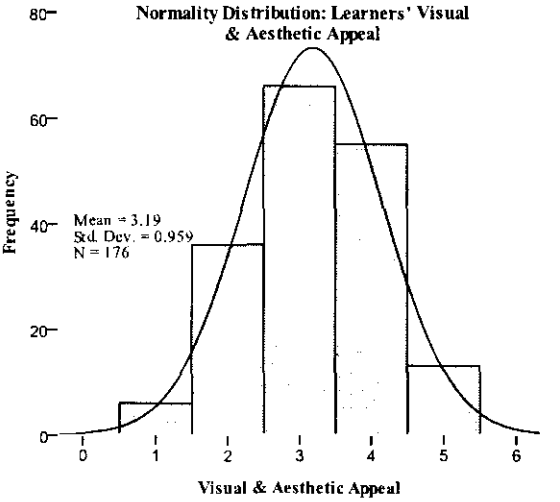


Figure 5.18: Visual & Aesthetic Appeal

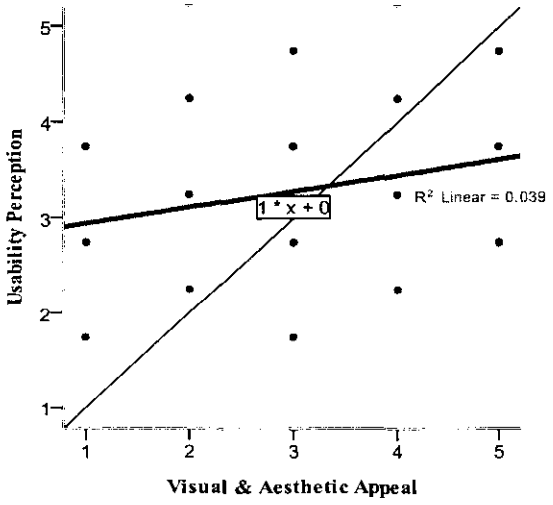


Figure 5.19: Scatter Plot of Usability Perception and Visual & Aesthetic Appeal

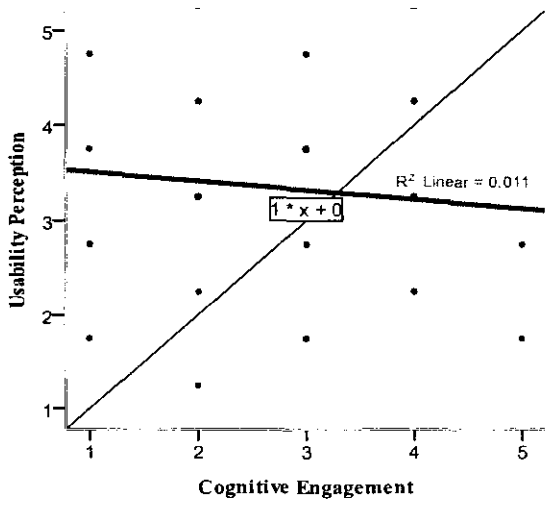


Figure 5.20: Scatter Plot of Usability Perception and Cognitive Engagement

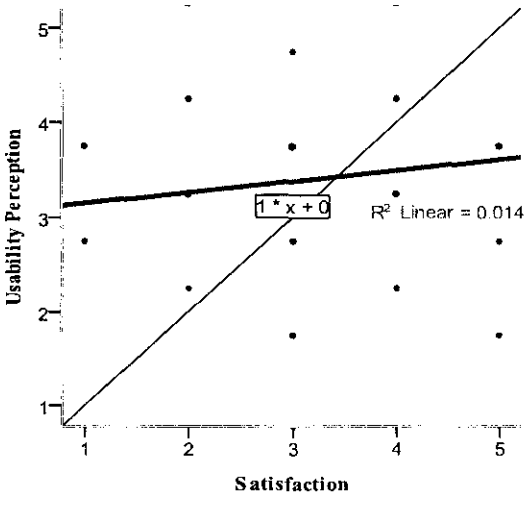


Figure 5.21: Scatter Plot of Usability Perception and Satisfaction

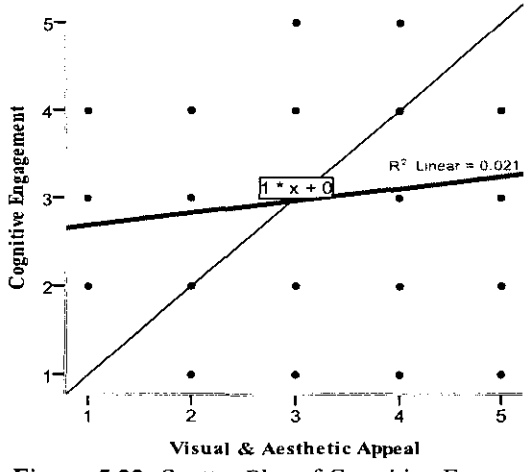


Figure 5.22: Scatter Plot of Cognitive Engagement and Visual & Aesthetic Appeal

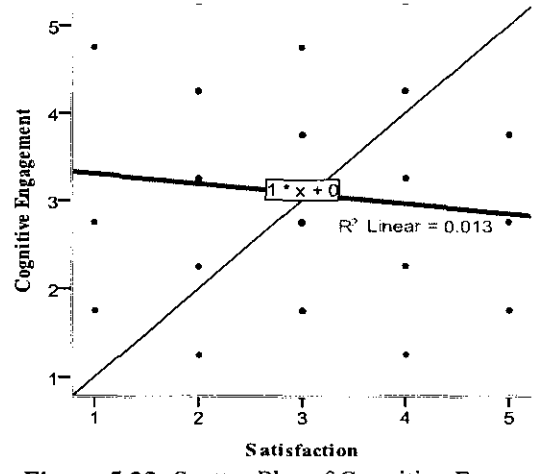


Figure 5.23: Scatter Plot of Cognitive Engagement and Satisfaction

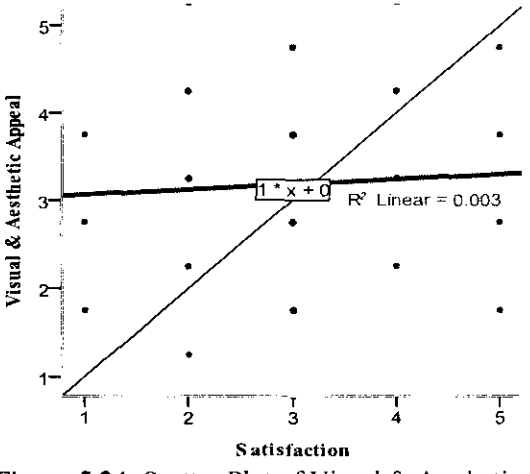


Figure 5.24: Scatter Plot of Visual & Aesthetic Appeal and Satisfaction

5.4.1.2 Homogeneity of Covariances

The second assumption of MANOVA known as Homogeneity of the Covariance matrices was also checked, which requires holding of equal variances for each one of the dependent variables. The assumption was checked by examining Box's Test of Equality of Covariance Matrices, in which if the "sig." value is less than .001 ($p <$ .001) then the assumption of Homogeneity of Covariances is considered to be violated. Results (Table 5.31) showed that this assumption had not been violated ($p =$ .728).

Table 5.31: Box's Test of Equality of Covariance Matrices

Box's M	16.417
F	.791
df1	20
df2	64622.715
Sig.	.728

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.
a. Design: Intercept + Learners' Aesthetic Perceptions (High, Medium, Low)

5.4.2 Hypothesis Testing (H^{16})

There will be significant multivariate effect of LAPs in IVE (high, medium, low) on four aesthetic motivational dimensions *(usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction)* of FLVE.

The overall F-test for the four aesthetic-motivational dimensions was examined in Multivariate Tests (Table 5.32), by analyzing the statistic called Wilks' lambda (λ), and the F-value associated with that. Lambda is a measure of the percent of variance in the depedent variable that is *not explained* by differences in the level of the independent variable, and varies between 1 and zero, the closer its value is to zero the better it is considered (e.g, no variance that is not explained by the IV). In case of LAP, Wilks' lambda is .425, and has an associated F-value of 4.303, which is significant at p. < 001. Furthermore, the partial eta squared (partial ε^2) associated with the main effect of LAPs is .092 and the power to detect the main effect is .995. Thus, *hypothesis H^{16} is accepted* due to statistically significant impact of LAPs in IVE on

four aesthetic-motivational dimensions measuring LLM in a FLVE. Since, the results for hypothesis testing were statistically significant, so follow-up tests were performed and also interpreted.

5.4.2.1 Alpha Correction

If the overall F-test is significant, then it is a common practice to go ahead and look at the individual dependent variables with separate ANOVA tests. However, the experiment-wise alpha protection provided by the overall or omnibus F-test does not extend to the univariate tests. It is thus important to make an alpha correction to account for multiple ANOVAs being run. Hence, confidence level is divided by the number of tests to be performed. In this case, F-test for the four dependent variables is required to be at $p < .013$ (.05/4)

5.4.2.2 Univariate ANOVAs

Table 5.33 shows that LAPs in IVEs have a statistically significant effect on three aesthetic-motivational dimensions measuring LLM in a FLVE, namely, *usability perception* ($F (2, 173) = 3.356$; $p = .007 < .013$; partial $\varepsilon^2 = .37$), *cognitive engagement* ($F (2, 173) = 8.440$; $p = .000 < .013$; partial $\varepsilon^2 = .89$) and *visual & aesthetic appeal* ($F (2, 173) = 5.237$; $p = .003 < .013$; partial $\varepsilon^2 = .65$), while a non-significant effect on one aesthetic-motivational dimension, *satisfaction* ($F (2, 173) = 1.900$; $p = .153 > .013$, partial $\varepsilon^2 = .021$)

Table 5.32: Multivariate Tests (H^{16})

	Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power(b)
Intercept	Pillai's Trace	.978	1851.875a	4.000	170.000	.000	.978	7407.499	1.000
	Wilks' Lambda	.022	1851.875a	4.000	170.000	.000	.978	7407.499	1.000
	Hotelling's Trace	43.574	1851.875a	4.000	170.000	.000	.978	7407.499	1.000
	Roy's Largest Root	43.574	1851.875a	4.000	170.000	.000	.978	7407.499	1.000
Learners' Aesthetic Perceptions	Pillai's Trace	.180	4.216	8.000	342.000	.000	.090	33.726	.994
	Wilks' Lambda	.425	4.303a	8.000	340.000	.000	.092	34.422	.995
	Hotelling's Trace	.208	4.389	8.000	338.000	.000	.094	35.110	.996
	Roy's Largest Root	.180	7.699c	4.000	171.000	.000	.153	30.797	.997

Computed using alpha = .05

Table 5.33: Tests of Between Subjects Effects (H^{16})

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent Parameter	Observed Power (b)
Corrected Model	Satisfaction	3.028 (a)	2	1.514	1.900	.153	.021	3.801	.049
	Usability Perception	4.296 (c)	2	2.148	3.356	.037	.037	6.712	.400
	Cognitive Engagement	13.068 (d)	2	6.534	8.440	.000	.089	16.881	.802
	Visual & Aesthetic Appeal	10.473 (e)	2	5.237	6.026	.003	.065	12.052	.739
Intercept	Satisfaction	1583.979	1	1583.979	1988.164	.000	.920	1988.164	1.000
	Usability Perception	1711.786	1	1711.786	2674.100	.000	.939	2674.100	1.000
	Cognitive Engagement	1380.598	1	1380.598	1783.394	.000	.912	1783.394	1.000
	Visual & Aesthetic Appeal	1568.144	1	1568.144	1804.509	.000	.913	1804.509	1.000
Learners' Aesthetic Perceptions	Satisfaction	3.028	2	1.514	1.900	.153	.021	3.801	.049
	Usability Perception	4.296	2	2.148	3.356	.007	.037	6.712	.509
	Cognitive Engagement	13.068	2	6.534	8.440	.000	.089	16.881	.802
	Visual & Aesthetic Appeal	10.473	2	5.237	6.026	.003	.065	12.052	.739
Error	Satisfaction	137.830	173	.797					
	Usability Perception	110.743	173	.640					
	Cognitive Engagement	133.926	173	.774					
	Visual & Aesthetic Appeal	150.339	173	.869					
Total	Satisfaction	1891.000	176						
	Usability Perception	2033.000	176						
	Cognitive Engagement	1725.000	176						
	Visual & Aesthetic Appeal	1949.000	176						
Corrected Total	Satisfaction	140.858	175						
	Usability Perception	115.040	175						
	Cognitive Engagement	146.994	175						
	Visual & Aesthetic Appeal	160.812	175						

a. R Squared = .021 (Adjusted R Squared = .010) b. Computed using alpha = .013 c. R Squared = .267 (Adjusted R Squared = .226) d. R Squared = .653 (Adjusted R Squared = .578) e. R Squared = .465 (Adjusted R Squared = .454)

5.4.3 Hypothesis Testing (H^{17})

There will be significant multivariate effect of LAPs in IVE (high, medium, low) on four aesthetic motivational dimensions *(usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction)* of FLVE, after adjusting for the effect of LST as a covariate.

Interpretation of results based on one-way MANCOVA (Table 5.34) revealed a significant overall multivariate main effect of LAPs in IVE on their LLM in FLVE after adjusting for the effect of covariate LST, Wilks' λ = .373, F (4, 169.000) = 3.332, p = .012 < .05, partial ε^2 = .073. Power to detect the effect was .836. The multivariate test results showed that LST has a significant influence on LAPs and LLM, therefore, *hypothesis H^{17} is accepted.* To further interpret influence of the covariate, follow-up tests are performed and analyzed.

5.4.3.1 Alpha Correction

For details on alpha correction section 5.4.3.1 to be referred.

5.4.3.2 Univariate ANOVAs

In order to examine how the four aesthetic-motivational dimensions (usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction) differ across LAPs, after adjusting for the effect of covariate (LST), Tests of Between-Subjects Effects (Table 5.35) was examined. Results showed that LST when included into the model as a covariate has a significant effect on all four aesthetic-motivational dimensions, *usability perception* (F (1, 172) = 1.764; p = .009 < .013; partial ε^2 = .51), *cognitive engagement* (F (1, 172) = 1.390; p = .000 < .013; partial ε^2 = .64), *visual & aesthetic appeal* (F (1, 172) = 2.393; p = .002 < .013; partial ε^2 = .73) and *satisfaction* (F (1, 172) = 1.370; p = .007 < .013; partial ε^2 = .58), measuring LLM in FLVE.

Interestingly, results also showed (Table 5.35) that LAPs in IVEs after adjusting LST as a covariate into the model have a statistically significant effect on two

aesthetic-motivational dimensions only, namely, *cognitive engagement* (F (2, 172) = 6.840; p = .001 < .013; partial ε^2 = .074) and *visual & aesthetic appeal* (F (2, 172) = 6.221; p = .002 < .013; partial ε^2 = .067), and non-significant effect on *usability perception* (F (2, 172) = 4.094; p = .018 > .013; partial ε^2 = .045) and *satisfaction* (F (2, 172) = 2.092; p = .127 > .013; partial ε^2 = .024).

Before accounting for LST as a covariate in the model, sum of squares in corrected model for aesthetic-motivational dimensions was observed as: *satisfaction* 3.028, *usability perception* 4.296, *cognitive engagement* 13.068, *visual & aesthetic appeal* 10.473. After accounting for the effect of the covariate, the amount of variation accounted for by each aesthetic-motivational dimension has been observed to be risen as: s*atisfaction* by 6.025 units, *usability perception* by 1.370 units, *cognitive engagement* by 18.778 units, *visual & aesthetic appeal* by 14.668 units.

Amount of variation or unexplained (error) variance for each aesthetic-motivational dimension has also substantially reduced after accounting for the effect of LST as a covariate in the model: *satisfaction* 111.262 (27 units reduction), *usability perception* 97.558 (13 units reduction), *cognitive engagement* 103.234 (31 units reduction), *visual & aesthetic appeal* 121.276 (29 units reduction).

Table 5.34: Multivariate Tests (H^{17})

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent Parameter	Observed Power b
Intercept	Pillai's Trace	.490	40.649a	4.000	169.000	.000	.490	162.596	1.000
	Wilks' Lambda	.510	40.649a	4.000	169.000	.000	.490	162.596	1.000
	Hotelling's Trace	.962	40.649a	4.000	169.000	.000	.490	162.596	1.000
	Roy's Largest Root	.962	40.649a	4.000	169.000	.000	.490	162.596	1.000
Learners' Aesthetic Perceptions	Pillai's Trace	. 811	4.627	8.000	340.000	.000	.098	37.019	.989
	Wilks' Lambda	.296	4.662a	8.000	338.000	.000	.099	37.295	.989
	Hotelling's Trace	.224	4.696	8.000	336.000	.000	.101	37.565	.990
	Roy's Largest Root	.169	7.173c	4.000	170.000	.000	.144	28.694	.980
Learners' Schematic Thinking	Pillai's Trace	. 927	3.332a	4.000	169.000	.012	.073	13.327	.836
	Wilks' Lambda	.373	3.332a	4.000	169.000	.012	.073	13.327	.836
	Hotelling's Trace	.079	3.332a	4.000	169.000	.012	.073	13.327	.836
	Roy's Largest Root	.079	3.332a	4.000	169.000	.012	.073	13.327	.836

a. Exact statistic
b. Computed using alpha = .013
c. The statistic is an upper bound on F that yields a lower bound on the significance level.
d. Design: Intercept + Learners' Aesthetic Perceptions + Schematic Thinking

Table 5.35: Tests of Between-Subjects Effects (H^{17})

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent Parameter	
Corrected Model	Satisfaction	6.897a	3	2.299	2.799	.042	.047	8.397	.461
	Usability Perception	6.391c	3	2.130	2.744	.045	.046	8.231	.451
	Cognitive Engagement	11.078d	3	3.693	4.562	.004	.074	13.685	.743
	Visual & Aesthetic Appeal	12.536e	3	4.179	4.847	.003	.078	14.542	.776
Intercept	Satisfaction	12.128	1	12.128	14.767	.000	.079	14.767	.907
	Usability Perception	56.188	1	56.188	72.360	.000	.296	72.360	1.000
	Cognitive Engagement	28.263	1	28.263	34.914	.000	.169	34.914	1.000
	Visual & Aesthetic Appeal	53.583	1	53.583	62.156	.000	.265	62.156	1.000
Learners' Aesthetic Perceptions	Satisfaction	3.437	2	1.718	2.092	.127	.024	4.185	.237
	Usability Perception	6.358	2	3.179	4.094	.018	.045	8.188	.522
	Cognitive Engagement	11.074	2	5.537	6.840	.001	.074	13.680	.805
	Visual & Aesthetic Appeal	10.725	2	5.363	6.221	.002	.067	12.441	.756
Learners' Schematic Thinking	Satisfaction	6.025	1	6.025	7.336	.007	.582	7.336	.579
	Usability Perception	1.370	1	1.370	1.764	.009	.513	1.764	.122
	Cognitive Engagement	1.126	1	1.126	1.390	.000	.641	1.156	.520
	Visual & Aesthetic Appeal	2.063	1	2.063	2.393	.002	.734	2.393	.171
Error	Satisfaction	111.262	172	.821					
	Usability Perception	97.558	172	.776					
	Cognitive Engagement	103.234	172	.810					
	Visual & Aesthetic Appeal	121.276	172	.862					
Total	Satisfaction	1842.000	176						
	Usability Perception	2165.000	176						
	Cognitive Engagement	1801.000	176						
	Visual & Aesthetic Appeal	1949.000	176						
Corrected Total	Satisfaction	120.724	175						
	Usability Perception	105.286	175						
	Cognitive Engagement	115.434	175						
	Visual & Aesthetic Appeal	134.064	175						

a. R Squared = .047 (Adjusted R Squared = .030) b. Computed using alpha = .013 c. R Squared = .378 (Adjusted R Squared = .362)
d. R Squared = .721 (Adjusted R Squared = .658) e. R Squared = .556 (Adjusted R Squared = .505)

5.4.4 Hypothesis Testing (H^{18})

Usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction in FLVE will be lowest for LAPs (high) in IVE.

To test H^{18} four aesthetic-motivational dimensions measuring LLM in FLVE are visualized in Barcharts on y-axis to examine data distribution and rating patterns associated with each catergorized LAPs in IVE on x-axis (See Figures 5.25 to 5.28).

5.4.4.1 Bar Charts

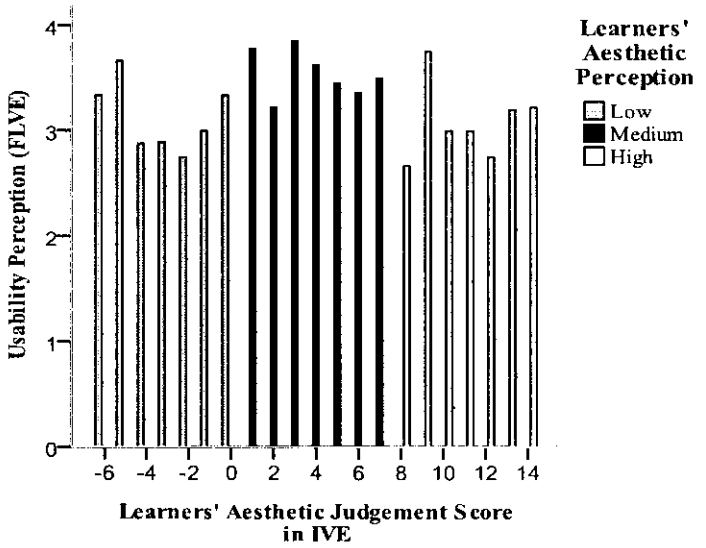


Figure 5.25: Usability Perception (FLVE) and Learners' Aesthetic Perceptions (IVE)

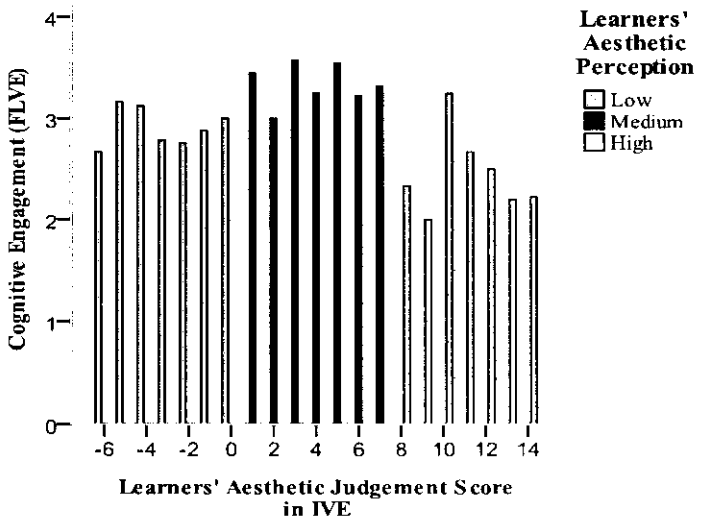


Figure 5.26: Cognitive Engagement (FLVE) and Learners' Aesthetic Perceptions (IVE)

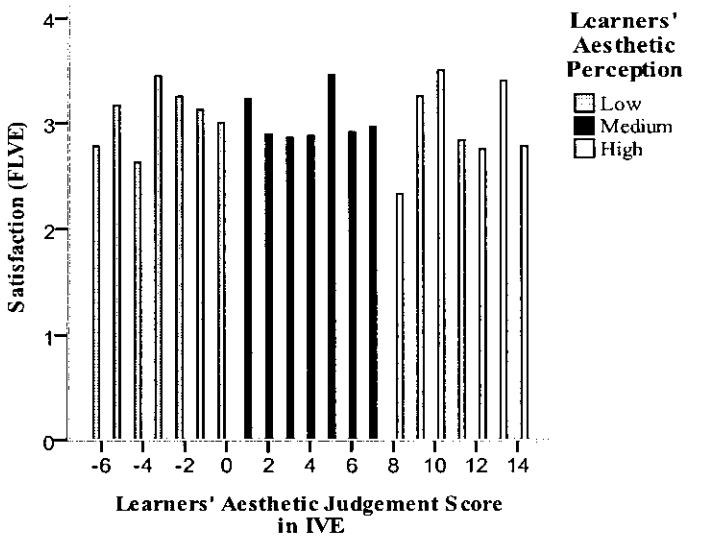


Figure 5.27: Satisfaction (FLVE) and Learners' Aesthetic Perceptions (IVE)

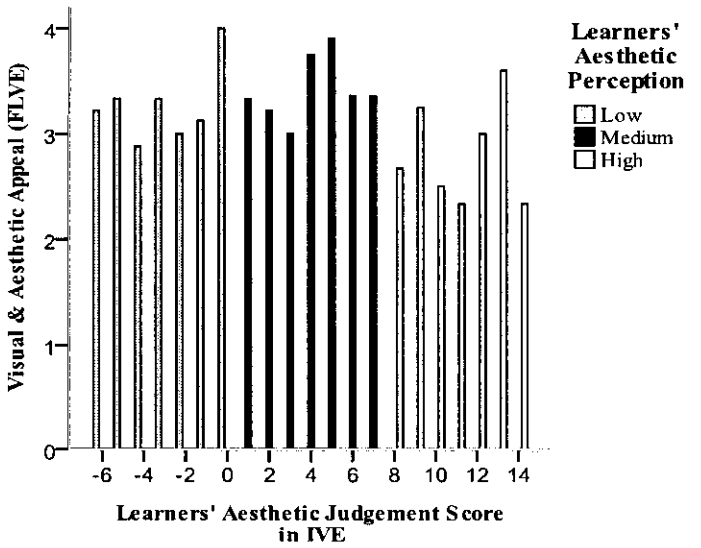


Figure 5.28: Visual & Aesthetic Appeal (FLVE) and Learners' Aesthetic Perceptions (IVE)

5.4.4.2 Descriptive Statistics

Table 5.36: Descriptive Statistics (H^{18})

	Learners' Aesthetic Perception	Mean	Std. Deviation	N
Cognitive Engagement	Low	2.89	.890	47
	Medium	3.32	.858	94
	High	2.43	.850	35
	Total	3.03	.928	176
Visual & Aesthetic Appeal	Low	3.21	1.020	47
	Medium	3.41	.897	94
	High	2.74	.919	35
	Total	3.23	.965	176
Usability Perception	Low	3.41	.866	47
	Medium	3.16	.901	94
	High	3.11	.832	35
	Total	3.32	.895	176
Satisfaction	Low	3.04	.806	47
	Medium	3.01	.933	94
	High	2.97	.891	35
	Total	3.01	.888	176

5.4.4.3 Levene's Test of Equality of Error Variances

The results of Levene's Test (Table 5.37) were non-significant; indicating group variances of four aesthetic-motivational dimensions were equal and assumption has not been violated.

Table 5.37: Levene's Test of Equality of Error Variances (H^{18})

	F	df1	df2	Sig.
Satisfaction	.473	2	173	.624
Cognitive Engagement	.091	2	173	.913
Visual & Aesthetic Appeal	.052	2	173	.950
Usability Perception	.083	2	173	.920

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + Learners' Schematic Thinking + Learners' Aesthetic Perceptions

5.4.4.4 Alpha Correction for Post Hoc Multiple Comparisons

Since post-hoc multiple comparison involves 12 tests to be performed (four aesthetic-motivational dimensions across three groups of aesthetic perceptions), therefore,

Confidence Level has been reset at (.05/12) = .0041. Post-hoc Multiple Comparisons after accounting for the effect of LST as a covariate are interpreted from Table 5.38.

5.4.4.5 Post-hoc Multiple Comparisons

Cognitive Engagement – LAP (high) in IVE differed significantly from LAP (medium), p = .000 < .004 and LAP (low), p = .002 < .004. Table 5.36 shows that LAP (high) rated the FLVE lowest in terms of providing *cognitive engagement* (M = 2.43, S.D. = .850) to sustain LLM.

Visual & Aesthetic Appeal – LAP (high) in IVE differed significantly from LAP (medium), p = .002 < .004 and LAP (low), p = .000 < .004. Table 5.36 shows that LAP (high) rated *visual and aesthetic appeal* of the FLVE lowest (M = 2.74, S.D. = .919) in terms of sustaining LLM.

Usability Perception – LAP (high) in IVE did not differ from LAP (medium), p = .999 > .004 and LAP (low), p = .089 > .004. Table 5.36 shows that LAP (high), M = 3.11, S.D. = .832, remained fairly close to LAP (medium), M = 3.16, S.D. = .901 and LAP (low), M = 3.41, S.D. = .866, but still lowest in terms of rating *usability perception* of the FLVE for sustaining LLM.

Satisfaction – LAP (high) in IVE did not differ from LAP (medium), p = .976 > .004 and LAP (low), p = .976 > .004. Table 5.36 shows that LAP (high), M = 2.97, S.D. = .891, remained fairly close to LAP (medium), M = 3.01, S.D. = .933 and LAP (low), M = 3.04, S.D. = .806, it is still lowest in terms of rating *satisfaction* provided by FLVE for sustaining LLM.

Based on these results, *hypothesis H^{18} is thus partially accepted* since LAP (high) in IVE only differed significantly from LAPs (medium and low) in two aesthetic-motivational dimensions only, i.e., cognitive engagement and visual & aesthetic appeal.

Table 5.38: Pairwise Multiple Comparisons (H^{18})

Dependent Variable	(I) Learners' Aesthetic Perception	(J) Learners' Aesthetic Perception	Mean Difference (I-J)	Std. Error	Sig	98.7% Confidence Interval for Differencea	
						Lower Bound	Upper Bound
Satisfaction	Low	Medium	.356	.182	.031	-.170	.881
		High	.385	.222	.938	-.255	1.025
	Medium	Low	-.356	.182	.031	-.881	.170
		High	.029	.171	.976	-.464	.523
	High	Low	-.385	.222	.938	-1.025	.255
		Medium	-.029	.171	.976	-.523	.464
Usability Perception	Low	Medium	-.505	.177	.036	-1.016	.006
		High	-.438	.215	.999	-1.060	.185
	Medium	Low	.505	.177	.036	-.006	1.016
		High	.067	.166	.065	-.413	.547
	High	Low	.438	.215	.999	-.185	1.060
		Medium	-.067	.166	.065	-.547	.413
Cognitive Engagement	Low	Medium	-.324	.181	.022	-.846	.197
		High	.276	.220	.002	-.360	.911
	Medium	Low	.324	.181	.022	-.197	.846
		High	.600	.170	.000	.110	1.090
	High	Low	-.276	.220	.002	-.911	.360
		Medium	-.600	.170	.000	-1.090	-.110
Visual & Aesthetic Appeal	Low	Medium	-.522	.186	.017	-1.060	.017
		High	-.051	.227	.001	-.707	.605
	Medium	Low	.522	.186	.017	-.017	1.060
		High	.470	.175	.003	-.035	.976
	High	Low	.051	.227	.001	-.605	.707
		Medium	-.470	.175	.003	-.976	.035

Based on estimated marginal means. a. Adjustment for multiple comparisons: Sidak. *. The mean difference is significant at the .013 level.

5.4.5 Hypothesis Testing (H^{19})

The relationship between four aesthetic-motivational dimensions and the covariate (LST) will be same across LAPs (high, medium, low) in IVE.

5.4.5.1 Homogeneity of Regression Slopes

This hypothesis was checked by plotting a scatter plot for each *LAPs (high, medium, low)* with the *covariate (LST)* on x-axis and four dependent variables *(usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction)* on y-axis. As shown in Figures 5.29 to 5.32 regression lines for each dependent variable against the covariate were fitted in their respective scatter plots to examine the assumption of *homogeneity of regression slopes* across three groups of LAPs (high, medium, low). All regression lines should look more or less same for model validation.

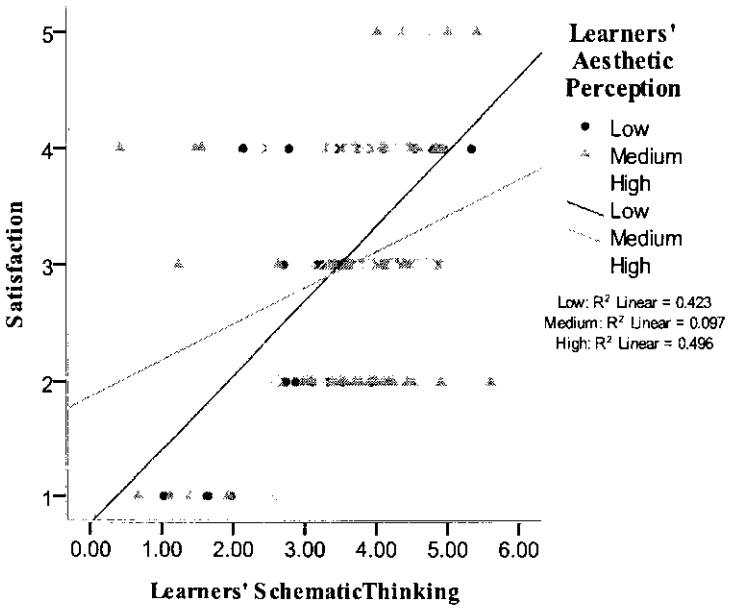


Figure 5.29: Homogeneity of Regression Slopes (Satisfaction)

Figure 5.29 examines homogeneity of regression slopes when data for three LAP groups (high, medium, low) is plotted in a scatter plot with dependent variable, satisfaction on y-axis and the covariate, LST on x-axis. There is a strong positive relationship between satisfaction from a FLVE and LST, for LAP (high), $R^2 = 0.496$,

and LAP (low), R^2 = 0.423 in IVE. For LAP (medium) in IVE. This overall relationship is still true but is based on a weak positive association (R^2 = 0.097).

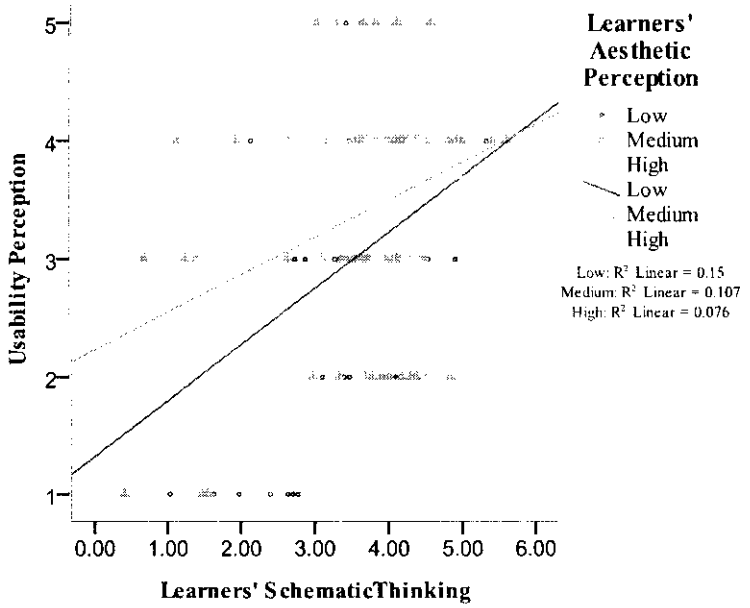


Figure 5.30: Homogeneity of Regression Slopes (Usability Perception)

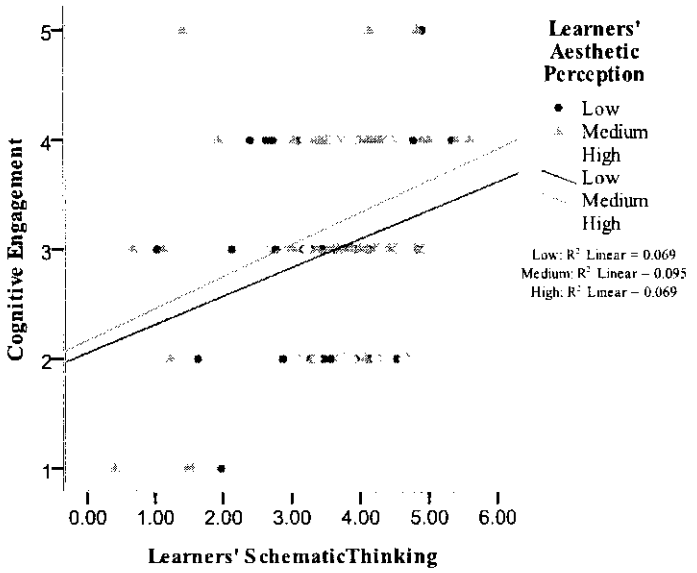


Figure 5.31: Homogeneity of Regression Slopes (Cognitive Engagement)

Figure 5.30 examines homogeneity of regression slopes when data for three LAPs groups (high, medium, low) is plotted in a scatter plot with dependent variable, usability perception on y-axis and the covariate, LST on x-axis. There is a strong positive relationship between usability perception of a FLVE and LST, for LAP (low),

$R^2 = 0.15$, in IVE. For LAP (high), $R^2 = 0.076$ and LAP (medium), $R^2 = 0.107$ in IVE. This overall relationship is true for all LAP groups but depicts a weak positive association.

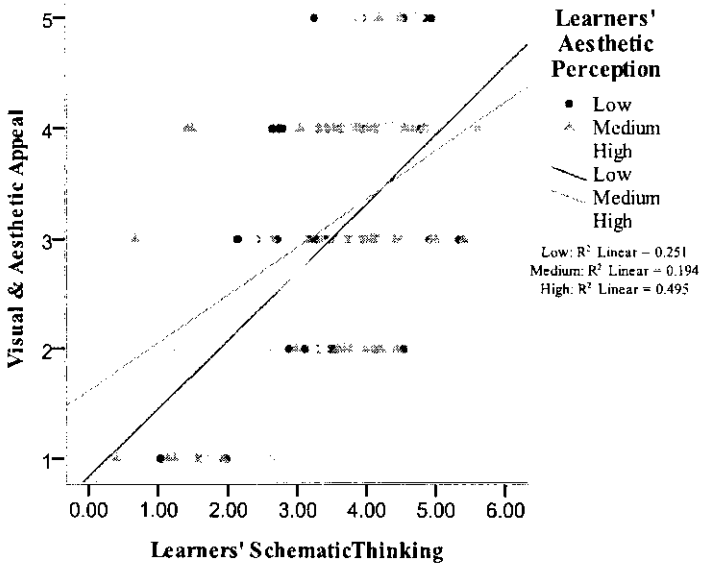


Figure 5.32: Homogeneity of Regression Slopes (Visual & Aesthetic Appeal)

Figure 5.31 examines homogeneity of regression slopes when data for three LAPs groups (high, medium, low) is plotted in a scatter plot with dependent variable, cognitive engagement on y-axis and the covariate, LST on x-axis. There is a weak but positive relationship between cognitive engagement experienced from a FLVE and LST, for LAP (high), $R^2 = 0.069$, LAP (medium), $R^2 = 0.095$ and LAP (low), $R^2 = 0.069$ in IVE. This overall relationship is true for all LAP groups, but is based on weak positive associations.

Figure 5.32 examines homogeneity of regression slopes when data for three LAPs groups (high, medium, low) is plotted in a scatter plot with dependent variable, visual & aesthetic appeal on y-axis and the covariate, LST on x-axis. There is a strong positive relationship between visual & aesthetic appeal of a FLVE and LST, for LAP (high), $R^2 = 0.495$, LAP (medium), $R^2 = 0.194$ and LAP (low), $R^2 = 0.251$ in IVE. This overall relationship is true for all LAP groups and is based on a strong positive association.

5.4.5.2 Interaction Effect

Table 5.39 was examined to study the Interaction Effect (denoted with *) of LAPs (high, medium, low) with LST across four aesthetic-motivational dimensions in FLVE. If this interaction is significant across any of the four dependent variables, then assumption of homogeneity of regression slopes is violated.

The Interaction Effect (Learners' Aesthetic Perceptions * Learners' Schematic Thinking) is observed to be non-significant: *satisfaction* p = .654, *usability perception* p = .855, *cognitive engagement* p = .667, and *visual & aesthetic appeal* p = .485. This indicates the assumption has not been violated and is tenable to ensure model's fitness.

Based on these results, *hypothesis* H^{18} *is accepted* since there is statistical evidence to support the relationship between four dependent variables and the covariate (LST) which has been found to be same across all classified groups of LAPs (high, medium, low) in IVE. Hence, homogeneity of the regression slopes is confirmed to ensure proposed aesthetic perception and motivation model's fitness.

Table 5.39: Tests of Between-Subjects Effects (H^{19})

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Satisfaction	7.251a	5	1.450	1.749	.126
	Usability Perception	4.503b	5	.901	1.088	.369
	Cognitive Engagement	16.137c	5	3.227	4.089	.002
	Visual & Aesthetic Appeal	12.935d	5	2.587	2.974	.013
Intercept	Satisfaction	25.475	1	25.475	30.734	.000
	Usability Perception	41.153	1	41.153	49.706	.000
	Cognitive Engagement	22.170	1	22.170	28.089	.000
	Visual & Aesthetic Appeal	26.251	1	26.251	30.178	.000
Learners' Aesthetic Perceptions	Satisfaction	1.108	2	.554	.668	.514
	Usability Perception	.613	2	.306	.370	.691
	Cognitive Engagement	.533	2	.266	.338	.714
	Visual & Aesthetic Appeal	.455	2	.227	.261	.770
Schematic Thinking	Satisfaction	2.591	1	2.591	3.126	.079
	Usability Perception	.418	1	.418	.505	.478
	Cognitive Engagement	2.215	1	2.215	2.807	.096
	Visual & Aesthetic Appeal	2.002	1	2.002	2.301	.131
Learners' Aesthetic Perceptions * Schematic Thinking	Satisfaction	.705	2	.353	.425	.654
	Usability Perception	.259	2	.130	.156	.855
	Cognitive Engagement	.640	2	.320	.405	.667
	Visual & Aesthetic Appeal	1.264	2	.632	.727	.485
Error	Satisfaction	140.909	170	.829		
	Usability Perception	140.747	170	.828		
	Cognitive Engagement	134.176	170	.789		
	Visual & Aesthetic Appeal	147.878	170	.870		

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Error	Satisfaction	140.909	170	.829		
	Usability Perception	140.747	170	.828		
	Cognitive Engagement	134.176	170	.789		
	Visual & Aesthetic Appeal	147.878	170	.870		
Total	Satisfaction	1842.000	176			
	Usability Perception	2150.000	176			
	Cognitive Engagement	1801.000	176			
	Visual & Aesthetic Appeal	1949.000	176			
Corrected Total	Satisfaction	148.159	175			
	Usability Perception	145.250	175			
	Cognitive Engagement	150.313	175			
	Visual & Aesthetic Appeal	160.812	175			

a. R Squared = .049 (Adjusted R Squared = .021)
b. R Squared = .031 (Adjusted R Squared = .003)
c. R Squared = .107 (Adjusted R Squared = .081)
d. R Squared = .080 (Adjusted R Squared = .076)

5.4.6 Hypothesis Testing (H^{20})

LAPs components in IVEs will be associated with LLM components in FLVEs for derivation of emerging themes.

5.4.6.1 Data Immersion (Coding Forms)

The first stage of qualitative analysis for emerging themes was based on examining Coding Form 1 and Coding Form 2 and categorizing adjectives by counting the number of times they were selected by respondents. Words that were popularly selected (at least 9 or more than 12 times) by respondents to reflect upon their aesthetic and disaesthetic experiences in IVEs are highlighted in dark grey color, while words that were moderately selected (at least 5 and maximum 8 times) are highlighted in light grey color (Table: 5.40).

Table 5.40: Summary of Ticked Words – Aesthetic Perceptions (H^{20})

Aesthetic Experience				Disaesthetic Experience			
□	Compelling	□	Spontenous	□	Loud	□	Inefficient
□	Adventurous	□	Creative	□	Annoyaing	□	Unrefined
□	Stimulating	□	Original	□	Disruptive	□	Invaluable
□	Imaginative	□	Revive	□	Vulgur	□	Time wastage
□	Innovative	□	Recharge	□	Boring	□	Frustrating
□	Refreshing	□	Amusing	□	Unattractive	□	Dull
□	Exciting	□	Enjoyable	□	Anxiety	□	Undesirable
□	Thrilling	□	Delightful	□	Poor quality	□	Rigid
□	Entertaining	□	Arousal	□	Impersonal	□	Ineffective
□	Funny	□	Glamorized	□	Hard	□	Extravagant
□	Harmonic	□	Colorful	□	Unpleasant	□	Colorless
□	Serene	□	Beautiful	□	Bizarre	□	Dry
□	Pleasant	□	Emotional	□	Orthodox	□	Monotonous

Likewise, words that were popularly selected (at least 8 or more than 11 times) by respondents to reflect upon their motivation and demotivation experiences in FLVEs are highlighted in dark grey color, while words that were moderately selected (at least 5 and maximum 7 times) are highlighted in light grey color (Table 5.41).

Table 5.41: Summary of Ticked Words – Motivation (H^{20})

Motivation				Demotivation			
□	Inspiring	□	Riveting	□	Inefficient	□	Exhausting
□	Encouraging	□	Interesting	□	Unrefined	□	Nerve-racking
□	Moving	□	Optimistic	□	Invaluable	□	Draining
□	Empowering	□	Positive	□	Monotonous	□	Anxious
□	Arousing	□	Constructive	□	Frustrating	□	Hard
□	Stirring	□	Impulsive	□	Dull	□	Abstract
□	Engaging	□	Persuasive	□	Undesirable	□	Perverse
□	Reliable	□	Instigating	□	Rigid	□	Illogical
□	Confidence	□	Deriving	□	Ineffective	□	Boring
□	Absorbing	□	Ambitious	□	Pessimestic	□	Intricate
□	Engrossing	□	Purposeful	□	Stressful	□	Tiring
□	Gripping	□	Enthusiasm	□	Flat	□	Plain
□	Involving	□	Energy	□	Eccentric	□	Gloomy

5.4.6.2 Qualitative Reporting

The second stage of qualitative data analysis was based on coding based on qualitative reporting. The data collected from Case study 1 and Case study 2 was simultaneously examined and excessive filtration was carried out of hand notes and memos to select and identify relevant codes (Table 5.42).

5.4.6.3 Identification of Emerging Themes: Triangulation

The codes identified were grouped together to identify an emerging theme (Table 5.43), which also completed the process of triangulation (see Chapter 4, Section 4.4.2.3).

5.4.6.4 Negative Case Analysis

The 6 themes that emerged from analysis of factors influencing upon LAPs in IVEs and LLM in FLVEs accounted for all of the cases, thus *ensuring validity of the derived emerging themes (H^{20}).*

Table 5.42: Data Immersion From Coding Forms and Qualitative Reporting (H^{20})

Research Questions (Qualitative Reporting)	Case Study 1 Universiti Teknologi PETRONAS (n = 17)		Case Study 2 Universiti Malaysia PAHANG (n = 27)	
What is your most favorite IVE and why do you like it so much?	Internet, Motion Pictures, Video Games, Television, Mobile Phones, Decorative Art, Theatre		Internet, Motion Pictures, Video Games, Television, Mobile Phones, Paintings, Drawing	
What makes your Informal Visual Media interaction so likeable/dislikeable? **(Coding Forms)**	Stimulating[6] Thrilling[4] Entertaining[6] Funny[4] Creative[3] Arousal[6] Glamourized[5] Harmonic[5] Amusing[6] Beautiful[1]	Colorful[1] Emotional[4] Loud[4] Dramatized[5] Frustrating[5] Annoying[4] Sensationalized[5] Unattractive[1]	Stimulating[6] Imaginative[3] Innovative[3] Thrilling[4] Funny[4] Arousal[6] Adventurous[4] Original□[3] Amusing[6]	Beautiful[1] Glamourized[5] Colorful[1] Emotional[4] Loud[4] Vulgar[2] Frustrating[5] Monotonous[5] Extravagant[4]
What makes your Informal Visual Media interaction so likeable/dislikeable? **(Qualitative Coding)**	Comical[4] Virtual reality[4] Bold[4] Multimedia effects[4] Special effects[1] Artistic[1] Highly Expressing[6]	Role-playing[3] Fiction[3] Visual flow[6] Musical[1] Creative communication[1] Story telling[3] Horror / Thrill[4]	Narration[3] Sustains interest[6] Interactive[1] Gripping sequences[1] Comical[4] Virtual reality[4]	Horror / Thrill[4] Graphical[1] Musical[1] Surprising[6] High quality & Standard[5] Animated[1] Interactive media[4] Fantasizing[3]
Has your personality been influenced (in terms of attitude/behavior/selection /judging/ opinion) due to your frequent interaction with Informal Visual Environments? **(Qualitative Coding)**	Awareness[2] Conversant[2] Critical skills[2] Technical skills[2] Enhanced retention[4]	Media persuasion[2] Selective fondness[2] Decision making[2]	Critical appreciation[2] Content analysis[2]	Knowledgeable[2] Decision making[2] Context analysis[2]

Table 5.42: Data Immersion From Coding Forms and Qualitative Reporting (H^{20}) (Continue)

Research Questions (Qualitative Reporting)	Case Study 1 Universiti Teknologi PETRONAS (n = 17)		Case Study 2 Universiti Malaysia PAHANG (n = 27)	
Appreciate/criticize aesthetics of Formal Learning Visual Environment that you interact with. **(Coding Forms)**	Engaging[4]	Monotonous[5]	Engaging[4]	Plain[1]
	Reliable[2]	Frustrating[5]	Reliable[2]	Persuasive[2]
	Constructive[2]	Dull[1]	Constructive[2]	Pessimistic[2]
	Persuasive[2]	Rigid[1]	Flat[1]	Frustrating
	Purposeful[2]	Boring[1]	Boring[1]	Dull[1]
	Inspiring[3]	Nerve-racking[4]	Nerve-racking[4]	Unrefined[1]
	Positive[3]			
Appreciate/criticize aesthetics of Formal Learning Visual Environment that you interact with. **(Qualitative Coding)**	Feeling of indifference[5]	Non interactive[1]	Time consuming[5]	Collaborative learning[6]
	Excessive use of mental energy[6]	Collaborative learning[6]	Colorless[1]	Flexible learning[6]
	Flexible learning[6]	Promotes learning attitude[6]	Responsive feedback[2]	
			Critical appraisal[2]	

Triangulation

[1] Code Grouped for Emerging Theme 1
[2] Code Grouped for Emerging Theme 2
[3] Code Grouped for Emerging Theme 3
[4] Code Grouped for Emerging Theme 4
[5] Code Grouped for Emerging Theme 5
[6] Code Grouped for Emerging Theme 6

Table 5.43: Identification of Emerging Themes (H^{20})

Emerging Themes	Response Record Coded to Category	% of Total Records (n = 44)	Top Terms/Term Groups in Category
Learners' Aesthetic Perceptions in Informal Visual Environments are enriched with *artistic qualities.*	32	72.7	Artistic, Colorful, Musical , Gripping sequences, Beautiful, Graphical, Animated, Interactive, Creative communication, Special effects, Dull, Rigid, Flat, Plain, Boring, Non-interactive, Colorless, Unrefined Unattractive
Learners' Aesthetic Perceptions in Informal Visual Environments are occupied with *critical judgments.*	37	84.1	Awareness, Conversant, Technical skills, Media persuasion, Selective fondness, Vulgar, Decision making, Critical appreciation, Content analysis, Knowledgeable, Context analysis, Reliable, Purposeful, Constructive, Persuasive, Pessimistic, Responsive feedback
Learners' Aesthetic Perceptions in Informal Visual Environments are elicited through *imaginative perceptions.*	28	63.6	Creative, Imaginative, Innovative, Original, Role-playing, Fiction, Storytelling, Narration, Fantasizing, Inspiring, Positive
Learners' Aesthetic Perceptions in Informal Visual Environments are influenced by the involvement of *multiple-senses.*	35	79.5	Thrilling, Engaging, Nerve-racking, Funny, Emotional, Loud, Annoying, Adventurous, Emotional, Extravagant, Comical, Virtual reality, Bold, Multimedia effects, Horror / Thrill, Interactive media, Enhanced retention
Informal Visual Environments have altered *learners' aesthetic threshold* so they experience lack of learning motivation in Formal Learning Visual Environments.	12	27.2	Glamorized, Harmonic, Dramatized, Frustrating, Sensationalized, Monotonous, High quality & standard, Feeling of indifference, Time consuming, Frustrating
Informal Visual Environments engage and sustain viewers' motivation by providing *cognitive absorption.*	23	52.2	Stimulating, Entertaining, Arousal, Amusing, Stimulating, Highly Expressing, Visual flow, Sustains interest, Surprising, Excessive use of mental energy, Flexible learning, Collaborative learning, Promotes learning attitude

5.5 Chapter Summary

This Chapter has reported hypotheses testing results on MDF, introduced in Chapter 3 and elaborated in Chapter 4. Results on assessing users' needs strongly highlighted influence of IVEs and IMFs on LLM and aesthetic expectations from FLVEs. These results also supported integration of F&IMFs into the proposed aesthetic perception and motivation model for F&IVEs. Results for developing a scale to embed LAPs and LLM in F&IVEs took a leap forward based on EFA performed on learners' aesthetic-emotions associated with F&IMFs. The developed scale unveiled four aesthetic-motivational dimensions where visual gaps are experienced by learners due to the difference between what they aesthetically expect (based on LAPs in IVEs) and what they see (LLM in FLVEs). Results of model testing were useful in formation of learners' mental models and determining causal relationships between research variables and their sub-measuring constructs for model testing (LST included as a covariate, LAPs in IVEs as an independent and LLM in FLVE as a dependent variable). Results for model validation examined model's multivariate effects, prognostication abilities, and interaction effects to validate and ensure model's fitness.

CHAPTER 6

DISCUSSION

6.0 Overview

This empirical research was conducted to answer four research questions (RQs) that are defined in Chapter 1. For hypotheses formulation and testing a Model Development Framework was introduced in Chapter 3 and further elaborated in Chapter 4. The five phases of the Model Development Framework resulted in four corresponding Model Evolutionary Stages. Chapter 5 presented results of the statistical procedures applied for testing hypotheses while Chapter 6 discusses the results as summarized in Table 6.1. The focus in this Chapter is to further elaborate upon the results by revisiting literature and discussing them in context of the four research questions. Section 6.1 will discuss RQ1 on assessing learning motivation and aesthetic needs in F&IVEs. Section 6.2 will discuss RQ2 on developing a scale based on Exploratory Factor Analysis to measure LAPs and LLM and how the scale facilitated in identifying visual gaps as experienced by learners in FLVEs. Section 6.3 will discuss RQ4 on model testing, based on formation of learners' mental models and interrelationship between variables. RQ4 was based on model validation based on examining model's multivariate main effects, prognostication, interaction effects and fitness, which will be discussed in Section 6.4. Finally, theoretical rationalization of the proposed aesthetic perception and motivation model based on Emerging Themes Analysis will be discussed in Section 6.4.4.

Table 6.1: Research Questions and Hypotheses Testing Results

Induction Stage - Users' Needs Assessment **RQ: 1** How learners' learning motivation and aesthetic needs are associated with F&IMFs in F&IVEs?	**Results**	**How the Results Support Research Questions and Objectives**
H^1: FLMFs will correlate with LLM.	Supported	It is a misconception that informal media technologies are meant for entertainment purpose only. They are rather a very important tool for cognitive socialization and absorption. They support communication, cooperation, way-finding, entertainment and are creating a new schemas on aesthetics of digital environments. They have an important role in shaping up our thought process and influencing upon what we may subconsciously like or dislike. This is confirmed from Study 1 & 2 that IVEs and IMFs are determinants of aesthetic expectations and learning motivation in FLVEs.
H^2: IMFs will not correlate with LLM in WBL.	Not supported	
H^3: LLM for WBL will be different across FLMFs *(attention, relevance, confidence, satisfaction).*	Supported	
H^4: LLM for WBL will be same across four IMFs *(challenge, curiosity, fantasy, control).*	Not supported	
H^5: Learners' aesthetic expectations in FLVEs will be different across three IVEs *(video-games, motion-pictures, SNWs).*	Partially supported	
H^6: Learners' aesthetic expectations in FLVEs will be different across four IMFs *(challenge, control, curiosity, fantasy).*	Supported	
H^7: Learners' aesthetic expectations from FLVEs will be different across three IVEs *(video-games, motion-pictures, SNWs)* by choice of IMFs *(challenge, control, curiosity, fantasy).*	Supported	
H^8: FLMFs *(attention, relevance, confidence, satisfaction)* and IMFs *(challenge, control, curiosity, fantasy)* will correlate to jointly predict learners' aesthetic expectations in FLVEs.	Supported	
Deduction Stage - Scale Development **RQ2:** How to develop a scale based on F&IMFs to measure LAPs and LLM in F&IVEs?	**Results**	**How the Results Support Research Questions and Objectives**
H^9: Learners' aesthetic-emotions associated with FLMFs (*attention*, *relevance*, *confidence*, *satisfaction*) and IMFs (*fantasy*, *challenge*, *curiosity*, *control*) will be correlated .	Supported	The scale developed in Study 3 embedded LAPs in IVEs and LLM in FLVEs into four dimensions that reflected learners' visual gaps (difference between what they aesthetically expected and what they viewed). Results also confirmed and validated scales' fitness.

Table 6.1: Research Questions and Hypotheses Testing Results (continue)

Testing Stage - Model Testing **RQ3:** How do the preliminary empirical analyses result in formation of learners mental models and infer relationships among research variables?	**Results**	**How the Results Support Research Questions and Objectives**
H^{10}: LAPs can be classified (high, medium, low).	Supported	New interaction designing paradigms, i.e., ubiquitous computing, tangible interaction, and ambient interfaces require new designing approaches to design well beyond those used for traditional graphical user interfaces. In Case Study 1, formation of learners' mental model based on LAPs and LST as a compound of (CI + GU) successfully tested model's association with other variables and in predicting LLM in FLVE. It is thus concluded that users' based schemata models can enhance classical measures of effectiveness, efficiency, and satisfaction, as well as convey aesthetical attributes.
H^{11}: LAPs in IVE and LLM in a FLVE will be correlated.	Partially supported	
H^{12}: LST will be correlated with CI and GU.	Suppported	
H^{13}: LAPs, LST, CI and GU will be correlated.	Partially supported	
H^{14}: LLM in FLVE will be different across LAPs (high, medium, low) in IVE after adjusting for the effect of LST as a covariate.	Supported	
H^{15}: LAPs in IVE and LST (CI + GU) will jointly predict significant variance in LLM in FLVEs than LAPs in IVE and LST (CI + GU) alone.	Supported	

Table 6.1: Research Questions and Hypotheses Testing Results (continue)

Evaluation Stage - Model Validation **RQ4:** How to validate results of aesthetic perception and motivation model for F&IVEs?	**Results**	**How the Results Support Research Questions and Objectives**
H^{16}: There will be significant multivariate effect of LAPs in IVE (high, medium, low) on four aesthetic motivational dimensions *(usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction)* of FLVE.	Partially Supported	In Case Study 2, model's multivariate effects, interaction effects, prognostication and fitness supported essence of this research i.e., perceptual limitations experienced by users' in FLVEs. This calls for a shift in aesthetic designing approach of FLVEs as new design themes like user experience, emotion, and artistic expression are emerging. Formal education must adapt to these changes by taking advantage of learners' new strengths in visual-spatial intelligence and aesthetic perception in IVEs and also compensate for their new weaknesses in higher-order cognitive processes such as abstract vocabulary, mindfulness, reflection, inductive problem solving, critical thinking, and imagination.
H^{17}: There will be significant multivariate effect of LAPs in IVE (high, medium, low) on four aesthetic motivational dimensions *(usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction)* of FLVE, after adjusting for the effect of LST as a covariate.	Supported	
H^{18}: Usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction in FLVE will be lowest for LAPs (high) in IVE.	Partially Supported	
H^{19}: The relationship between four aesthetic-motivational dimensions and the covariate (LST) will be same across LAPs (high, medium, low) in IVE.	Supported	
H^{20}: LAPs components in IVEs will be associated with LLM components in FLVEs for derivation of emerging themes.	Supported	

6.1 Users' Needs Assessment

RQ: 1 How learners' learning motivation and aesthetic needs are associated with F&IMFs in F&IVEs?

MDF Phase 2 addressed RQ1 (through H^1 & H^8) which was to assess learners' motivation and aesthetic needs in F&IVEs. Hypotheses testing results on assessing learners' motivation needs (H^1 & H^4) will be discussed in Section 6.1.1, while results on assessing learners' aesthetics needs (H^5 & H^8) will be discussed in Section 6.1.2.

6.1.1 Learners' Motivation Needs in F&IVEs

H^1 investigated influence of FLMFs of FLVEs upon WBL, which was examined by way of computing Pearson Correlation Coefficients and results showed a strong positive association ($r = 0.680$, $p < .001$). For H^2 it was hypothesized that IMFs of IVEs have no influence on WBL and results again showed a significant relationship ($r = 0.519$, $p < .001$). H^3 investigated if LLM for WBL was different across four FLMFs (Attention, Relevance, Confidence, Satisfaction) and results showed significant results ($F (3, 249) = 40.377$, $p = .000$), while H^4 investigated if LLM for WBL was same across four IMFs (Challenge, Curiosity, Control, Fantasy) and results showed significant mean differences ($F (3, 249) = 34.034$, $p = .002$).

These statistical findings although led to rejection of H^2 & H^4 they also implied that LLM needs in WBL are associated with IVEs and IMFs. This means that learning today can no longer be considered as a stagnant process, which used to be dependent on predetermined conditions earlier. It has rather adopted a more vibrant mode and can occur in F&IVEs, provided that learners' are able to engage themselves constructively for building their knowledge base.

6.1.2 Learners' Aesthetic Needs in F&IVEs

H^5 investigated aesthetic expectations of the respondents from FLVEs who reported integration of IMFs will make FLVEs motivationally engaging or disengaging, and

also indicated their choice of IVE from the given three options of (1) SNWs, (2) Motion-pictures, and (3) Video-games. Respondents who indicated that integration of IMFs will make FLVEs motivationally engaging, showed significantly higher aesthetic expectations from FLVEs ($F = 3.681$, $p = .010$, $\eta^2 = .029$) than those who reported otherwise. H^6 investigated aesthetic expectations of the respondents from FLVEs who indicated integration of IMFs will make FLVEs motivationally engaging or disengaging, and also rated their favorite IMF from the given four options of (1) Challenge, (2) Control, (3) Curiosity, and (4) Fantasy. Respondents who reported that integration of IMFs will make FLVEs motivationally engaging, depicted significantly higher aesthetic expectations from FLVEs ($F = 6.681$, $p = .044$, $\eta^2 = .017$) than those who reported otherwise. In H^7 levels of aesthetic expectations from FLVEs differed significantly ($F = 4.350$, $p = .038$, $\eta^2 = .138$) across respondents who indicated their choice of IVE and also picked their favorite IMF. Hypotheses testing results for H^5, H^6 & H^7 strongly supported the argument defended in this research that influence of IVEs on learners' aesthetic and motivation needs is an important consideration which is overlooked by instructional and interface designers in aesthetic-motivational designing of FLVEs. Therefore, the proposed aesthetic perception and motivation model should be based on both F&IMFs.

H^8 was formulated to determine how the proposed aesthetic perception and motivation model will predict learners' motivation and aesthetic needs, if it is jointly based on F&IMFs. H^8 was tested by performing statistical procedure in two steps. In Step 1, Pearson Correlation Coefficients of the eight motivational factors (Attention, Relevance, Confidence, Satisfaction, Challenge, Control, Curiosity, Fantasy) was computed to determine their association with learners' aesthetic expectations and motivation in F&IVEs and to also ascertain their individual range and strength of association. Correlations go from zero (0), which indicates a non-linear relationship, to one (1) which indicates a perfect linear relationship and means everything falls exactly on the regression line. While positive and negative relationships are simply an indication whether it is an uphill or downhill /or a direct or an inverse association. The Pearson Correlation Analysis showed that all eight correlations were statistically significant at $p < .01$ or .05, indicating they are reliably different from zero.

In Step 2, Multiple Regression Analysis was performed and ANOVA results showed ($F(8, 249) = 68.350$; $p < .001$) that a predicting model based on F&IMFs significantly improved model's ability to determine learners' aesthetic expectations and motivation in FLVE. The value of the R^2 is a measure of how much of the variability in the outcome is accounted for by the predictors, which in H^8 were a combination of F&IMFs given by John Keller and Malone & Lepper. The R^2 value = 0.648, which means all predicting motivational variables approximately account for 65% of the variation in predicting aesthetic expectations from F&IVEs. The adjusted R^2 gives some idea of how well the results of the proposed model can be generalized, and the closer its value is to R^2, the better it is for the model. In this case, difference for the model was reasonable (0.648 - 0.634 = .014 or 1.4%). This shrinkage means that if the model results were derived from the population rather than sample, it would account for approximately 1.4% less variance in the outcome.

The F&IMFs given John Keller and Malone & Lepper share a certain degree of overlap, e.g., attention and curiosity are related concepts and motivational critiques Hardré [202] suggests that *"integration of two models may provide an optimal instructional design model"*. Since, no study was found in the literature that had integrated these two models [203] results of H^8 reaffirmed that integration of the two motivational models is important in context of aesthetic and motivational designing of FLVEs to cater for learners' aesthetic and motivational needs.

Hypotheses testing results of Phase 2 (H^1 to H^8) strongly supported the influence of IVEs on LLM and aesthetic expectations from FLVEs and provided empirical base to argue that learners' interaction with different IVEs has influenced upon their motivation and aesthetic needs in FLVEs. Results showed that learners' have aesthetic expectations from FLVE based on their IVEs interaction behavior, indicating existence of learners' new schemas on aesthetics of digital environments. In order to cater for learners' new schemas on aesthetics of digital environments, the proposed aesthetic perception and motivation model should be based on F&IMFs to inculcate characteristics of both F&IVEs. Results also showed that a predicting model based on F&IMFs significantly improved its ability to determine learners' aesthetic expectations and motivation in FLVE. Apparently, this may sound but in interaction

designing media aesthetics of IVEs can realistically be applied in FLVEs. In Motion-pictures, for instance, visual flow of information followed by narration or story telling keeps the viewers cognitively engaged and motivated, especially, when the story is reproduced in conjunction with auditory and visual mechanics, the viewers are fully absorbed in the screen-play. This can be applied in FLVEs by improving aesthetic designing techniques for sustaining learners' visual momentum. Similarly, framing of scenes indicate framing of content in scenes. This approach is related to the concept of closure in designing of interfaces and can be useful in designing of content for multimedia based instructional material. By implementing the concept of closure and progressive disclosure, learners' will not be over-whelmed by the amount of information presented to them and will be in a position to organize information as per their learning interests.

6.2 Scale Development

RQ2: How to develop a scale based on F&IMFs to measure LAPs and LLM in F&IVEs?

MDF Phase 3 addressed RQ2 (through H^9) which was to develop a scale by examining LAPs and LLM in F&IVEs. When literature was reviewed no scale was identified that had embeded LAPs and LLM or measured one variable in context of another. This identified a potential gap. To test H^9 methodology based on investigating learners' aesthetic-emotions was applied because it is said that emotions play an important role in human memory as they are a said to be *"reflection of the situations humans are in"* [283]. The motivational variables in Keller and Malone & Lepper's models were chosen to study associated aesthetic-emotions, treated as adjectives. Based on VT1 and VT2, EFA was performed on initial and revised lists of aesthetic-emotion items, in two different IVEs. A four factor solution based on oblimin direct rotation method was extracted and following classifications of the aesthetic-motivational dimensions were derived.

1. **First Factor:** 8 aesthetic-emotion items loaded high on the first factor, out of which 5 were identified as related to usefulness of the website, (easiness .835,

resourceful .913, organized .923, informed .770, orientation .644). While aesthetic-emotions, decisiveness (.625), personalized (.926) and realistic (.846), add aesthetic-motivational value to the usefulness of the website, by way of instigating control, creating relevance in the visual experience and influence upon overall usability perception. Therefore, first aesthetic-motivational dimension was classified as usability perception.

2. Second Factor: 7 aesthetic-emotion items loaded high on the second factor, out of which 5 aesthetic-emotion items, (elegant .825, colorful .782, inspirational .771, mesmerizing .745, imaginative .652) directed towards aesthetic appeal of the website, and also originated from the same motivational factor fantasy. However, aesthetic-emotion items thoughtful (.522) and affective (.548) are sentimental states based on motivational factor attention. Therefore, the second aesthetic-motivational dimension was classified as visual and aesthetic appeal.

3. Third Factor: 6 aesthetic-emotion items loaded high on the third factor, out of which 4 were identified to be representing users' engagement level (stimulating .868, interactive .811, innovative .615, proficient .621). While the remaining 2 aesthetic-emotions, interesting (.936) and surprising (.568), rely on cognitive paradigm and add aesthetic-motivational value to the engagement experience by retaining attention and generating curiosity. Therefore, the third aesthetic-motivational dimension was classified as cognitive engagement.

4. Fourth Factor: 7 aesthetic-emotion items loaded high on the fourth factor, of which 5 factors directed towards users' satisfaction since they all originated from the same motivational factor satisfaction, (ego-gratification .751, happy .855, reliable .657, relaxed .671, memorable .705). While aesthetic-emotion item, energized (.625) is a reflection of users' confidence level and eminence (.722) is a high-inclined emotional state based on motivational factor fantasy. These two aesthetic-emotion items significantly add aesthetic-motivational value to users' satisfaction level. Therefore, the fourth aesthetic-motivational dimension was classified as satisfaction.

The four factor aesthetic-emotion solution is considered be 'good-a-fit' because Bartlett's test of sphericity [283] and the Kaiser-Meyer-Olkin measure of sampling adequacy are acceptable measures to assist researchers in assessing the adequacy of their correlation matrices for factor analysis. Bartlett's test of sphericity showed significant results ($\chi 2$ (55) = 496.536, $p < .05$), while the KMO measure of sampling adequacy was 0.743, which as per the interpretation (Chapter 4, Table 4.1) fell within the *"middling range"*, i.e., 0.70-0.79, indicating if factor analysis is conducted, the factors extracted will account for fare or adequate amount of variance. Also the percentage of variance accounted by both unrotated and rotated solutions was approximately same, about 75%. Finally, the loading pattern for all four factors also emerged to be fairly clear with little or no ambiguity. As Gorsuch [284] put it, *"If the simple structure is clear, any of the more popular procedures can be expected to lead to the same interpretations"*.

Furthermore, the four aesthetic-motivational dimensions of the scale are argued to be where learners' experience cognitive fatigue due to visual gaps in what they expect (based on their new schemas on aesthetics of digital environments) and what they actually see in a FLVE. In psychology the term cognitive fatigue is referred to the idea that self-regulated thinking or behavior is an exhaustible resource that can be used up in a rational or a linear way [285]. It is an important concept because in FLVEs learning immensely depends upon learner's self-regulated behavior which is based on their intrinsic motivation. Cognitive fatigue becomes more pronounced when users' are provided with vast amount of information related to a topic that they don't have ability or desire to understand, either because it is complex or confusing. This occurs due to the involvement of high order cognitive processes. In FLVE a learner is not just interacting with the its interface but it is an interaction with vast amount of information, multimedia types, prototypes, simulations, graphics, animations etc. To perceive aesthetics a learner relays upon his/her prior or stored information (schemas) to make quick judgments based on aesthetic layout of the information, colors, texture, visual appeal, narrative style of the content presented etc. [207]. These judgments surface due to the information processing by brain at the logical reasoning level, which is very limited and enforces decisions to be taken more

rationally such as based on emotions because that requires little cognitive or mental effort.

If Learner-Interface Interaction is perceived to be aesthetic it means a good mental integration of all visual elements in the learning environment. It also suggests formation of an aesthetic perception based on low order cognitive processes (exertion of low mental effort) due to little difference between what learners' schemas are expecting and what is actually seen. Wilson *et al.* [286] observed that *"cognitive fatigue leads to impaired performance on tasks that require or involve high order cognitive processes"*. This signifies that formation of an aesthetic perception based on high order cognitive processes (exertion of high mental effort) is due to big difference between what learners' schemas are expecting and what is actually seen. Exertion of high or low mental effort is based upon big or small differences in what learners' schemas are expecting to see and what is actually seen. Consequently visual gaps can either be big or small because a visual gap is understood as an outcome of difference between what users' expect and what they see [13]. Furthermore, a negative correlation of mental effort with LLM in online learning environment has been reported in a study conducted to assess learners' usability perception and motivation in FLVEs [287]. This indicates that LLM in FLVE diminishes as the level of mental effort increases in online learning environment. Mental effort, as said earlier, signifies involvement of high or low order cognitive processes and existence of big or small visual gaps. Visual gaps that occur due to difference in LAPs in IVE and LLM in FLVEs thus have the tendency to influence (positive or negative) upon LLM. The is supported by the control theory of self-regulation that *"human behavior is a result of two directional perspectives, how they are doing in meeting their goals and how they close any gaps that they experience between their actual and desired behavior"* [288]. In Learner-Interface Interactions if learners' experience lack of LLM in a FLVE, report stress or pressure in relating or understanding what they are seeing, or are unable to pay attention to the content of the visual environment [289], it is an indication of existence of higher visual gaps in what they are expecting and what they actually there. If visual gaps are small, this indicates higher likelihood of self-regulated behavior and LLM in FLVEs and vice versa.

The four aesthetic-motivational dimensions of the developed scale essentially combine LAPs in IVEs and LLM in FLVE and are argued to be where learners' may experience cognitive fatigue due to visual gaps in what they expect and what they actually see. To ascertain higher LLM it is suggested that interface designers may design FLVEs in view of learners' aesthetic expectations from digital environments because *"if designers will continually apply their own schemas in designing of interfaces they will only be affecting users' who share similar schemas to them"* [122]. It is therefore high time that new designing practices are introduced to implement learners' new schemas on aesthetics of digital environments for motivational designing of FLVEs.

6.3 Model Testing (Case Study 1)

RQ3: How do the preliminary empirical analyses result in formation of learners mental models and infer relationships among research variables?

MDF Phase 4 addressed RQ3 (through H^{10}, H^{11}, H^{12}, H^{13} & H^{14}). The phase was implemented by a true experimental design, involving learners participating in visual screening of F&IVEs and filling out pretest-posttesting questionnaires. For many researchers it is a preferred method to *"to compare participant groups and measure the degree of change occurring as a result of treatments or interventions"* [290]. The model testing involved formation of learners' mental models (Section 6.3.1) and interrelationship testing of variables (Section 6.3.2) as discussed in next sections.

6.3.1 Formation of Learners' Mental Models

Formation of learners' mental models was the second important milestone in MDF (after scale development) for which H^{10} was designed and tested. In H^{10} learners' aesthetic rating of IVEs were transformed into AJS and compared with that of expert AJS. This comparison served as a baseline to ensure item discrimination validity (IDV) and to classify LAPs as high, medium and low in IVEs (Chapter 4, Section 4.3.1.7). Analysis on H^{10} resulted in formation of learners' mental models, serving as

an explanation of learners' thought process about how they are likely to perceive aesthetics of F&IVEs, as it is believed *"usability is strongly tied to the extent to which a user's mental model matches and predicts the action of a system"* [291]. This further signifies importance of implementing learners' new schemas in designing of FLVEs and suggests how motivationally charged up they will be if Learner-Interface Interactions are designed in alignment with learners' mental models. Moreover, user's mental model is the *"way that the user perceives that the system works"* [292] and learners' mental models in this research are the *way learners' perceive and compare aesthetics of FLVEs with IVEs*. Formation of mental models also enables users' with common characteristics to be grouped together by *"building a knowledge base of users' mental models and associated behavior based on common cues"* [293]. Therefore, learners' classified with high aesthetic perceptions were basically those whose AJS fell closest to or within expert evaluation range, indicating a common associated behaviour such as learners' with high aesthetic perceptions are likely to be *'as good as expert evaluators'* or share schemas similar with that of HCI experts.

6.3.2 Interrationship Testing of Variables

The conceptualized model was based on three research variables (LST, LAPs, LLM). To address RQ3, hypothesis H^{11} to H^{14} were designed and tested to investigate interrelationships between research variables and their measuring constructs. Results are discussed in the next sections.

6.3.2.1 LAPs and LLM

Studies [13], [96] have reported that aesthetics of an online course particularly the layout, the use of graphics, and the ease of use, were important in motivating learners' and to keep them persistently engaged in WBLEs. H^{11} investigated interrelationship between LAPs in IVE and their LLM in a FLVE and results showed a negative relationship, Correlation Coefficient r = -.191, significant at $p < .05$. This means that as one variable increases in value, the second variable decreases. The significance value also indicates that the relationship between the two variables is genuine. As it is

established from literatures that aesthetic qualities of a FLVE have a persuasive role in intensifying learning motivation [24], impact on the learning experience and amount of knowledge to be retained [29]. Results for H^{11} depicted negative association, indicating as LAPs improve in IVE, LLM in FLVE tends to diminish.

In context of learners' mental models this further suggests that if aesthetic qualities of a FLVE are not perceived to be aesthetic by learners' with high aesthetic perceptions in IVEs their learning motivation is likely to be most negatively influenced than learners' with medium and low aesthetic perceptions. This would be due to the involvement of high order cognitive processes creating big visual gaps based on difference between LAP (High) in IVE and LLM in FLVE. Similarly, if aesthetic qualities of FLVE are not perceived to be aesthetic by learners' with low aesthetic perceptions in IVEs, LLM is likely to be not so negatively influenced, due to the involvement of low order cognitive processes creating small visual gaps based on difference between LAP (Low) in IVE and LLM in FLVE.

6.3.2.2 LST, CI and GU

In media aesthetics of IVEs, viewers' schemas function to provide them CI of events and GU, where many things come together to make a whole [114]. This association of LST with CI and GU was tested in H^{12}. Results showed that relationship between LST and CI was statistically significant ($r = 0.689$, $p < .001$) suggesting that learners' CI of their interaction behavior with IVEs strongly reinforce their schematic thinking. CI is an extremely subjective judgement which can vary from subject to subject. In the proposed model, CI is an outcome of number of sub-measuring constructs (self-concept, self-efficacy, visual media engagement, self-enhancement, visual media interaction attitude, visual media innovativeness, visual media attribution, visual media persuasion, visual media salience) and environmental context factors. All these variables as whole have a correlation of 0.689 with LST. The value of R^2 is $(0.689)^2 = 0.474$. This explains how much of the variability in LST is accounted for by CI factors. In percentage terms CI is highly correlated with LST and accounts for 47% of the variability in predicting LST.

GU shares a strong positive correlation with LST ($r = 0.773$, $p < .001$). GU is a combination of visual perception principles (proximity, symmetry, similarity, common fate, good continuation, isomorphism, closure, figure-ground, focal point, simplicity, pregnanz, unity). The value of R^2 is $(0.773)^2 = 0.597$. This explains much of the variability in LST is accounted for by GU. In percentage terms, it indicates GU accounts for 60% of the variability in LST. This is because GU affects users in a predetermined manner and paves way to leverage upon the physiological and cognitive responses that are hard wired into users' brain [164].

Hypothesis testing results for H^{12} showed CI and GU to be strong predictors of LST and signified inclusion of CI and GU into the proposed model.

6.3.2.3 LAPs and LST

It is said *"we perceived what is there from our past-experiences, rather than having to buildup images in our mind, each time from scratch"* [112]. This suggests that perceptions are formed as a result of our schematic thinking. This association of LAPs with LST (CI + GU) was tested in H^{13}. Results showed that LST (CI + GU) had a negative and non-significant correlation with LAPs ($r = -.273$ and $p = .053 > .05$). However, sub-measuring variables of LST, CI and GU, were also correlated with LAPs, of which GU shared a strong positive correlation with LAPs ($r = .456$, $p < .05$) indicating it to be a strong predictor of LAPs in IVEs. This was perhaps because GU is said to provide an understanding of aesthetic perception and cognition in a learning environment [162]. When interpreting direction of causality of these relationships, GU which is a combination of visual perception principles (proximity, symmetry, similarity, common fate, good continuation, isomorphism, closure, figure-ground, focal point, simplicity, pregnanz, unity) as a whole have a correlation of 0.456 with LAPs. The value of R^2 is $(0.456)^2 = 0.207$ indicating GU accounts for 21% of the variability in predicting LAPs.

In correlation analysis of H^{13}, although LST did not correlate significantly with LAPs ($p > .05$), the significance value ($p = .053$) was marginally higher than significance level (.05) suggesting a probable significant relationship. Moreover, one

of LST sub-measuring variable (CI) correlated insignificantly with LAPs, while the second sub-measuring variable (GU) was found to share a strong positive and significant correlation with LAPs. This called for further investigation in order to ascertain interrelationship between LST and LAPs, for which H^{14} was designed with LST (CI + GU) now considered as a covariate in the proposed model to reduce within group error variance and eliminate confounding results of H^{13}. LLM in FLVE was included as a dependent variable as the relationship between LAPs and LLM was already ascertained from literature review and in H^{11} and LAPs in IVEs were included as a fixed factor. It is interesting to note H^{14} results that when the effect of LST was controlled as a covariate in the proposed aesthetic perception and motivation model, LAPs in IVE became significant ($p = 0.03 < .05$). The amount of variation accounted for by the model increased to 31.92 units for the corrected model, of which LAPs accounted for 25.19 units. Most important, the large amount of variation or unexplained variance in LLM for FLVE that is accounted for by the covariate (LST) reduced to 79.05 units.

Hypothesis testing results for H^{13} & H^{14} showed that LAPs as suggested by literature, are not only formed due to LST, but LAPs too can reinforce LST. This makes these two variables very much dependent on one another, especially for the formation of learners' mental models.

Moreover, a significant and strong correlation of GU with LAPs and a non-significant weak correlation of CI with LAPs created confusing in interpreting relationship between LST and LAPs for model development, because when taken together GU and CI are strong predictors of LST. To eliminate confounds, LST when included as a covariate in the model, and results showed improvement in model's prediction ability and reduction in its unexplained variance for LLM in FLVEs.

6.3.2.4 Models' Comparison through HRM

H^{15} was designed to examine how measuring constructs for LAPs in IVEs and LST predict LLM in FLVE. The analysis was done using Hierarical Regression Modeling

and interpreting the value of R^2 which is a measure of how much of variability in predicting LLM for FLVEs is accounted for by the variables in model 1-2-3.

For model 1, R^2 is 0.241, indicating about 24% of the variance in predicating LLM in FLVE is accounted for by measuring constructs of LAPs in IVEs, of which emphasis and rhythm were found to be strong predicting factors due to their higher SBVs. For model 2, R^2 is 0.430, indicating about 43% of the variance in predicting LLM in FLVE is accounted for by measuring constructs of LAPs in IVE and CI factors reinforcing LST, of which rhythm and self-efficacy were strong predicting factors due to their higher SBVs. Finally for model 3, R^2 is 0.726, indicating about 73% of the variance in predicting LLM in FLVE is accounted for by measuring constructs of LAPs in IVEs, CI factors and learners' GU reinforcing LST, of which similarity, unity, closure, rhythm and self-efficacy were strong predicting factors due to their higher SBVs.

Difference between R^2 of model 1 and 2 is (0.430 – 0.241) = 0.189. This means, when measuring constructs for CI were entered in model 2 along with measuring constructs for LAPs, the ability of the model to predict variance in LLM for FLVE increased by 19%. This change is significant at $p = .038 < .05$. Difference between R^2 of model 2 and 3 is (0.726 – 0.430) = 0.296. This means, when measuring constructs for GU were entered in model 3 along with measuring constructs for LAPs and CI, the ability of the model to predict variance in LLM for FLVE increased by 30%. This change is significant at $p = .043 < .05$.

Based on results of H^{15}, model 3 which was based on measuring constructs of LAPs and LST (CI + GU) was selected as an aesthetic perception and motivation model for F&IVEs.

6.4 Model Validation (Case Study 2)

RQ4: How to validate results of aesthetic perception and motivation model for F&IVEs?

MDF Phase 5 addressed RQ4 (through H^{16}, H^{17}, H^{18} & H^{19}) which was to validate the results of the developed model. The phase was implemented by a true experimental design based on pre-posttesting of F&IVEs, as it is regarded as the *"most accurate form of experimental research that well suits to prove or disprove a hypothesis mathematically, with statistical analysis"* [290]. Model validation was based on examining its multivariate main interaction effects, prognostication and fitness. Results are discussed in the subsequent sections.

6.4.1 Model's Multivariate Main Interaction Effects

In statistics multivariate testing or multi-variable testing is a technique for testing hypotheses on complex multi-variable systems and is *"especially useful in testing perceptions"* [294]. This testing is particularly used when there are two or more dependent variables [265]. Results of H^{16} based on MANOVA showed a significant multivariate main effect of LAPs (High, Medium, Low) in IVE on four aesthetic-motivational dimensions of FLVE, Wilks' $\lambda = .425$, $F(8, 340.00) = 4.303$, $p < .001$, partial $\varepsilon^2 = .092$. Power to detect the effect was .995. As denoted by large value of Wilks' Lambda, which is the proportion of variance in the dependent variables not accounted for by the independent variables and the significance level, changes in independent variables, i.e., LAPs (High, Medium, Low) in IVEs were strong predictor of variance in four aesthetic-motivational dimensions of FLVEs.

For any experimental design, the most important investigation is considered to be the *"definite causal link between the independent and dependent variable"* [290]. This is because casual relationship between the independent variable and dependent variable is the basis of most statistical tests. In Phase 3, when model testing was performed, correlation analysis between LAPs in IVEs and LLM in FLVEs depicted a negative correlation, indicating an increase in one variable leads to a decrease in another and vice versa. However, this result did not imply any causation of relationship between the two variables, i.e., which variables causes other to change negatively. To reduce the causation risk of errors caused by interpretation of correlations, controlled variables known as confounding variables are used to *"reduce the possibility of any other factor influencing changes in the dependent variable"*.

Such controlled variables are introduced as covariates in general linear modeling to improve the accuracy of the model. In proposed model, LST was included as a covariate and tested in H^{17} because *"in a general linear model, a covariate is any continuous predictor, which may or may not be controllable"* [295]. LST is believed to an uncontrollable variable, because it is measured as a combination of CI and GU which are based upon learners' personal judgement and can vary wildly, meaning same individuals may rate things differently depending upon time of day and their current mood [290]. This indicates results of LST are difficult to repeat, inherently less reliable and can create confounding results. MANCOVA result of H^{17} showed significant multivariate main effect for LAPs (High, Medium, Low) in IVE on the four aesthetic-motivational dimensions of FLVE after adjusting for the effect of LST, as a covariate, Wilks' $\lambda = .373$, $F(4, 169.000) = 3.332$, $p = .012 < .05$, partial $\varepsilon^2 = .073$. Power to detect the effect was .836. The multivariate effect results for testing H^{16} and H^{17} provided protection against Type 1 Error and also implied that LAPs (High, Medium, Low) in IVE and LST were significant predictors of LLM in FLVE.

Hypotheses testing results for H^{16} and H^{17} signified that LAPs in IVEs and LST predict LLM in FLVEs. However, any scientific research design only puts forward a possible cause for the studied effect, as in this case possible cause of lack of LLM in FLVEs is examined to be associated with LAPs in IVEs and LST, one treated as an independent variable while the other as a covariate in the proposed model. The causal relationships among these variables will become more apparent, as research techniques are further refined and honed because there is always the chance that another unknown factor contributed to these results and findings. This is known as *"the third variable problem"* in empirical data analysis and interpretation [296]. Likewise, true experimental designs as deployed in this research at times can be too accurate and direct to misleading results, especially when using multivariate statistics. In such a case, it is very difficult to obtain a complete rejection or acceptance of a hypothesis because the standards of proof required are so difficult to reach. Therefore, based on testing results, it makes sense to accept H^{16} and H^{17} but that still requires further deliberations to confer validity of the proposed model.

6.4.2 Model's Prognostication

Based on studies [44]–[47], reviewed in Chapter 2, Section 2.2, it was said that IVEs of today are producing learners' with a new schema on aesthetics of digital environments due to the media aesthetics of IVEs. This has resultantly made learners' critical in judging aesthetics of FLVEs by establishing *"perceptual filters"* [49] that provide a *"contextual frame of reference and form prejudice aesthetic perceptions"* [48]. Thus, it is argued that FLVEs of today are unable to sustain LLM due to these perceptual filters formed due to learners' new schemas on aesthetics of digital environments. To support this argument, it was assumed in H^{17} that learners' with high aesthetic perceptions in IVE are likely to be more critical in judging aesthetics of FLVEs than other groups, indicating existance of perceptual filters and formation of prejudice aesthetic perceptions. Similarly learners' with high aesthetic perceptions in IVEs were hypothesized to experience most negative perception of FLVE than other groups, due to the involvement of high order cognitive processes creating big visual gaps based on difference between LAP (High) in IVE and LLM in FLVE.

Results for H^{18} were somewhat surprising and brought into limelight new aspects for discussion to validate the model. Post-hoc multiple comparisons led to partial rejection of H^{18} since LAP (High) in IVE differed significantly from LAP (Medium) and LAP (Low) in only two aesthetic-motivational dimensions of FLVE, i.e., cognitive engagement and visual & aesthetic appeal. However, drawing a conclusion should be based on several factors of the research process and not just because the literature suggested or researcher got the expected results. Before concluding results, it is important to base them on the validity and reliability of the measurements, i.e., how good the measurement was to reflect the real world and what more could have affected the results. Such observations are often referred to as *"empirical evidence"* to support logical reasoning/thinking, and anyone should be able to check the observation and logic, to see if they also reach the same conclusions. The empirical findings for H^{18} led to its partial rejection, but when the comparable validity of the F&IVE was examined, Destination Organics (IVE) and Universiti Malaysia PAHANG's websites (FLVE) were found to be rated almost equally by HCI experts

in terms of their usability perception (Section 4.4.1.6, Chapter 4). This provided new empirical evidence to draw conclusion on model's prediction abilities.

Results of testing H^{18} showed that usability perception and satisfaction were the two aesthetic-motivational dimensions where LAP (High) did not differ from other two groups. The new empirical evidence suggests this result is due to the less comparability difference in usability provided by Destination Organics (IVE) and UMP's websites (FLVE). LAP (High) in IVE were expected to experience high visual gaps on all four aesthetic-motivational dimensions of FLVE. So, it was hypothesized that LAP (High) in IVE will differ from LAP (Medium) and LAP (Low) in terms of being least motivationally inspired on all four aesthetic-motivational dimensions. The classification of LAPs was based on HCI's expert AJS, indicating LAP (High) were more likely to have schemas similar to that of HCI experts. Since HCI experts rated F&IVE of UMP and Destination Organic websites almost same in terms of providing usability, so LAP (High) in IVE (assumed to be sharing similar schemas with that of HCI experts) did not also differ from LAP (Medium) and LAP (Low) in terms of judging the usability perception of FLVE.

Empirical evidence also suggested that LAP (High) in IVE did not differ from other groups in judging satisfaction. This could be due to how usability and satisfaction are related to each other. ISO elaborates upon measuring usability through effectiveness, efficiency, and satisfaction [297].

There are also studies that have used satisfaction as a direct measure of usability [287] and reported a strong correlation of satisfaction with usability [298]. Therefore, it can be said that LAP (High) in IVE did not differ from LAP (Medium) and LAP (Low) in rating aesthetic-motivational dimension satisfaction because it is a construct for measuring usability. The rationale behind usability perception to be same across all three groups is accredited to little comparability difference between the F&IVEs. Since usability is measured through satisfaction, it can be said that their strong association has resulted in having similar results for them.

Although results for H^{18} showed that LAP (High) only differed from LAP (Medium) and LAP (Low) on two aesthetic-motivational dimensions, LAP (High)

remained lowest in terms of mean score on all four aesthetic-motivational dimensions. These results support model's prediction abilities and imply that learners' with high aesthetic perceptions in IVEs experienced higher visual gaps due to the existence of big difference between what they aesthetically expected and what they saw. It also indicates that aesthetics of FLVEs are motivationally more important for learners' with high aesthetic perceptions in IVEs than for other groups, as *"low-motivated individuals are found to pay less attention to the core informational content and are swayed by visual cues*" [299].

Moreover, existence of higher visual gaps is an indication of stronger influences of IVEs media aesthetics on viewers' schematic thinking and aesthetic perception. Kang & Kim [300] demonstrated that the quantity of content was just an indicator of informativeness for low-motivated individuals and they considered entertainment and informativeness as equally important. Their study also reported that highly-motivated individuals did not compare informativeness to entertainment. This means learners' with high aesthetic perceptions in IVEs, experienced higher visual gaps on all four aesthetic-motivational dimensions of FLVEs because entertainment and informativeness are equally important for them, than for the other groups. Another study reported that low-motivated individuals strongly favored a 'feel good website' while the highly-motivated individuals favored a site that stimulates positive emotions only after rational consideration [301]. This explains learners' with high aesthetic perceptions in IVE were least motivationally inspired on all four aesthetic-motivational dimensions of FLVE because they wanted a more vibrant, visually appealing environment that evoked the feeling of a *'feel good website'* in them.

Hypothesis testing results for H^{18} are in support of the proposed models' prediction abilities and argument that learners' interaction with IVEs has resulted in creation of new schema on aesthetics of digital environments, which is an important consideration overlooked by instructional and interface designers in motivational designing of FLVEs for improving Learner-Interface Interactions.

6.4.3 Model's Fitness

To determine proposed model's fitness, H^{19} was tested to validate model by testing for the assumption of homogeneity of regression slopes, i.e., relationship between the four aesthetic-motivational dimensions of FLVE (usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction) and the covariate of the model, LST is true for all groups of aesthetic perceptions (High, Medium, Low) in IVE [269]. If this relationship is different *even* in one of aesthetic perception groups, the aesthetic perception and motivation model for F&IVEs is inaccurate or void, since it is not a true representative of all groups. Hypothesis testing was based on computing interaction effects of the three variables, and results were non-significant across four aesthetic-motivational dimensions; satisfaction $p = .654$, usability perception $p = .855$, cognitive engagement $p = .667$, visual & aesthetic appeal $p = .485$. This indicated that the relationship between four aesthetic-motivational dimensions and the covariate is *same* across all classified groups of LAPs (High, Medium, Low) in IVEs.

Results for testing H^{19} were used to validate aesthetic perception and motivation model because homogeneity of regression slopes is an important assumption, often referred as a *conservative approach* for determing model's fitness. The assumption essentially examines interaction effect of the covariate with dependent variables across different groups of respondents. Covariate as discussed earlier are confounding variables as results based on covariates are difficult to repeat and have low validity as a measuring construct [302]. Narrowing of focus onto the covariate can seriously jeapordize fitness of the whole model. If the assumption of homogeneous regression slopes cannot be satisfied, the model including the covariate should not be interpreted, because *"the relationships between the factors and the dependent variable change with different scores of the covariate"* [302]. However, this research is primarily based upon investigating learners' new schemas on aesthetics of digital environments, that are formed due to their interaction with media aesthetics of IVEs and to examine visual gaps between LAPs in IVEs and LLM in FLVEs. Therefore determining model's fitness through homogeneity of regression slopes is indispensable.

Even though learners' with high aesthetic perceptions rated the four aesthetic-motivational dimensions of FLVEs least motivationally inspiring and also differed

significantly from the other two groups on two aesthetic-motivational dimensions of cognitive engagement and visual and aesthetic appeal. The non-significant results for H^{19} indicate that *trend* in LST (as denoted by trend or regression lines in Chapter 5, Figure 5.1.8a-d) was not different across the three aesthetic perception groups on all four aesthetic-motivational dimensions of FLVE. This suggests assumption on meeting homogenity of regression slopes has been met implying that if the interaction of the covariate is removed from the aesthetic perception and motivation model, it will become a full factorial model. The aesthetic perception and motivation model for F&IVEs stands validated.

6.4.4 Theoretical Rationalization

Hypothesis H^{20} meant to gather an in-depth understanding of components associated with LAPs in IVEs and LLM in FLVE; therefore it was examined by qualitative research methodology, based on grounded theory. ETA resulted in evolution of six themes, which will be discussed in subsequent sections.

6.4.4.1 Theme 1: Learners' aesthetic perceptions in IVEs are enriched with artistic qualities

This theme emerged as a result of codes categorized as theme 1 (Chapter 5, Table 5.4.2). The assessment of codes pointed towards having or developed artistic qualities by learners' when interacting with IVEs or using IMTs. For example:

" It is rich in interactive features, so I feel inventive". (Internet)

"...feel full of ideas due to creative communication by advertisements". (Television)

"...fashion sense has improved, I know a lot more than before". (Television)

"I do notice qualities of line, color, shape, texture, and font in websites". (Internet)

"...the music and sound effects are high quality and seem real". (Video-games)

6.4.4.2 Theme 2: Learners' aesthetic perceptions in IVEs are enlightened with critical judgment

This theme emerged as a result of codes categorized as theme 2 (Chapter 5, Table 5.4.2). The assessment of codes highlighted that media aesthetics of IVEs have enlightened LAPs by setting up relevant criteria to make critical judgments. For example:

"...designing of automobiles has to do with aesthetic value and not function". (Television)

"...made me a critical evaluator of aesthetics". (Internet, Television)

"...blue color is about manhood, doesn't fit in endorsement of feminity". (Television)

"...a learning environment without learning objectives is futile". (FLVE)

"...informed about world's cultures, cuisines and tourism". (Television, Internet)

6.4.4.3 Theme 3:Learners' aesthetic perceptions in IVEs are elicited through imaginative perceptions

This theme emerged as a result of codes categorized as theme 3 (Chapter 5, Table 5.4.2). The codes pointed towards extensive deployment of aesthetic tactice by IVEs, that result in indulgement of viewers by using their imaginative perceptions. Such perceptions are based upon figment of learners' imagination and has no limit or boundaries. For example:

"... can take on any role, like street-fighter, kungfu panda, lara croft". (Video-games)

" ... role playing is captivating and exciting". (Video-games)

"... story narration in chunks makes me guess what may come ahead (Motion-pictures)"

"...imagine myself in Egypt or on some expedition". (Television, Video-Games)

"...exciting to derive luxury cars". (Video-games)

6.4.4.4 Theme 4: Learners' aesthetic perceptions in IVEs are influenced by the involvement of multiple-senses

This theme emerged as a result of codes categorized as theme 4 (Chapter 5, Table 5.4.2). The categorized codes revealed that IVEs apply a range of aesthetic tactics to involve viewers' multiple senses. Sensual senses work together to give our mind information and this process is called multi-sensory association. For example:

"... they create an emotional-drama". (Motion-pictures)

"I feel relaxed, happy and entertained through comedy movies". (Motion-pictures)"

"Blogging gives freedom of speech and expression". (Internet)

"... feel thrilled and adventurous when playing online-games". (Internet, Video-games)

"...horror flicks are tempting and scary at the same time". (Motion-pictures)

"provides liberty to make comments, play online-games and have company". (Internet)

6.4.4.5 Theme 5: Media aesthetics of IVEs have altered learners' aesthetic threshold so they experience lack of learning motivation in FLVEs

This theme emerged as a result of codes categorized as them 5 (Chapter 5, Table 5.4.2). The categorized codes pointed towards learners' aesthetic threshold, which is a subjective judgment based upon outer beauty or appearance. The IVEs are rich in media aesthetics and by employing a range of aesthetic tactics influenced upon learners' aesthetic threshold, making them judge benefits of FLVE on the basis of its visual appeals than the learning benefits it can bring to them. For example:

" everything on the big screen seems larger than life and glamorized. (Motion-pictures)

"... the presentation of ideas is excellent, seems perfect and beautiful". (Television)

"... colors and visuals create a flawless world of desires and illusion". (Motion-pictures, Video-games)

"... mostly exaggerated and beautifully dramatized". (Television, Motion-pictures)

"sometimes it seems dull due to lack of connection". (FLVE)

"... non interactive and somewhat boring". (FLVE)

"...provides flexible learning and uses mental energy". (FLVE)

"it is monotonous". (FLVE)

6.4.4.6 Theme 6: IVEs engage and sustain motivation by providing cognitive absorption

This theme emerged as a result of codes categorized as theme 6 (Chapter 5, Table 5.4.2). Cognitive absorption corresponds to a state of deep involvement with a software program (Léger, 2010) and IVEs sustain visual momentum of their interaction design, thus viewers are cognitively absorbed. Visual momentum refers to how a program maintains a user's interest across successive displays (Jones, 1989). For example:

"... never feel bored or tired". (Video-games)

"Time flies on internet". (Internet)

"...don't feel like leaving". (Internet)

"...story narration keeps adequately interested till to the end". (Motion-pictures)
"... has gripping sequences and fascinating story-lines to spellbind". (Motion-pictures, Video-Games)
" ... engage by providing multiple information from different sources". (Internet)"

The proposed model's theoratical rationlization provides strenght to the emperical results. In this research it has been argued that IVEs are producing learners' with new schemas on aesthetics of digital environments. This resultantly has made learners' critical in judging aesthetics FLVEs by establishing *"perceptual filters"* [49] that provide a *"contextual frame of reference and form prejudice aesthetic perceptions"* [48]. Learners' new schemas on aesthetics are formed due to the media aesthetics of IVEs, because *"television, motion-pictures, internet and visual computer or screen displays may no longer be considered as means of simple message distribution, but*

essential elements for communicating media aesthetics" [48]. In support of this argument and emperical findings of the proposed aesthetic perception motivation model, theoratical rationalization indicate that learners' aesthetic perceptions that are formed under their new schemas are enriched with artistic qualities, critical evalution, imaginations, and are based upon association of multiple-senses.

It is further argued that inadequate research in aesthetic-motivational designing of FLVEs by examining learners' new schemas on aesthetics of IVEs can be a reason for learners' to experience lack of LLM, which is a growing concern among instructional and interface designers [50]. The rationale behind can be linked to visual gaps between LAPs in IVEs and LLM in FLVEs. A visual gap exists due to the difference between what learners' *aesthetically expect* and *what they see*. These visual gaps create "cognitive fatigue" as according to the control theory of self-regulation [54], *"humans persistently try to reduce gaps between their actual and desired behavior"* and lesser the gaps in what they expect and what they desire, is an indication of experiencing lesser cognitive fatigue and higher intrinsic motivation, which is crucial for self-regulated learning in FLVEs. In support of this argument and emperical findings of the proposed aesthetic perception motivation model, theoratical rationalization indicate that visual gaps are experienced by learners in FLVEs because IVEs have altered learners' aesthetic threshold. Moreover, IVEs provide learners' cognitive absorption and sustain their visual interest, lack of this aspect in aesthetic-motivational designing of FLVEs also contributes towards enlarging of visual gaps and cognitive fatigue, eventually influencing upon LLM in FLVEs.

CHAPTER 7

CONCLUSION

7.1 Dissertation Summary

In FLVEs an aesthetic and motivating interface is desirable for learners'; however, creating such an interface can be challenging for designers. Both motivation research and aesthetic studies have endeavored to improve the design of online instruction and enhance learners' learning experience from different perspectives. While a few discussions have been documented in literature involving LAPs and LLM in FLVEs, no empirical evidence is available to demonstrate how IVEs may affect LAPs and LLM experiences in FLVEs by influnencing upon LST. As IVEs of today that learners' of FLVEs interact with are rich in media aesthetics and have resultantly created a new schema on aesthetics of digital environments. This new schema has made learners' critical in judging aesthetics of digital environments by establishing perceptual filters which provides contextual frame of reference and forms prejudice aesthetic perceptions. No studies have been conducted to show how LAPs in IVEs formed due to their new schema on aesthetics of digital environments may influence upon LLM in FLVEs, which is a rapidly growing field of online learning. Inadequate research in aesthetic-motivational designing of FLVEs by examining learners' new schemas on aesthetics of IVEs, can be a reason for learners' to experience lack of LLM, which is a growing concern among instructional and interface designers. This study was the first that not only investigated learners' new schamas by establishing learners' mental models based on LAPs in IVEs but also developed an aesthetic-emotion scale that equated LAPs and LLM in F&IVEs to measure the effect of learners' new schema. This study examined how LAPs in IVEs affect LLM in FLVEs by creating visual gaps, which exists due to the difference between what learners' aesthetically expect and what they see.

Results from this study filled the current lacunae in experimental data in the self-paced online learning environments. The study also demonstrated the benefits of four aesthetic-motivational dimensions of the developed aesthetic-emotion scale (usability perceptions, cognitive engagement, visual & aesthetic appeal, and satisfaction) by examining visual gaps created by LAPs in IVEs and LLM in FLVEs. The study proposed an aesthetic perception and motivation model for F&IVEs based on three research variables, LST, LAPs and LLM. Research findings led to a new understanding of the associations between LAPs in IVEs and LLM in FLVEs and provide a basis for future studies to formally develop design guidelines and/or aesthetic-motivational metrics in the e-learning context.

7.2 Aesthetic Perception and Motivation Model for F&IVEs

This section concludes research findings of this study in respect of its stated research objectives for model development.

7.2.1 Research Objective 1

Research objective 1 was to investigate learners' needs in terms of motivation and aesthetics by comparing F&IMFs associated with F&IVEs. This objective was met in Phase 2 (H^1 to H^8) of MDF – Users' needs assessment.

It is interesting to note that literature evidence in support of the influence of IVEs and IMFs talks mainly about its learning benefits in informal context. In designing of Learner-Interface Interactions there significance is barely emphasized or emperically investigated. Moreover, hypotheses testing results of Phase 2 strongly supported the influence of IVEs and IMFs on learners' motivation and aesthetic needs and provide an empirical base to argue that learners' interaction with different IVEs has influenced upon their motivation and aesthetic needs in FLVEs. It is therefore concluded that IMFs make learning environments cognitively engaging and to sustain LLM they are

crucial factors that should not be overlooked in aesthetic-motivational designing of FLVEs.

7.2.2 Research Objective 2

Research objective 2 was to develop a scale by embedding F&IMFs associated with F&IVEs. This objective was met in Phase 3 (H^9) of MDF – Scale development.

The scale was developed by embedding F&IMFs associated with Keller and Malone & Leppers' motivational models through learners' aesthetic-emotions, treated as adjectives. The scale was identified with four aesthetic-motivational dimensions (usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction). It is therefore concluded that four aesthetic-motivational dimensions are where learners' experience cognitive fatigue due to visual gaps in what they expect (based on their new schemas on aesthetics of digital environments) and what they actually see in a FLVE.

7.2.3 Research Objective 3

Research objective 3 was to to test association between three variables of the model, (1) LST (2) LAPs (3) LLM. This objective was met in Phase 4 (H^{10} to H^{14}) of MDF – Model testing.

The study concludes that LST functions to provide learners' with CI of their visual media interaction behavior and GU where many things come together to make a whole. When interacting with IVEs or IMTs a generic person can not be assumed since each person will have a unique "Gestalt" of experience, personality, biology, and social/environmental contexts that will influence on how he/she will experience and understand a media message or have an aesthetic perception based on his/her new schema. If we look at schema as an if or then event, it can create a set of expectations about how the world works. This might influence how learners' perceive aesthetics, view technology for adoption and validity of online versus offline information. In this

research LST is associated with LAPs to form learners' mental models. This study has shown that learners' perceptual processes exhibit sufficient consistency in making accurate predictions, e.g., learners' with high aesthetic perception in IVEs will respond to a specific Gestalt perception or an aesthetic stimuli or a contextual pattern in FLVEs. This association of LST with LAPs indicates that media aesthetics of IVEs through LST have altered LAPs by making them judge aesthetics of FLVEs in a contextual frame of reference. Such habitual media aesthetics cue reductions in IVEs make learners' perceptually selective and formed prejudiced aesthetic perceptions. Therefore, this research concludes that IVEs (television, motion-pictures, mobile phones, video-games, internet) may no longer be considered as means of simple message distribution, but essential elements for communicating media aesthetics that have altered LAPs and formed new schemas (set of aesthetic expectations) on digital environments. In Learner-Interface Interactions if learners' experience lack of LLM in a FLVE, report stress or pressure in relating or understanding what they are seeing, or are unable to pay attention to the content of the visual environment it is an indication of existence of higher visual gaps in what they are expecting and what they actually there. If visual gaps are small, this indicates higher likelihood of self-regulated behavior and LLM in FLVEs and vice versa. Thus, it is concluded that if learners' new schemas on aesthetics of digital environments are implemented in designing of FLVEs they can be kept cognitively engaged and intrinsically motivated.

7.2.4 Research Objective 4

Research objective 4 was to validate aesthetic perception and motivation model for F&IVEs. This objective was met in Phase 5 (H^{15} to H^{20}) of MDF – Model validation.

Hypotheses testing results showed that media aesthetics of IVEs have resulted in establishment of new schema (set of aesthetic expectations) on digital environments which is used by learners' as a cognitive model or a shortcut to view aesthetics of FLVEs. This suggests that every moment we open our eyes our brain is filling in vast amount of additional information. The brain does not always tell us what is out there it also invents much of it, and over a past few decades, scientists have begun to

believe how humans can create a highly personally inner world. Discovery of two way communication pathways of brain has totally revolutionized understanding of the visual world. Vision can no longer be considered as one-way street, with information flooding in from the outside world. Instead, it is a two-way street with massive amounts of stored information flowing backwards from deep inside the brain. Human's perception of the world around them is affected as much by what their brain expects to see, as by what is actually in front of them. The brain uses stored information and prior schematic knowledge to fill in visual gaps and altered visual perceptions (new schema) are formed based on what has been seen earlier. Likwise, learners' new schema directs their aesthetic perceptions by selecting information that agrees with what they want to see and screen out other data that might interfere with their mind-constructs. Likewise with the onslaught of changing stimuli and to make FLVEs understandable learners' new schemas establish perceptual filters. It is just like doing a Google search, when words are entered into the search bar Google compares those words with the corresponding arrangement of knowledge or schema, and then displays that knowledge as search results. If LST and LAPs on aesthetics and motivation are known, it will allow instructional and interface designers to broaden defining things and situations learners' are faced with. When interpreting multivariate effects of the model LST was included as a covariate as it influenced upon LAPs in IVEs and also upon four aesthetic-motivational dimensions. LST as a covariate eliminated confounds and increased the percentage variance explained by the model in predicting LLM in FLVEs. Furthermore, non-significant results for H^{19} indicate that trend in LST was not different across the three aesthetic perception groups (high, medium, low) on all four aesthetic-motivational dimensions (usability perception, cognitive engagement, visual & aesthetic appeal, satisfaction). This suggests assumption on meeting homogenity of regression slopes has been met, implying that if the interaction of the covariate is removed from the aesthetic perception and motivation model, it will become a full factorial model. It is therefore concluded that the model developed is validated for generalization of its findings.

7.3 Recommendations for Designing Learner's Interface Interactions

The recommendations presented in this section can be used by instructional and interface designers as a checklist for designing Learner-Interface Interactions in FLVEs. These recommendations are based on the four aesthetic-motivational dimensions of the scale developed by examining learners' aesthetic-emotions in IVEs.

7.3.1 Usability Perception

Usability perception is the perceived usefulness of the environment. In WBL, learners' usability perception is governed by hypermedia applications that provide structural freedom and navigational support to the learning environment. Learners' aesthetic-emotions in IVEs, related to this aesthetic-motivational dimension, measure the suggested aesthetic-designing parameters of the FLVEs, as shown in Table 7.1.

Table 7.1: Aesthetic-Motivational Dimension (Usability Perception)

Aesthetic-Emotions	Aesthetic-Designing Checklist
Easiness	How accessible the information is in the learning environment, and how easy it is to use and learn from simulations, modeling, charts, videos, graphics, animations and modern instructional techniques?
Usefulness	How useful the learning environment is in terms of supporting adaptive learning, which can be used by anyone, regardless of their learning objectives or digital skills?
Organized	How organized the learning environment is in its navigational structure, visual presentation and providing self-organized learning?
Orientation	Does the learning environment provide concept maps as graphical representation of relationships among concepts for their quick orientation?
Decisiveness	How does the learning environment promote decisiveness and self-determination in learners' through their active participation?
Informed	Does the learning environment foster meaningful and productive learning in learners' by using complex and contextual situations?
Realistic	How well the virtual aspects of the learning environment are designed to cater for realistic needs of learners' such as self assessment and peer assessment in virtual classrooms?
Personalized	How learners' scaffolding needs are met by linking their prior knowledge to present learning, by guiding them through the multifaceted simulation activities and helping them in reflecting upon their experiences by linking relevant theoretical frameworks.

7.3.2 Visual & Aesthetics Appeal

A learning environment can be as simple as a nice HTML website based on principles of good graphic design or can be an elaborative fully scripted visual experience with high quality production, but if it is not aesthetically appealing to learners', it will not be registered. Thus, need for aesthetics comes natural to humans, and aesthetics of a FLVE has more to do with its feel and experience, which are highly subjective in nature. Learners' aesthetic-emotions in IVEs, related to this aesthetic-motivational dimension measure the aesthetic feel of FLVEs, and aesthetic-designing parameters are suggested in Table 7.2.

Table 7.2: Aesthetic-Motivational Dimension (Visual & Aesthetic Appeal)

Aesthetic-Emotions	Aesthetic-Designing Checklist
Elegant	How do the visual elements of the learning environment elegantly connect together to inspire learning motivation?
Inspirational	How does the learning environment inspires learners' learning motivation by using anecdotes for providing illustration of the concepts, real-world situations and abstract ideas and by providing interactivity to create engaging and motivating content?
Imaginative	How imaginative the learning environment is in terms of designing its learning segments as a story, by including history, prologues, actions, animations, establishing characters, moving the story forward towards a climax. Along the way, how does it incorporate the necessary knowledge and skills, challenges and quizzes learners' on relevant matters?
Mesmerizing	How does the learning environment mesmerizes learners' by using visuals that support the message of the content and also represent one or more of its key elements, by enhancing visual interest and retention in animations, graphics, simulations etc., and by conveying complex information in an entertaining way.
Thoughtful	How thoughtful is the narrative structure of the learning environment?
Colorful	How colorful the learning environment in terms of truly representing its brand identity, expressing emotions, being visually aesthetic and influencing upon learners' learning motivation.
Affective	How affective is the learning environment in communicating its emotions as an instructional medium and also reflecting upon those of learners'?

7.3.3 Cognitive Engagement

An aesthetically designed learning environment not only should present content material in an interesting manner, but also engage learners' cognitively. If learners' are able to interpret their interaction experience of the learning environment in a definite way, then the content presented to them was clearly meaningful. Learners' aesthetic-emotions in IVEs, associated with this aesthetic-motivational dimension measure their interaction experience in FLVEs and suggested aesthetic-designing parameters are discussed in Table 7.3.

Table 7.3: Aesthetic-Motivational Dimension (Cognitive Engagement)

Aesthetic-Emotions	Aesthetic-Designing Checklist
Innovative	How innovative the learning environment is in terms of providing innovative learning situations, based on adaptive systems, intelligent tutoring, conversational and advisory systems?
Interesting	Does the learning environment sustain interest of the learners' by using audio/visual materials, progressive disclosures, games, puzzles, and quizzes?
Interactive	How does the learning environment supports (i) ubiquitous learning (i.e. just in time, any time, anywhere), (ii) enables Learners' to locate digital information artifacts important to a concept (media files, slide presentations, web pages, etc.) and (iii) uses interactive video and audio technologies?
Stimulating	How the learning environment stimulates learning through informal knowledge exchange networks, participation in online discussion and collaborative learning processes?
Surprising	How does the learning environment surprises by throwing new learning challenges (that are neither too difficult nor too easy) at learners'? Does the difficulty level of the next challenge increases at the right pace, once a Learner successfully completes a given task or challenge?
Proficient	How proficient the learning environment is in terms of (i) using appropriate language comprehendible to learners', (ii) designing of the environment by keeping in view digital skills of the learners' and (iii) coordination of imagery, auditory/verbal processing?

7.3.4 Satisfaction

A learning that occurs without meeting its desired learning objectives is considered futile. And in case of FLVEs, learners' are the best judge to decide this. Therefore,

learners' aesthetic-emotions in IVEs, that are related to this aesthetic-motivational dimension, point towards learners' endorsement of FLVEs from learning perspective and measure the following suggested aesthetic-designing parameters as mentioned in Table 7.4.

Table 7.4: Aesthetic-Motivational Dimension (Satisfaction)

Aesthetic-Emotions	Aesthetic-Designing Checklist
Ego-gratification	Do learners' experience a state of ego-gratification at the completion of learning tasks?
Happy	Does the learning environment employs positive psychology to create an environment that fosters happiness as a feeling translated into learning activities, while limiting the feeling of anxiety and stress?
Energized	In order to cater for the ability, different interests and preferred learning styles, does the learning environment energizes learners' behavior, by appropriately using worksheets, exercises, games, music, films, documentaries, literature, newspapers, internet resources, text books and revision guides?
Eminence	How the learning environment reflects and maintains its institutional eminence? How is it absorbed by learners'?
Reliable	Do learners' consider content material distributed by the learning environment as being reliable? Moreover, how do learners' sense about their personal privacy being at stake?
Memorable	Do learners' consider their interaction experience with learning environment as memorable?
Relaxed	Do learners' consider their interaction experience with learning environment as relaxed?

7.4 Research Benefits

From this research, instructional designers, usability and aesthetic professionals will benefit from new understanding of LAPs and LLM in F&IVEs. This study revealed that aesthetic design elements of IVEs have impacts on motivation components of FLVEs. Interface designing professionals will be able to take benefit from additional knowledge on LAPs in IVEs and include them in Learner-Interface Interactions in FLVEs, since LLM is an important factor that needs to be considered in usability practices and this research has shown that LAPs in IVEs affect LLM in FLVEs, therefore, they are closely associated phenomenon. The aesthetic-emotion designing

recommendations based on four aesthetic-motivational dimensions are informative for both instructional designers and aesthetic professionals to select proper tactics or design Learner-Interface Interactions or features. It is hoped that this study will demonstrate the benefits of the integration of learners' motivation and aesthetic needs associated with IMFs of IVEs in the e-learning context. It is also hoped that learners' will gain an advantage with new E-Learning systems that are easy-to-use, useful, engaging and visually appealing to sustain LLM.

7.5 Future Research

Results from this study provide a launching point for many additional studies regarding aesthetic perception and motivation in F&IVEs. The effects of LAPs in IVEs on LLM in FLVEs found in this study need to be verified by additional empirical studies with more E-Learning systems and diverse learners' in F&IVEs. The tutorials should cover a wide range of topic areas with various levels of instructional objectives. The learners should include different age groups, cultures, background, experiences and socio-economic status. For future work, Gender (Male/Female) can also be included as a fixed variable to perform randomized block covariate experimentations.

With regards to the effects of aesthetic-motivational designing, this study highlighted four dimensions such as usability perception, cognitive engagement, visual & aesthetic appeal and satisfaction. Future study should be directed to refine the understanding of the relationships between these four aesthetic-motivational dimensions. Each of the aesthetic-motivational dimensions needs to be further studied to find out how the relevant aesthetic and motivational design features could contribute to their positive or negative impacts on LLM.

The design recommendations proposed in this study should be empirically verified and guidelines with more details need to be developed. Existing aesthetic and motivational design strategies and tactics may also need to be re-examined for their targeted impacts on LLM. Moreover, aesthetic threshold and cognitive absorption provided by IVEs is an interesting area of research for future studies as well.

There is a wealth of opportunity for research into gender differences in F&IVEs. What types of aesthetic design features are preferred by females or males in F&IVEs? How females differ from males on four aesthetic-motivational dimensions of F&IVEs? Why females are more motivated than males in F&IVEs? How male & females aesthetic perceptions differ in IVEs and how that is related to LLM in FLVEs? How to aesthetic-motivationally design FLVEs to accommodate both genders? When assigning online students into groups or teams for instructional activities with varied aesthetic perceptions in IVEs, what needs to be considered in order to balance the gender differences in aesthetics and motivation and how to encourage collaboration? Future experimental studies may also consider using a factorial design experiment to compare the differences between males and females.

This study used self-reported methods for aesthetic perception and motivation assessment. Both standardized Likert-scale instruments and open-ended questionnaires were used in pre-post screening of F&IVEs. It remains somewhat undecided which type of method is better in terms of validity, reliability, sensitivity and feasibility for learners' in F&IVEs. The standardized instruments had good overall reliability, but the resulting score seemed not sensitive enough to detect the differences between treatment groups. Additional assessment methods need to be investigated for their feasibility to evaluate LAPs in IVEs and LLM in FLVEs.

Although studying aesthetic perceptions and motivation in F&IVEs can be challenging, the work is beneficial to solve real-life design problems of online learning applications. Most importantly, the result will help develop engaging, enjoyable and inspiring E-learning systems that benefit millions of online learners. Online learners can be at a distance with their face invisible and voice unheard, but their motivation needs, aesthetic needs and frustrations are central to human factors professionals who care for them.

7.6 Research Limitations

The research was undertaken to determine LAPs (examined through learners new schema or set of aesthetic expectations i.e., LST (CI + GU)) in IVEs and how that

influenced upon LLM (examined through aesthetic-emotions) in FLVEs. A general aesthetic perception and motivation model for F&IVEs which has been proposed in this research was extensively developed, tested and validated by conducting true experimental designs involving pre-posttesting of F&IVEs. The F&IVEs used for experimentation in this research were primarily web-based in nature hence becoming a limitation to this research. Moreover, the selection of the F&IVEs and results interpretation had been explicitly based on aesthetic and usability comparisons of the F&IVEs. This comparison was set as a validity measure for experimentation but also acted as a limitation. Likewise, research variables used in developing aesthetic perception and motivation model were limited to (1) Learners Schematic Thinking, (2) Learners Aesthetic Perceptions, and (3) Learners' Learning Motivation. The three variables were equated through learners' aesthetic-emotions, treated as adjectives, associated with F&IMFs in models given by Keller and Malone & Lepper. This was again an important research limitation. The scale developed in Phase 3 of the MDF was identified with four aesthetic-motivational dimensions (usability perception, visual & aesthetic appeal, cognitive engagement, satisfaction). These four aesthetic-motivational dimensions exclusively served the purpose to measure visual gaps between LAPs in IVE and LLM in FLVE. The outcome or dependent variables in this research were the four aesthetic -motivational dimensions hence acting as another research limitation. The targeted groups of this study were learners (Male/Female, Age 18-25) who were required to be enrolled atleast in one degree program (either undergraduate or post-graduate) of an institution and were active users of an e-learning system or learners' in a WBLE.

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LIST OF PUBLICATIONS

Journal Publications

1. S. Riaz, D. R. Rambli and R. Salleh, "Aesthetic Perception & Motivation: Study to Develop a Motivational Scale by Examining Aesthetic-Emotions of Learners' In Informal Visual Environments," *Information Technology Journal*, vol. 10, pp. 1268–1284, 2011.

2. S. Riaz, D. R. Rambli and R. Salleh, "Study to Investigate Learning Motivation Factors within Formal and Informal Learning Environments and Their Influence upon Web-Based Learning," *International Journal of Emerging Technologies in Learning,* vol. 5, no. 4, pp. 41–50, 2010.

Conference Punlications

1. S. Riaz, D. R. Rambli and R. Salleh, "Influence of Informal Visual Environments and Informal Motivational Factors on Learners' Aesthetic Expectations From Formal Learning Visual Environments," In *Proceedings of the 2nd International Conference on Software Engineering and Computer Systems*, J. M. Zain et al. (Eds): ICSECS 2011, Part I, CCIS 179, Pahang, Malaysia, pp. 292–305, 2011.

2. S. Riaz, D. R. Rambli and R. Salleh, "Integrating Media Psychology within Theoretical Framework of Instructional Designing for Web-based Learning Environments (WBLEs)," In *Proceedings of the 5th International Conference on e-Learning,* Penang, Malaysia pp. 463–471, 2010.

3. S. Riaz, D. R. Rambli and R. Salleh, "Ergonomics & Media Psychology: Perceptual & Visual Limitations to Human Cognition Factors in a Web-based Interface Design," *In Proceedings of the International Conference on Intelligence and Information Technology*, vol. 1, Lahore, Pakistan, pp. 493–498, 2010.

APPENDIX A

SELF REPORTING QUESTIONNAIRE TO ASSESS LEARNERS' MOTIVATION NEEDS IN F&IVEs

Instruction: Please indicate (bold tick) your level of agreement to the statements below.

Strongly Disagree (SDA)	Disagree (DA)	Neutral (N)	Agree (A)	Strongly Agree (SA)
5	4	3	2	1

Section 1: Formal Learning Visual Environments (FLVEs)

Rate your level of agreement with the statements given below:	SDA	DA	N	A	SA
Learners' collaborative learning and sharing makes a FLVE highly motivating	5	4	3	2	1
Learners' get personalized attention in a FLVE	5	4	3	2	1
Learners' find practical relevance to what they are learning in a FLVE	5	4	3	2	1
Learners' gain confidence of what they are learning in a FLVE	5	4	3	2	1
In FLVE learners' achieve greater satisfaction when their learning objectives are met	5	4	3	2	1
Learning objectives are targeted and attained in a FLVE	5	4	3	2	1
I thinking effective transferring of skills to Learners takes place in a FLVE	5	4	3	2	1
A FLVE instigates higher intrinsic learning motivation in Learners	5	4	3	2	1
A FLVE instigates higher extrinsic learning motivation in Learners	5	4	3	2	1
A FLVE encourages technical and critical thinking among Learners	5	4	3	2	1

Section 2: Informal Visual Environments (IVEs)

Rate your level of agreement with the statements given below:	SDA	DA	N	A	SA
An IVE is full of temptations and leads to incidental learning	5	4	3	2	1
Learning objectives of an IVE are met by involving learners in leisure and fun-filled activities	5	4	3	2	1
IVEs make learners to fantasize about world of illusions and story-telling	5	4	3	2	1
IVEs throw learning challenges at learners in order to engage their attentions	5	4	3	2	1
IVEs generate curiosity to captivate learners' senses by using unusual images, sound effects, narration and animations	5	4	3	2	1
Learners' in an IVE are empowered to control their activities	5	4	3	2	1
An IVE instigates intrinsic learning motivation in Learners	5	4	3	2	1
An IVE instigates extrinsic learning motivation in Learners	5	4	3	2	1

Section 3: Video-Games

Vide-Games instigate Motivation by:	SDA	DA	N	A	SA
Inculcating advance thinking skills in learners	5	4	3	2	1
Providing enjoyment and pleasure	5	4	3	2	1
Providing interactivity	5	4	3	2	1
Providing goal- setting pleasure	5	4	3	2	1
Provoking problem-solving skills	5	4	3	2	1
Providing winning satisfaction	5	4	3	2	1
Providing efficient response feedback on outcomes and performance	5	4	3	2	1

Section 4: Social Networking Websites (SNWs)

SNWs instigate Learning Motivation by:	SDA	DA	N	A	SA
Instigating sense of real participation	5	4	3	2	1
Enforcing no extrinsic compulsion	5	4	3	2	1
Providing immense freedom of speech and actions, e.g. Blogging	5	4	3	2	1
Creating and sharing virtual objects	5	4	3	2	1

Providing special interest news	5	4	3	2	1
Participating in collaborative projects	5	4	3	2	1
Downloading (music, videos etc.)	5	4	3	2	1
Providing Cognitive absorption	5	4	3	2	1

Section 5: Motion-Pictures

Motion-Pictures instigate Learning Motivation by:	SDA	DA	N	A	SA
Sustaining adaptive visual flow	5	4	3	2	1
Intriguing story and narration style	5	4	3	2	1
Providing musical cognition	5	4	3	2	1
Ensuring emotion bonding occurs between the viewers and the actors	5	4	3	2	1
Sustaining interest through climax and excellent visual executions of shots	5	4	3	2	1
Providing special effects and animations	5	4	3	2	1

Section 6: Web-Based Learning (WBL)

Rate your level of agreement with the statements given below:	SDA	DA	N	A	SA
WBLEs are highly-interactive, so collaborative learning becomes fun and exciting	5	4	3	2	1
WBLEs are collaborative in nature, so learners can participate and discuss their ideas	5	4	3	2	1
WBLEs expose learners to complex real-life environments	5	4	3	2	1
WBLEs provide experts' guidance to facilitate advanced learning	5	4	3	2	1
WBLEs provide flexibility to learners to connect to their class any time, from anywhere	5	4	3	2	1
WBLEs provide flexibility to learners to learn from a wider range of information and sources	5	4	3	2	1

Section 7: Tick (1) of Your 'Most' Favorite Informal Motivational Factor:

Challenge	Curiosity	Fantasy	Control

Section 8: Tick (1) of Your 'Most' Favorite Formal Learning Motivational Factor:

Attention	Relevance	Confidence	Satisfaction

Section 9: Your 'Intrinsic Learning Motivation' is higher in:

Formal Learning Visual Environment	Informal Visual Environment

Section 10: Rate Your Level of 'Learning Motivation' in WBLEs:

Highly Discouraging	Discouraging	Neutral	Motivating	Highly Motivating
5	4	3	2	1

☺ Thank you very much for completing this questionnaire ☺

APPENDIX B

SELF REPORTING QUESTIONNAIRE TO ASSESS LEARNERS' AESTHETIC NEEDS IN F&IVEs

Instruction: Please indicate (bold tick) your level of agreement to the statements below.

Highly Nonessential(HNE)	Nonessential (NE)	Neutral (N)	Essential (E)	Highly Essential (HA)
5	4	3	2	1

Section 1: Rate the following Aesthetic Parameters in terms of how 'Essential' they are for aesthetic designing of Formal Learning Visual Environments:

	HNE	NE	N	E	HE
Clarity of the content and layout	5	4	3	2	1
Use of specific colors to express visual hierarchy	5	4	3	2	1
Use of contrasting colors or scale to draw emphasis upon focal point of interest	5	4	3	2	1
Image branding	5	4	3	2	1
Contrast in use of colors	5	4	3	2	1
Contrast in visual orientation	5	4	3	2	1
Consistency of design pattern in interior pages	5	4	3	2	1
Consistency in maintaining visual interest of the environment	5	4	3	2	1
Consistency in sustaining feel of the environment	5	4	3	2	1
Visual flow in interaction design	5	4	3	2	1
Verbal flow in layout design	5	4	3	2	1
Balance in size of visual elements	5	4	3	2	1
Balance in use of colors	5	4	3	2	1
Use of white space in relation to the format of the design	5	4	3	2	1
Creative use of lines, shapes, visual elements to suggest direction or guide visual orientation	5	4	3	2	1
Coherence in the overall aesthetic design	5	4	3	2	1

Section 7: Tick (1) of Your 'Most' Favorite Informal Motivational Factor:

Challenge	**Curiosity**	**Fantasy**	**Control**

Section 8: Tick (1) of Your 'Most' Favorite Formal Learning Motivational Factor:

Attention	**Relevance**	**Confidence**	**Satisfaction**

Section 8: Tick (1) of Your 'Most' Favorite Informal Visual Environment:

Social Networking Websites	**Motion-Pictures**	**Video-Games**

Section 10: Rate Your Level of 'Aesthetic Expectations' from FLVEs:

Very High	**High**	**Neutral**	**Low**	**Very Low**
1	2	3	4	5

☺ Thank you very much for completing this questionnaire ☺

APPENDIX C

INITIAL LIST OF AESTHETIC-EMOTION ITEMS FOR SCALE DEVELOPMENT

Instruction: Please indicate (bold tick) your level of agreement to the statements below.

Strongly Disagree (SDA)	Disagree (DA)	Neutral (N)	Agree (A)	Strongly Agree (SA)
1	2	3	4	5

When viewing _____ website, kindly check the appropriate rating box (1-5) to indicate the degree to which each Aesthetic-Emotion is experienced by you.

Aesthetic–Emotions (Informal)	SDA	DA	N	A	SA	Aesthetic–Emotions (Formal)	SDA	DA	N	A	SA
1. Fancy	1	2	3	4	5	1. Spontaneous	1	2	3	4	5
2. Imaginative	1	2	3	4	5	2. Creative	1	2	3	4	5
3. Successful	1	2	3	4	5	3. Original	1	2	3	4	5
4. Reputation	1	2	3	4	5	4. Thoughtful	1	2	3	4	5
5. Inspirational	1	2	3	4	5	5. Interesting	1	2	3	4	5
6. Elegant	1	2	3	4	5	6. Affective	1	2	3	4	5
7. Mesmerizing	1	2	3	4	5	7. Natural	1	2	3	4	5
8. Pride	1	2	3	4	5	8. Meaningful	1	2	3	4	5
9. Impressive	1	2	3	4	5	9. Knowledgeable	1	2	3	4	5
10. Organized	1	2	3	4	5	10. Familiar	1	2	3	4	5
11. Structured	1	2	3	4	5	11. Conversant	1	2	3	4	5
12. Contingency	1	2	3	4	5	12. Expertise	1	2	3	4	5
13. Firmness	1	2	3	4	5	13. Proficiency	1	2	3	4	5
14. Supportive	1	2	3	4	5	14. Easiness	1	2	3	4	5
15. Determined	1	2	3	4	5	15. Effective	1	2	3	4	5
16. Decisiveness	1	2	3	4	5	16. Efficient	1	2	3	4	5
17. Excitement	1	2	3	4	5	17. Energized	1	2	3	4	5
18. Surprising	1	2	3	4	5	18. Competence	1	2	3	4	5
19. Incompleteness	1	2	3	4	5	19. Contented	1	2	3	4	5
20. Extraordinary	1	2	3	4	5	20. Pleased	1	2	3	4	5
21. Sensitive	1	2	3	4	5	21. Ego-Gratification	1	2	3	4	5
22. Secrecy	1	2	3	4	5	22. Relaxed	1	2	3	4	5
23. Paradoxes	1	2	3	4	5	23. Reliable	1	2	3	4	5
24. Bizarre	1	2	3	4	5						
25. Orientation	1	2	3	4	5						
26. Focused	1	2	3	4	5						
27. Alertness	1	2	3	4	5						
28. Vigilant	1	2	3	4	5						
29. Innovative	1	2	3	4	5						
30. Randomness	1	2	3	4	5						
31. Predictability	1	2	3	4	5						

Original List of Aesthetic-Emotions: 54 items

APPENDIX D

REVISED LIST OF AESTHETIC-EMOTION ITEMS FOR SCALE DEVELOPMENT

Instruction: Please indicate (bold tick) your level of agreement to the statements below.

Strongly Disagree (SDA)	Disagree (DA)	Neutral (N)	Agree (A)	Strongly Agree (SA)
1	2	3	4	5

When viewing _____ website, kindly check the appropriate rating box (1-5) to indicate the degree to which each Aesthetic-Emotion is experienced by you.

Aesthetic – Emotions (Informal)	SDA	DA	N	A	SA	Aesthetic – Emotions (Formal)	SDA	DA	N	A	SA
1. Imaginative	1	2	3	4	5	1. Spontaneous	1	2	3	4	5
2. Successful	1	2	3	4	5	2. Creative	1	2	3	4	5
3. Reputation	1	2	3	4	5	3. Original	1	2	3	4	5
4. Inspirational	1	2	3	4	5	4. Thoughtful	1	2	3	4	5
5. Elegant	1	2	3	4	5	5. Interesting	1	2	3	4	5
6. Mesmerizing	1	2	3	4	5	6. Affective	1	2	3	4	5
7. Eminence	1	2	3	4	5	7. Striking	1	2	3	4	5
8. Harmonic	1	2	3	4	5	8. Gimmick	1	2	3	4	5
9. Guilty Pleasures	1	2	3	4	5	9. Meaningful	1	2	3	4	5
10. Colorful	1	2	3	4	5	10. Knowledgeable	1	2	3	4	5
11. Organized	1	2	3	4	5	11. Familiar	1	2	3	4	5
12. Structured	1	2	3	4	5	12. Expertise	1	2	3	4	5
13. Supportive	1	2	3	4	5	13. Proficiency	1	2	3	4	5
14. Decisiveness	1	2	3	4	5	14. Memorable	1	2	3	4	5
15. Informed	1	2	3	4	5	15. Realistic	1	2	3	4	5
16. Excitement	1	2	3	4	5	16. Personalized	1	2	3	4	5
17. Surprising	1	2	3	4	5	17. Easiness	1	2	3	4	5
18. Incompleteness	1	2	3	4	5	18. Effective	1	2	3	4	5
19. Extraordinary	1	2	3	4	5	19. Efficient	1	2	3	4	5
20. Paradoxes	1	2	3	4	5	20. Energized	1	2	3	4	5
21. Bizarre	1	2	3	4	5	21. Competence	1	2	3	4	5
22. Arousal	1	2	3	4	5	22. Resourceful	1	2	3	4	5
23. Stimulating	1	2	3	4	5	23. Contented	1	2	3	4	5
24. Mysterious	1	2	3	4	5	24. Pleased	1	2	3	4	5
25. Orientation	1	2	3	4	5	25. Ego-Gratification	1	2	3	4	5
26. Focused	1	2	3	4	5	26. Relaxed	1	2	3	4	5
27. Vigilant	1	2	3	4	5	27. Reliable	1	2	3	4	5
28. Innovative	1	2	3	4	5	28. Happy	1	2	3	4	5
29. Randomness	1	2	3	4	5						
30. Interactive	1	2	3	4	5						
31. Intensified	1	2	3	4	5						

Revised List of Aesthetic-Emotions: 59 items

APPENDIX E

AESTHETIC RATING EVALUATION OF F&IVEs FOR FORMATION OF MENTAL MODELS

Instruction: Please indicate (bold/tick) your level of agreement to the statements below.

Disaesthetic (DA)	Low Aesthetic (LA)	Neutral (N)	Aesthetic (A)	Highly Aesthetic (HA)
1	2	3	4	5

Section 2: Rate Alpine Meadows Website on the following 11 constructs in terms of how 'Aesthetic' it is:

Constructs	**DA**	**LA**	**N**	**A**	**HA**
Hierarchy	1	2	3	4	5
Emphasis	1	2	3	4	5
Contrast	1	2	3	4	5
Tension	1	2	3	4	5
Balance	1	2	3	4	5
Rhythm	1	2	3	4	5
Flow	1	2	3	4	5
Depth	1	2	3	4	5
Scale	1	2	3	4	5
Movement	1	2	3	4	5
Unity	1	2	3	4	5

Rate Your Level of 'Motivation' for Alpine Meadows Website

Very Low	**Low**	**Neutral**	**High**	**Very High**
1	2	3	4	5

Rate Your Level of 'Learning Motivation' for UTP's E-Learning System

Very Low	**Low**	**Neutral**	**High**	**Very High**
1	2	3	4	5

APPENDIX F

EVALUATION OF LEARNERS' SCHEMATIC THINKING (CONTEXTUAL INTERPRETATION) FOR FORMATION OF MENTAL MODELS

Section 3: Learners' Contextual Interpretation of their Visual Media Interaction behavior

Kindly indicate which of the following describes your personality lifestyle association and interaction behavior with informal Visual Media Technologies, in the best possible way. **Tick Only One Option Please**

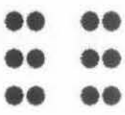
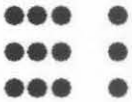
Rate your overall level of Visual Media Interaction.	Which of the following informal Visual Medias you interact most frequently with?	Rate level of your favorite Visual Media Addiction.	Avg. number of Hours spent playing Video-Games / Day.
☐ Very High	☐ Motion-Pictures	☐ Highly Addictive	☐ One to three hours
☐ High	☐ Video-Games	☐ Addictive	☐ Three to six hours
☐ Neither High Nor Low	☐ Television	☐ Neutral	☐ 7 + hours
☐ Low	☐ Internet	☐ Non-Addictive	☐ Others (specify:_____)
☐ Very Low	☐ Others	☐ Highly Non-Addictive	☐ None
Avg. Number of Hours Spent Viewing Television / Day	Avg. Number of Hours Spent Surfing on Internet / Day.	Self-Concept: The degree to which interacting with Visual Media is perceived to enhance your image or status in today's social system.	Self-Efficacy: Rate the Level of Your Expertise In Interacting with Visual Media.
☐ One to three hours	☐ One to three hours	☐ Very High	☐ Very High
☐ Three to six hours	☐ Three to six hours	☐ High	☐ High
☐ 7 + hours	☐ 7 + hours	☐ Neither High Nor Low	☐ Neither High Nor Low
☐ Others (specify:_____)	☐ Others (specify:_____)	☐ Low	☐ Low
☐ None	☐ None	☐ Very Low	☐ Very Low
Media Engagement: Rate your level of cognitive engagement when Interacting with Visual Media.	Media Persuasion: Rate the impact of cognitive comparison of Visual Media in relation to your self-image.	Self-Enhancement: Rate the degree to which positive influence of visual media is visible in your personality.	Attribution: Rate the degree to which your Visual Media interaction experience IS gratifying?
☐ Highly Engaging	☐ Highly Influencing	☐ Highly Affective	☐ Highly Satisfying
☐ Engaging	☐ Influencing	☐ Affective	☐ Satisfying
☐ Neutral	☐ Neutral	☐ Neutral	☐ Neutral
☐ Disengaging	☐ Dissuading	☐ Non - Affective	☐ Dissatisfying
☐ Highly Disengaging	☐ Highly Dissuading	☐ Highly Non - Affective	☐ Highly Dissatisfying

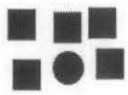
Media Interaction Attitude: Rate your level of likeness/ dislikeness Visual Media interaction.	Media Innovativeness: Rate your personality's adventurous side with respect to sharing comfort with Visual Media interaction and Technological innovations.	Visual Salience: Rate your ability to detect striking stimulus in a Visual Environments.	Aesthetic Personality: Rate your personality in terms of how generally aesthetic you are in dealing with your day in day out activities?
☐ Highly Likeable Attitude	☐ Very High	☐ Excellent	☐ Very High
☐ Likeable Attitude	☐ High	☐ Good	☐ High
☐ Neutral	☐ Neither High Nor Low	☐ Average	☐ Neutral
☐ Dislikeable Attitude	☐ Low	☐ Below Average	☐ Low
☐ Highly Dislikeable Attitude	☐ Very Low	☐ Very Low	☐ Very Low
Rate positive behavior of your Family in support of your Visual Media technologies usage and interaction behavior.	Rate positive behavior of your social surroundings in support of your Visual Media technologies usage and interaction behavior.	Rate the level of support provided by your culture to facilitate in technological adoptions.	Do you feel inclined towards interacting with Visual Media technologies because of your Job nature (Jn) or due to Personal interest (Pi)?
☐ Highly Supportive	☐ Highly Supportive	☐ Highly Supportive	☐ Mostly due to Pi
☐ Supportive	☐ Supportive	☐ Supportive	☐ Mostly due to Pi and some due to Jn
☐ Neutral	☐ Neutral	☐ Neutral	☐ Neutral
☐ Non-Supportive	☐ Non-Supportive	☐ Non-Supportive	☐ Mostly due to Jn and some due to Pi
☐ Highly Non-Supportive	☐ Highly Non-Supportive	☐ Highly Non-Supportive	☐ Mostly due to my Jn
Rate your level of anticipation for a positive emotional change when interacting with Visual Media Technologies	Rate your (or family's) Economic state to afford Visual Media Technologies.	Rate your future aspirations with regards to finding a job related to Visual Media Technologies	Rate your level of Learning Motivating in a Formal Learning Visual Environment.
☐ Very High	☐ Excellent	☐ Very High	☐ Very High
☐ High	☐ Good	☐ High	☐ High
☐ Neither High Nor Low	☐ Average	☐ Neutral	☐ Neutral
☐ Low	☐ Below Average	☐ Low	☐ Low
☐ Very Low	☐ Very Low	☐ Very Low	☐ Very Low

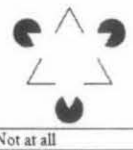
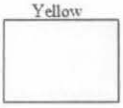
APPENDIX G

EVALUATION OF LEARNERS' SCHEMATIC THINKING (GESTALT UNDERSTANDING) FOR FORMATION OF MENTAL MODELS

Section 4: Gestalt Visual Perception Understanding

How balanced are below images?				
				
(1) Not balanced at all	(1) Not balanced at all	(1) Not balanced at all	(1) Not balanced at all	(1) Not balanced at all
(2) Somewhat balanced	(2) Somewhat balanced	(2) Somewhat balanced	(2) Somewhat balanced	(2) Somewhat balanced
(3) Semi balanced	(3) Semi balanced	(3) Semi balanced	(3) Semi balanced	(3) Semi balanced
(4) Balanced	(4) Balanced	(4) Balanced	(4) Balanced	(4) Balanced
(5) Highly Balanced	(5) Highly Balanced	(5) Highly Balanced	(5) Highly Balanced	(5) Highly Balanced
Where is this road heading?	**Is this Aesthetic?**	**Can you see?**	**How aesthetic are these two images?**	
				
(1) Nowhere	(1) Not at all	(1) It is not clear	(1) Not at all	(1) Not at all
(2) May be somewhere	(2) Somewhat	(2) There are no two faces	(2) Somewhat	(2) Somewhat
(3) Its moving somewhere	(3) Neutral	(3) There is a vase only	(3) Neutral	(3) Neutral
(4) From up to down	(4) Yes, it is	(4) There are two faces only	(4) Yes, it is	(4) Yes, it is
(5) From down to up	(5) Yes, it is for sure	(5) There is a vase hidden in two faces	(5) Yes, it is for sure	(5) Yes, it is for sure

Does it have a 'focal point'?	**What does it indicate?**	**How aesthetic are these three images?**		
				
(1) No, it does not.	(1) Nothing really!	(1) Not at all	(1) Not at all	(1) Not at all
(2) Not sure, may be.	(2) Not sure	(2) Somewhat	(2) Somewhat	(2) Somewhat
(3) Can't say	(3) Seems it does	(3) Neutral	(3) Neutral	(3) Neutral
(4) Seems like it does	(4) Help or Thought	(4) Yes, it is	(4) Yes, it is	(4) Yes, it is
(5) Yes, it does	(5)Help & Thought	(5) Yes, it is for sure	(5) Yes, it is for sure	(5) Yes, it is for sure

Can you visualize this as being 'complete'?	**Does the image at extreme right catch your attention?**	**What do these three colors symbolize?**		
		Purple 	Red 	Yellow 
(1) Not at all	(1) Not at all	(1) Sky	(1) Sky	(1) Sky
(2) I feel I can, but not sure	(2) Unusual but not sure	(2) Friendship	(2) Tranquility	(2) Sunflower
(3) Neutral	(3) Neutral	(3) Not sure	(3) Not sure	(3) Not sure
(4) I can try	(4) Somewhat	(4) Luxury	(4) Dominance	(4) Happiness
(5) Yes I can visualize	(5) Yes, it does for sure.	(5) Royalty	(5) Danger	(5) Sunny Day

APPENDIX H

LEARNERS' QUALITATIVE REPORTING TO REFLECT UPON THEIR AESTHETIC PERCEPTIONS IN F&IVEs

Section 5: Choose appropriate 'words adjectives' to reflect upon your Aesthetic Disaesthetic experiences in Informal Visual Environments

Aesthetic Experience				**Disaesthetic Experience**			
=	Compelling	=	Spontenous	=	Loud	=	Inefficient
=	Adventurous	=	Creative	=	Annoying	=	Unrefined
=	Stimulating	=	Original	=	Disruptive	=	Invaluable
=	Imaginative	=	Revive	=	Vulgur	=	Time wastage
=	Innovative	=	Recharge	=	Boring	=	Frustrating
=	Refreshing	=	Amusing	=	Unattractive	=	Dull
=	Exciting	=	Enjoyable	=	Anxiety	=	Undesirable
=	Thrilling	=	Delightful	=	Poor quality	=	Rigid
=	Entertaining	=	Arousal	=	Impersonal	=	Ineffective
=	Funny	=	Glamorized	=	Hard	=	Extravagant
=	Harmonic	=	Colorful	=	Unpleasant	=	Colorless
=	Serene	=	Beautiful	=	Bizarre	=	Dry
=	Pleasant	=	Emotional	=	Orthodox	=	Monotonous

Suggest Additional Words Adjectives (as many as you want):

_____

_____

_____

APPENDIX I

LEARNERS' QUALITATIVE REPORTING TO REFLECT UPON THEIR MOTIVATION IN F&IVEs

Section 6: Choose appropriate 'words adjectives' to reflect upon your Motivating De-motivating experiences in Formal Learning Visual Environments

Motivation				**Demotivation**			
☐	Inspiring	☐	Riveting	☐	Inefficient	☐	Exhausting
☐	Encouraging	☐	Interesting	☐	Unrefined	☐	Nerve-racking
☐	Moving	☐	Optimistic	☐	Invaluable	☐	Draining
☐	Empowering	☐	Positive	☐	Monotonous	☐	Anxious
☐	Arousing	☐	Constructive	☐	Frustrating	☐	Hard
☐	Stirring	☐	Impulsive	☐	Dull	☐	Abstract
☐	Engaging	☐	Persuasive	☐	Undesirable	☐	Perverse
☐	Reliable	☐	Instigating	☐	Rigid	☐	Illogical
☐	Confidence	☐	Deriving	☐	Ineffective	☐	Boring
☐	Absorbing	☐	Ambitious	☐	Pessimestic	☐	Intricate
☐	Engrossing	☐	Purposeful	☐	Stressful	☐	Tiring
☐	Gripping	☐	Enthusiasm	☐	Flat	☐	Plain
☐	Involving	☐	Energy	☐	Eccentric	☐	Gloomy

Suggest Additional Words Adjectives (as many as you want):

_____

_____

_____

APPENDIX J

TRANSFORMATION OF AESTHETIC RATINGS INTO AESTHETIC JUDGEMENT SCORES

Transformation of Evaluators Aesthetic Rating of Alpine Meadows Website into Aesthetic Judgment Scores (AJS)

Evaluators		Hierarchy	Emphasis	Contrast	Tension	Balance	Rhythm	Flow	Depth	Scale	Movement	Unity	AJS
HCI Expert		4	4	5	4	4	4	5	5	4	4	5	15
Media Psychologist		4	4	4	5	4	4	4	4	4	5	5	14
1	Learner	4	4	4	3	4	4	5	4	4	4	4	11
2	Learner	4	5	5	4	3	4	3	4	4	4	4	12
3	Learner	4	5	5	5	4	4	3	4	4	4	4	13
4	Learner	4	4	4	5	4	3	3	5	5	4	4	12
5	Learner	4	4	3	3	5	5	5	4	4	5	5	14
6	Learner	5	4	2	4	4	4	3	4	5	4	4	10
7	Learner	5	5	3	4	3	3	3	4	4	4	4	9
8	Learner	3	2	3	4	3	4	4	3	5	4	4	6
9	Learner	4	4	2	3	3	2	2	3	4	4	5	3
10	Learner	5	5	1	4	3	3	4	4	3	3	5	7
11	Learner	5	5	2	1	4	4	2	5	2	5	5	4
12	Learner	4	4	2	2	4	3	2	5	4	5	5	7
13	Learner	4	3	1	4	4	5	4	4	5	4	4	9
14	Learner	4	4	2	4	4	4	2	5	5	4	4	9
15	Learner	5	5	2	3	3	3	2	4	5	5	4	8
16	Learner	4	3	4	3	3	4	3	3	4	4	5	7
17	Learner	4	4	5	2	5	4	4	4	4	4	4	11
18	Learner	4	2	3	2	3	4	3	5	3	5	5	6
19	Learner	4	3	2	1	2	1	1	4	3	5	5	-2
20	Learner	3	2	3	2	5	5	5	3	4	3	3	5
21	Learner	3	2	3	2	4	4	3	4	5	4	5	6
22	Learner	3	4	3	3	4	5	4	5	5	4	5	12
23	Learner	3	3	4	3	3	4	3	4	4	4	5	7
24	Learner	4	4	3	5	4	3	5	4	3	4	5	11
25	Learner	4	3	4	5	3	4	5	4	5	4	5	13
26	Learner	5	4	1	4	4	2	5	2	5	4	4	7
27	Learner	4	1	4	4	1	5	4	4	4	4	4	6
28	Learner	4	3	4	4	4	5	5	4	4	2	4	10
29	Learner	4	4	3	4	3	4	4	4	5	4	4	10
30	Learner	3	4	4	3	4	4	4	3	5	4	4	9
31	Learner	4	1	4	1	1	4	4	2	4	2	5	-1
32	Learner	4	4	3	3	4	3	3	4	3	3	5	6
33	Learner	4	2	3	1	1	2	4	1	5	3	5	-2
34	Learner	4	3	3	4	3	3	4	3	4	4	5	7
35	Learner	3	3	5	3	5	4	4	4	4	4	4	10
36	Learner	4	4	4	3	3	5	4	5	5	2	5	11
37	Learner	5	2	5	4	3	2	3	5	4	2	4	6
38	Learner	4	5	1	5	4	5	3	3	5	4	4	10
39	Learner	4	5	4	5	4	3	4	3	4	4	5	14
40	Learner	3	4	3	4	4	4	4	4	4	4	4	8
41	Learner	4	4	4	4	1	2	5	5	2	4	4	6
42	Learner	4	3	4	5	4	4	4	4	4	4	4	11
43	Learner	5	4	3	4	3	5	4	5	5	5	4	14
44	Learner	5	5	4	3	5	5	4	5	5	5	4	17
45	Learner	4	2	4	4	1	4	5	5	5	4	4	9
46	Learner	4	5	4	3	3	5	3	4	4	4	4	10
47	Learner	4	5	5	4	5	5	4	5	4	5	5	18
48	Learner	5	4	5	3	5	4	5	5	4	4	4	15
49	Learner	5	2	3	3	3	2	4	5	4	4	4	6
50	Learner	4	4	1	3	1	2	5	2	5	1	4	-1
51	Learner	5	3	3	4	5	3	3	4	4	3	4	8
52	Learner	4	5	1	5	4	5	3	3	5	4	4	12

APPENDIX K

LEARNERS' AESTHETIC PERCEPTION CLASSIFICATION

Classification of Learners' AJS into Aesthetic Perceptions (High, Medium, Low) in Informal Visual Environments

Evaluators		Hierarchy	Emphasis	Contrast	Tension	Balance	Rhythm	Flow	Depth	Scale	Movement	Unity	AJS	Classification Code
1	Learner	4	4	4	3	4	4	5	4	4	4	4	11	2
2	Learner	4	5	5	4	3	4	3	4	4	4	4	12	3
3	Learner	4	5	5	5	4	4	3	4	4	4	4	13	3
4	Learner	4	4	4	5	4	3	3	5	5	4	4	12	3
5	Learner	4	4	3	3	5	5	5	4	4	5	5	14	3
6	Learner	5	4	2	4	4	4	3	4	5	4	4	10	2
7	Learner	5	5	3	4	3	3	3	4	4	4	4	9	2
8	Learner	3	2	3	4	3	4	4	3	5	4	4	6	2
9	Learner	4	4	2	3	3	2	2	3	4	4	5	3	1
10	Learner	5	5	1	4	3	3	4	4	3	3	5	7	2
11	Learner	5	5	2	1	4	4	2	2	2	5	5	4	1
12	Learner	4	4	2	2	4	3	2	5	4	5	5	7	2
13	Learner	4	3	1	4	4	5	4	4	5	4	4	9	2
14	Learner	4	4	2	4	4	4	2	5	5	4	4	9	2
15	Learner	5	5	2	3	3	3	2	4	5	5	4	8	2
16	Learner	4	3	4	3	3	4	3	3	4	4	5	7	2
17	Learner	4	4	5	2	5	4	4	4	4	4	4	11	2
18	Learner	4	2	3	2	3	4	3	5	3	5	5	6	2
19	Learner	4	3	2	1	2	1	1	4	3	5	5	-2	1
20	Learner	3	2	3	2	5	5	5	3	4	3	3	5	2
21	Learner	3	2	3	2	4	4	3	4	5	4	5	6	2
22	Learner	3	4	3	3	4	5	4	5	5	4	5	12	3
23	Learner	3	3	4	3	3	4	3	4	4	4	5	7	2
24	Learner	4	4	3	5	4	3	5	4	3	4	5	11	2
25	Learner	4	3	4	5	3	4	5	4	5	4	5	13	3
26	Learner	5	4	1	4	4	2	5	2	5	4	4	7	2
27	Learner	4	1	4	4	1	5	4	4	4	4	4	6	2
28	Learner	4	3	4	4	4	5	5	4	4	2	4	10	2
29	Learner	4	4	3	4	3	4	4	4	5	4	4	10	2
30	Learner	3	4	4	3	4	4	4	3	5	4	4	9	2
31	Learner	4	1	4	1	1	4	4	2	4	2	5	-1	1
32	Learner	4	4	3	3	4	3	3	4	3	3	5	6	2
33	Learner	4	2	3	1	1	2	4	1	5	3	5	-2	1
34	Learner	4	3	3	4	3	3	4	3	4	4	5	7	2
35	Learner	3	3	5	3	5	4	4	4	4	4	4	10	2
36	Learner	4	4	4	3	3	5	4	5	5	2	5	11	2
37	Learner	5	2	5	4	3	2	3	5	4	2	4	6	2
38	Learner	4	5	1	5	4	5	3	3	5	4	4	10	2
39	Learner	4	5	4	5	4	3	4	3	4	4	5	14	3
40	Learner	3	4	3	4	4	4	4	4	4	4	4	8	2
41	Learner	4	4	4	4	1	2	5	5	2	4	4	6	2
42	Learner	4	3	4	5	4	4	4	4	4	4	4	11	2
43	Learner	5	4	3	4	3	5	4	5	5	5	4	14	3
44	Learner	5	5	4	3	5	5	4	5	5	5	4	17	3
45	Learner	4	2	4	4	1	4	5	5	5	4	4	9	2
46	Learner	4	5	4	3	3	5	3	4	4	4	4	10	2
47	Learner	4	5	5	4	5	5	4	5	4	5	5	18	3
48	Learner	5	4	5	3	5	4	5	5	4	4	4	15	3
49	Learner	5	2	3	3	3	2	4	5	4	4	4	6	2
50	Learner	4	4	1	3	1	2	5	2	5	1	4	-1	1
51	Learner	5	3	3	4	5	3	3	4	4	3	4	8	2
52	Learner	4	5	1	5	4	5	3	3	5	4	4	12	3

Classification Coding used in SPSS:
1 – Low Aesthetic Perceptions
2 – Medium Aesthetic Perception
3 – High Aesthetic Perception

APPENDIX L

QUANTIFYING USERS' AESTHETIC AND USABILITY PERCEPTIONS

Quantifying Users' Aesthetic & Usability Perceptions of Websites

AESTHETIC PERCEPTION	Score (1-20)	**FUNCTIONALITY**	Score (1-20)
Statements		*Statements*	
The website provides visitors with an engaging and memorable experience		Users receive timely responses to their queries submissions	
The visual impact of the site is consistent with the brand identity		Task progress is clearly communicated (e.g., success pages or email updates)	
Graphics, Collaterals and Multimedia add value to the aesthetic experience		The website and applications adhere to common security and privacy standards	
The website delivers on the perceived promise of the brand		Online functions are integrated with offline business processes	
The website leverages the capabilities of the medium to enhance or extend its aesthetic appeal		The website contains administration tools that enhance administrator efficiency	
AESTHETICS TOTAL		FUNCTIONALITY TOTAL	
USABILITY PERCEPTION	Score (1-20)	**CONTENT**	Score (1-20)
Statements		*Statements*	
The website prevents errors and helps the user recover from them		Link density provides clarity and easy navigation	
Overall page weight optimized for main target audience		Content structured in a way that facilitates the attainment of user goals	
The website helps its visitors accomplish common goals and tasks		Content is up-to-date and accurate	
The website adheres to its own consistency and standards		Content is appropriate to customer needs and business goals	
The website provides content for users with disabilities		Content across multiple languages is comprehensive	
USABILITY TOTAL		CONTENT TOTAL	

APPENDIX M

WEBSITE MOTIVATIONAL ANALYSIS CHECKLIST

Website Motivational Analysis Checklist WebMAC Middle© (v.2.0)

WebMAC Middle is not a test. *There are no wrong answers.* It is a way of finding out what is good about this Web site and what needs to be improved. You are the judge. After reading each statement, circle the face that best describes how you would rate this Web site.

Before using ***WebMAC Middle***, it's a good idea to spend at least 20-30 minutes exploring the Web site to be evaluated in order to have some familiarity with its content and structure. You may need to go through the Web site at least once more to complete this checklist.

Rate your level of agreement with each of the 24 statements by placing the appropriate number value on the line in front of each item. If you are not sure about any item, select the best response you can give.

3 = I definitely agree.
2 = I mostly agree.
1 = I somewhat agree.
0 = I do NOT agree

Example of completed item:

-3- 0. This Web site makes me happy.

Read each question carefully. Think about your experience with this Web site before answering each question. If you need more help understanding how to use ***WebMAC Middle***, ask your teacher for help.

Name _____ URL _____

WebMAC Middle (2.0)

3 = I definitely agree.
2 = I mostly agree.
1 = I somewhat agree.
0 = I do NOT agree.

___ 1. I like the colors and backgrounds used at this Web site.

___ 2. This Web site is well-organized.

___ 3. The information at this Web site is accurate and unbiased.

___ 4. All the buttons and other mechanisms for moving around in this Web site work the way they should.

___ 5. Something (such as a picture or title) on the home page of this Web site caught my attention.

___ 6. I can read and understand most or all of the words at this Web site.

___ 7. This Web site has connections (links) to other interesting or useful Web sites.

___ 8. If I get lost or need help at this Web site, there are ways of getting help.

___ 9. This Web site is fun and interesting to explore.

___ 10. There is a menu or site map that helps me understand how much and what kinds of information I will find there.

___ 11. All information at this Web site is related to the main topic.

___ 12. I can control how fast I move through this Web site at all times.

CONTINUED →

3 = I definitely agree.
2 = I mostly agree.
1 = I somewhat agree.
0 = I do NOT agree.

___ 13. There are surprising or unusual things at this Web site.

___ 14. The purpose of this Web site is clear to me.

___ 15. I find the information contained in this Web site to be current and up-to-date.

___ 16. I do not need any special skills or experience to use this Web site.

___ 17. The variety of formats (e.g. text, images, sound) keeps my attention.

___ 18. No matter where I am at this Web site I can return to the home page or exit.

___ 19. The information at this Web site is useful to me.

___ 20. All of the Web site's links work the way they should.

___ 21. This Web site has unusual or unique features that make it more interesting.

___ 22. There is enough of what I am interested in (or looking for) on this Web site.

___ 23. There was a way to communicate with the author of this Web site.

___ 24. At all times, I can control what information at this Web site I wish to see.

Now, you are ready to answer the final questions.

WebMAC Middle (2.0)

This is a Web site I would like to visit again at another time. YES ☐ NO ☐

This is a Web site that friends my age would like to visit. YES ☐ NO ☐

Based on your experience with this Web site, please write below what you think are the best things about this Web site. Then, write what you think could be improved about this Web site.

"Best Things About This Web site"

a.) _____

b.) _____

c.) _____

"Things That Need Improvement"

a.) _____

b.) _____

c.) _____

Overall, would you give this Web site a ***thumbs up*** or a ***thumbs down?*** Circle your answer. (If you just can't make up your mind, then circle the person who is scratching his head.)

Gets my vote!

Undecided

Needs lots of improvement!

Wait for instructions from your teacher or library media specialist before scoring.

Scoring WebMAC Middle (2.0)

Place your score for each question next to the number of that question. Notice that odd-numbered questions are under column A and even-numbered questions are under column B.

A	B
1. ___	2. ___
3. ___	4. ___
5. ___	6. ___
7. ___	8. ___
9. ___	10. ___
11. ___	12. ___
13. ___	14. ___
15. ___	16. ___
17. ___	18. ___
19. ___	20. ___
21. ___	22. ___
23. ___	24. ___
TOTAL A Scores ____	TOTAL B Scores____

Understanding Your Scores

The "A" score represents how interesting or useful you feel this Web site is. A low score indicates that you don't feel it has much to offer to you personally.

The "B" score refers to how well the Web site works. This covers things like how easy or difficult it was to find your way around, how well the designer did his or her job of making sure everything works correctly, and how clear and organized the information was. A low score here, for example, means that you did not feel confident that you could easily find your way around or get the information you needed.

Once you have scored WebMAC Middle, you can refer to the score key below to see how well the Web site rated. A Web site that gets high scores in both A and B is an *Awesome Website!*

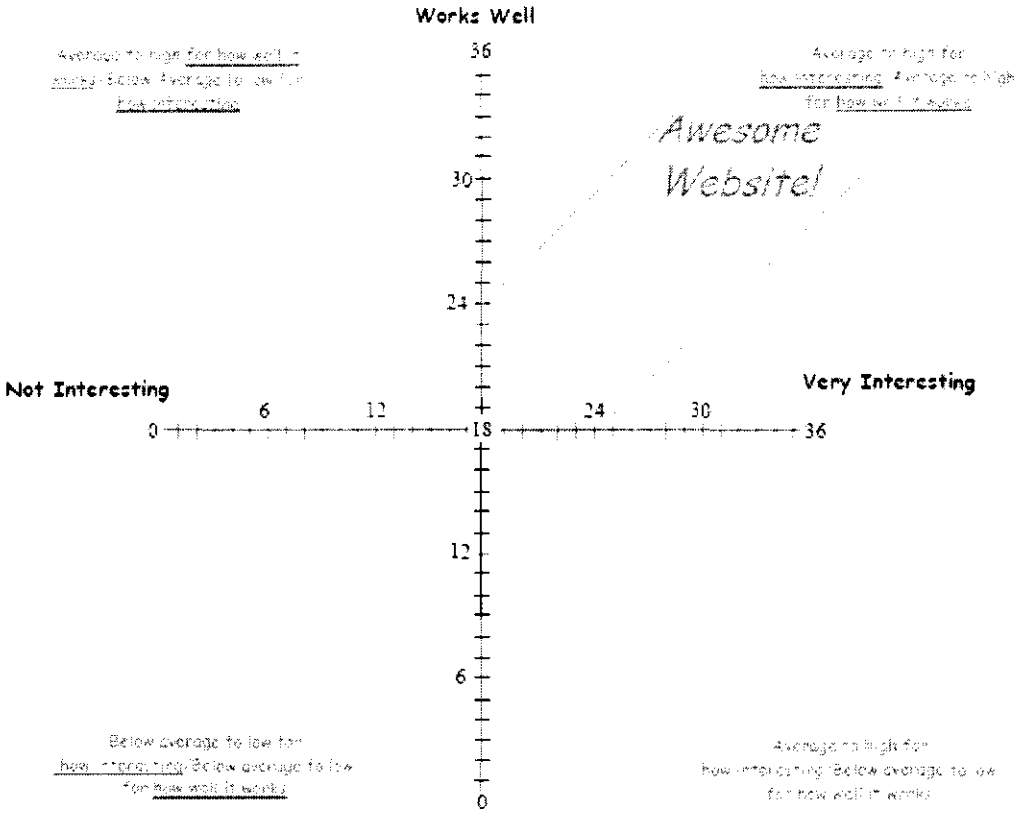
SCORE KEY

A (How Interesting)		*B (How Well It Works)*	
0 - 9	Poor	0 - 9	Poor
10 - 17	Below Average	10 - 17	Below Average
18 - 24	Average	18 - 24	Average
25 - 30	Good	25 - 30	Good
31 - 36	Outstanding	31 - 36	Outstanding

Outstanding **A** + Outstanding **B** = ***Awesome Website!***

Rating This Web Site

DIRECTIONS: On the grid below, you will notice that the horizontal line is for the "How Interesting" score (the *A* score) and the vertical line is for the "How Well It Works" score (or the *B* score). Place a dot for the *A* score along the *Not Interesting -- Very Interesting* line; place a dot for the *B* score along the *Works Well -- Works Poorly* line. Then, draw straight lines to their point of intersection. Good Websites will have both scores in the upper right section. An *Awesome Website* will have scores that fall in the extreme upper right section.



APPENDIX N

ASSESSING MULTIVARIATE AND INTERACTION EFFECTS OF THE FOUR AESTHETIC-MOTIVATION DIMENSIONS

Instruction: Please indicate (bold tick) your level of agreement to the statements below.

Strongly Disagree (SDA)	Disagree (DA)	Neutral (N)	Agree (A)	Strongly Agree (SA)
1	2	3	4	5

When viewing Universiti Malaysia PAHANG's E-Learning System, kindly check the appropriate rating box (1-5) to indicate the degree to which each Aesthetic-Emotion is experienced by you.

Aesthetic–Emotions	**SDA**	**DA**	**N**	**A**	**SA**	**Aesthetic–Emotions**	**SDA**	**DA**	**N**	**A**	**SA**
Usability Perception						Visual & Aesthetic Appeal					
Easiness	1	2	3	4	5	Elegant	1	2	3	4	5
Resourceful	1	2	3	4	5	Inspirational	1	2	3	4	5
Organized	1	2	3	4	5	Imaginative	1	2	3	4	5
Decisiveness	1	2	3	4	5	Mesmerizing	1	2	3	4	5
Informed	1	2	3	4	5	Thoughtful	1	2	3	4	5
Orientation	1	2	3	4	5	Colorful	1	2	3	4	5
Realistic	1	2	3	4	5	Affective	1	2	3	4	5
Personalized	1	2	3	4	5						
Aesthetic–Emotions	**SDA**	**DA**	**N**	**A**	**SA**	**Aesthetic–Emotions**	**SDA**	**DA**	**N**	**A**	**SA**
Cognitive Engagement						Satisfaction					
Innovative	1	2	3	4	5	Ego-Gratification	1	2	3	4	5
Interesting	1	2	3	4	5	Happy	1	2	3	4	5
Interactive	1	2	3	4	5	Energized	1	2	3	4	5
Stimulating	1	2	3	4	5	Eminence	1	2	3	4	5
Surprising	1	2	3	4	5	Reliable	1	2	3	4	5
Proficient	1	2	3	4	5	Memorable	1	2	3	4	5
						Relaxed	1	2	3	4	5