EFFECTS OF MULTIMEDIA INDUCED EMOTIONS ON ACHIEVEMENT, INTRINSIC MOTIVATION AND SATISFACTION AMONG POLYTECHNIC STUDENTS WITH DIFFERENT LEVELS OF EMOTIONAL INTELLIGENCE

by

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LIST OF ABBREVIATIONS

10^{th} MP	Tenth Malaysian Plan
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
CAPs	Critical Agenda Projects
CATLM	Cognitive Affective Theory of Learning with Media
CGPA	Cumulative Gross Point Average
CI	Confidence interval
CTML	Cognitive Theory of Multimedia Learning
DePAN	Dasar e-Pembelajaran Negara
DV	Dependent variables
EI	Emotional intelligence
ELS	E-Learning Satisfaction
EM	Expectation maximization
EQ	Emotional intelligence quotient
ES	Effect size
HCI	Human computer interaction
HEI	High emotional intelligence
ICT	Information and communication technology
ID	Instructional design
IMI	Intrinsic Motivation Inventory
IQ	Intelligence quotient
IV	Independent variable
KR_{20}	Kuder-Richardson Formula 20

LEI	Low emotional intelligence
MAR	Missing at Random
MCAR	Missing Completely at Random
MOE	Ministry of Education
MOHE	Ministry of Higher Education
MV	Moderator variables
NegD	Negative Design
NeuD	Neutral Design
NKRA	National Key Result Area
OBE	Outcome-based education
OCC	Ortony, Clore and Collins
PosD	Positive design
PPS	Probability Proportionate to Size
QAMLM	Quality Assurance of Multimedia Learning Material
S.D.	Standard Deviation
S.E.	Standard Error
SEM	Standard error of measurement
TEIQue – SF	Traits Emotional Intelligence Questionnaire – Short Form
TTS	Text-to-speech
UX	User experience

LIST OF SYMBOLS

pt	Point
Hz	Hertz
η^2	Eta square
d	Standardised difference between two means *(Cohen's d)*
p	Statistically significant effect
MS'_{Error}	Difference in mean square (error)
$\overline{X'}$	Mean
η^2_p	Partial eta square
K	Number of items
P	Proportion of persons who responded correctly to an item
Q	Proportion of persons who responded incorrectly to an item
σ^2	Total score variance

KESAN EMOSI TERARUH MULTIMEDIA TERHADAP PENCAPAIAN, MOTIVASI INTRINSIK DAN KEPUASAN DALAM KALANGAN PELAJAR POLITEKNIK YANG BERBEZA TAHAP KECERDASAN EMOSI

ABSTRAK

Kajian ini meneroka kesan emosi teraruh dalam pembelajaran berasaskan multimedia bagi pelajar politeknik dengan aras kecerdasan emosi (KE) yang berbeza. Bidang kajian ini adalah sama dengan penyelidikan berasaskan reka bentuk emosi dalam pembelajaran multimedia. Tujuan kajian ini adalah untuk mengkaji bagaimana emosi boleh diaruh melalui elemen-elemen multimedia dan juga bagaimana personaliti emosi seseorang mempengaruhi e-pembelajaran secara kognitif dan afektif. Oleh itu, tiga jenis perisian kursus direka bentuk dan dibangunkan untuk mengaruh samada emosi positif (PosD), neutral (NeuD) atau negatif (NegD) dengan menggunakan nilai estetika berasaskan warna, fon dan imej. Kaedah menggunakan elemen multimedia untuk mengaruh emosi untuk menghasil pembelajaran yang positif didefinisikan sebagai reka bentuk emosi dalam pembelajaran multimedia. Hasil kajian ini dinilai secara kuantitatif dengan menggunakan ujian Pra dan Pasca berbentuk penilaian objektif untuk menentukan pencapaian pembelajaran, *Post-Experimental Intrinsic Motivation Inventory* (IMI) digunakan untuk menentukan tahap motivasi intrinsik dan *E-Learning Satisfaction (ELS) Inventory* untuk menentukan kepuasan pembelajaran. Pelajar turut dikategorikan berdasarkan aras KE mereka (Tinggi/Rendah) yang ditentukan menggunakan *Traits Emotional Intelligence Questionnaire – Short Form (TEIQue–SF)*. Reka bentuk faktorial 3×2 yang berasaskan kuasi-eksperimen digunakan untuk menentukan kesan utama dan interaksi antara ketiga-tiga sistem pembelajaran multimedia dan dua aras KE terhadap hasil pembelajaran bagi 205

pelajar bidang kejuruteraan dari politeknik Malaysia. Kajian ini mendapati bahawa reka bentuk emosi yang merupakan variabel tidak bersandar memberi kesan terhadap pemikiran kognitif pelajar iaitu dari segi skor pencapaian. Manakala, KE yang merupakan variabel moderator memberi kesan secara afektif dan ini diperhati melalui skor motivasi intrinsik dan kepuasan pembelajaran. Turut didapati bahawa terdapat kesan interaksi antara reka bentuk emosi dan KE terhadap kepuasan pembelajaran dimana pelajar dengan aras KE yang tinggi lebih cenderung untuk mentafsir perisian kursus yang direka bentuk berdasarkan emosi sebagai lebih memuaskan berbanding dengan pelajar yang mempunyai aras KE yang rendah. Dapatan kajian turut menunjukkan bahawa estetika negatif yang digunakan dalam reka bentuk negatif mempunyai kesan pembelajaran yang serupa dengan reka bentuk positif. Secara keseluruhan, didapati bahawa bagi mencapai hasil pembelajaran yang positif dalam e-pembelajaran kursus kejuruteraan, dicadangkan unsur-unsur KE dan juga reka bentuk emosi diintegrasikan dalam pembangunan perisian permbelajaran kursus tersebut.

EFFECTS OF MULTIMEDIA INDUCED EMOTIONS ON ACHIEVEMENT, INTRINSIC MOTIVATION AND SATISFACTION AMONG POLYTECHNIC STUDENTS WITH DIFFERENT LEVELS OF EMOTIONAL INTELLIGENCE

ABSTRACT

This study explored the effects of induced emotions in multimedia based learning on polytechnic students with different levels of emotional intelligence (EI). The field of research is similar with studies in the area of emotional design in multimedia learning. The purpose of this study was to highlight the effects of induced emotions through multimedia elements and how personality traits effects multimedia learning cognitively and affectively. Therefore, three types of coursewares were designed and developed to either induce positive (PosD), neutral (NeuD) or negative (NegD) emotions based on the aesthetic value of colours, fonts and images. This method of redesigning essential multimedia elements to induce emotions for a positive outcome is defined as emotional design in multimedia learning. The outcome of the study was examined quantitatively by utilising Pre and Post objective tests to assess learning achievement, Post-Experimental Intrinsic Motivation Inventory (IMI) to determine intrinsic motivation and E-Learning Satisfaction (ELS) Inventory to determine satisfaction. Students were grouped based on their levels of EI (High/Low Emotional Intelligence) which was established using the Traits Emotional Intelligence Questionnaire – Short Form (TEIQue–SF). In this quasi- experimental study, a 3×2 factorial design was used to determine the main and interaction effects of the three different coursewares and two levels of EI on the learning outcome of 205 Malaysian polytechnic engineering students. The findings showed that emotional design which is

the independent variable of this study effected students cognitively that is through their achievement score. Whereas, EI as the moderating variable, effected students affectively which was observed through the intrinsic motivation and satisfaction scores. There is also an interaction effect between emotional design and EI on satisfaction, where students with high levels of EI perceived emotionally designed coursewares as more satisfying in comparison to students with low levels of EI. It was also found that, negative aesthethics applied through negative design had similar effects with the positive design towards the learning outcomes. Overall, it was found that to achieve a positive learning outcome through e-learning in engineering education, it is recommended that EI and emotional design are integrated into the design and development of these learning tools.

CHAPTER 1

INTRODUCTION

1.1 Overview

This study is aimed at investigating learning outcomes when emotions are induced in a multimedia learning environment which is similar with studies on emotional design in multimedia learning. The learning outcomes explored in this study are achievement, intrinsic motivation and satisfaction and it focuses on Malaysian polytechnic engineering students. The effects of emotional intelligence (EI) as a moderating variable in multimedia-based learning are also explored. The chapter begins with a background review on Malaysia's direction on e-learning focusing upon issues relating to emotional education, integration and development into the education system. Then, research objectives, questions, hypotheses are identified. This is followed by graphical representations and discussions on the theoretical and research framework of this study. Next, the significance, limitations and definition of terms used in this study are discussed. Lastly, this chapter is summarised by a graphical representation on the rationale of this study.

1.2 Background of the Study

The New Economic Model (NEM), Tenth Malaysian Plan (10^{th} MP) and the Malaysia's Transformation Plan are programmes and policies developed to produce a high-income nation through highly skilled and knowledgeable workforce. To achieve this goal, the information and communication technology (ICT) and education sector were identified as part of the 12 National Key Economy Areas that could improve the

nation's economy. Hence, the Ministry of Higher Education (MOHE) introduced the National Higher Education Strategic Plan that focuses on 21 Critical Agenda Projects (CAPs) to aid in achieving this goal. Through CAPs and the National Key Result Area (NKRA), e-learning was identified as one of the critical areas that should be focused on to improve the country's socio-economic growth (Mohamed Amin, Zaidan, Abdul Halim, & Hanafi, 2011).

On the contrary, a country's social-economic growth is also dependent on its human capital development. The 21st century skills that caters for this development could only be achieved if people were educated holistically (Eow, Wan Zah, Roselan, & Rosnaini, 2010; Mohd. Effendi & Ahmad Zamri, 2013). Although, this is in line with the Malaysian National Philosophy of Education which emphasises that students should have an education system that harmoniously develops them intellectually, spiritually, emotionally and physically (Ministry of Education of Malaysia, 2012), is the philosophy achievable? Malaysian education system promotes intellectual growth through subjects like Mathematics, English and Sciences, spiritual growth through Islamic or religious studies, while physical growth through sports and co-curriculum activities; but how are students educated emotionally? According to Fazhuda (2012), emotional education in Malaysia is left to "develop on its own by chance" (pg. 29) and this is alarming (Spendlove, 2007). Emotional education is critical in helping students cope with learning pressure, anxiety and daily challenges in and out of the classroom (Mohd. Effendi & Ahmad Zamri, 2013). Therefore, the question is how could emotional education be integrated in our classrooms especially when e-learning has become the new 'face' for teaching and learning? As a result, we are faced with

fulfilling two goals of the nation concurrently: emotional education (Malaysian National Philosophy of Education); and effective e-learning (NKRA).

E-learning in Malaysian Polytechnic Institutions

E-learning are courses delivered using computers by using text, images, sound and videos which also includes multimedia-based learning (Clark & Mayer, 2008). One of the initial e-learning projects through CAP was the National e-Learning Policy (*Dasar e-Pembelajaran Negara* (DePAN)) introduced in 2010. DePAN which realises the 1Malaysia concept, NEM, 10th Malaysian Plan and the Malaysian Innovation Agenda plan, urged institutes of higher education to rise up as globally competitive institutions that implements e-learning technology (Ministry of Higher Education of Malaysia, 2011a). By 2015, all institutes of higher education should be able to produce 50% original e-content that is either online or standalone, and it should be developed by subject-matter experts (SME) with the help of multimedia personnel in their respective institutions (Ministry of Higher Education of Malaysia, 2011a).

This goal also applies for Malaysian polytechnics as government-based institutes of higher education under the Ministry of Education (MOE). Polytechnics provide technical and non-technical education at diploma, higher diploma and degree level. Prior to enrolling in polytechnics, students who are typically from generation Z are already exposed to a wide range of ICT technologies and therefore have higher expectation on technology application (Rassiah, Chidambaram, & Sihombing, 2011). However, the applications of ICT for teaching and learning among polytechnic lecturers are fairly low (Mohamad Fadzil, Kamarul Ariffin, & Mohd. Syahrizad Elias, 2010) as majority of lecturers focus mainly on desktop applications (e.g. Microsoft

Word, Excel) and presentation softwares (e.g. Microsoft PowerPoint) (Kumar, Muniandy, & Wan Ahmad Jaafar, 2014; Norazah, Mohamed Amin, & Zaidan, 2011; Siti Noridah, 2012). Consequently, this leaves a void in multimedia-based e-learning (Norazah et al., 2011) because it could offer a unique method for teaching and learning in the classroom (Mohler, 2001; Neo & Neo, 2004; Shank, 2005). Multimedia provides real-time representations of processes (Clark & Feldon, 2005) that could positively influence engineering education (Lee, 2008). To date, the Curriculum Development and Evaluation Division of Department of the Polytechnic Education has implemented the Polytechnic e-Learning Portal (Department of Polytechnic Education, 2014) as a platform for lecturers to upload and manage e-learning materials. However, empirical studies on polytechnic students' acceptance on e-learning shows that their confidence in e-learning is also dependent on their perception on the interface and how they relate emotionally with the technology itself (Khairul Azhar, Ahamad Tarmizi, & Mohd. Sanusi, 2013; Mohd. Sanusi & Mazeree, 2013). Empirical research has also claimed that e-learning lacks emotionality apparent in face-to-face teaching observed in the classroom setting and this might be one of the negative traits of e-learning (Sandanayake, Madurapperuma, & Dias, 2011). Therefore, this highlights that research is needed in understanding how to promote and integrate emotions in user interaction especially in e-learning.

Emotional Education in Malaysian Polytechnic Institutions

As discussed previously, emotions are one the four main pillars for holistic education in Malaysia. Malaysian polytechnic institutions adapted the holistic approach through the implementation of outcome-based education (OBE) (Ministry of Higher Education of Malaysia, 2011b). OBE focuses on designing learning contents to achieve the

desired cognitive, psychomotor and emotional (affective) outcomes. Cognitive and psychomotor skills are associated to the learning contents and curriculum whereas affective outcome deals with skills related to adapting to these contents. Affective outcomes are essential in dealing with stress and anxiety related to learning (Fazhuda, 2012). It also relates to how individuals manage situations emotionally such as interest, attitude, motivation, self-concept and behaviour while learning (Mohd Ghazali et al., 2008). This repertoire of skill is similar with the definition of EI.

EI is an ability that applies emotions to enhance cognition for a positive outcome (Mayer, Roberts, & Barsade, 2008a). It is a form of intelligence where emotions are emphasised as the controlling factor in intellectual activities such as reasoning, learning, planning and perception (Chakraborty & Konar, 2009). According to Goleman (1995), 20 percent of a person's success are influenced by their intelligence quotient (IQ) and the balance 80 percent depends on skills that develop their EI. Hence, individuals with high levels of EI portray a high degree of self-motivation, self-reflection, self-awareness and self-knowledge of their emotions (Caust, 2008). Thus, by acknowledging EIs benefits, the Malaysian Education Blueprint 2013-2025 also highlighted EI as an important skill in developing leadership abilities. The Ministry of Education of Malaysia (2012), defined it as an "ability to understand and work effectively with others and to influence others positively" (pp.2-7). Therefore, enabling students to thrive globally and be concurrently educated as per the national philosophy of education (Aminuddin, Tajularipin, & Rohaizan, 2009).

For engineering graduates, EI helps them gain employment and achieve successful careers (Riemer, 2003) since it helps to build confidence, motivation, self-discipline,

self-regulation and leadership skills (Zeidner, Matthews, & Roberts, 2009). Zeidner et al., (2009) added that even if students have adequate cognitive ability, lacking of EI may have negative influence on their academic achievement. This is because learning requires emotional management (Darling-Hammond et al., 2003) and EI is *one* of the solutions in managing emotions related to learning (Aminuddin et al., 2009; Caust, 2008). In the context of e-learning, students with high EI are more intrinsically motivated and independent compared to students with low EI (Arockiam & Selvaraj, 2011; Behnke & Greenan, 2011). Concurrently, the adaption of technology in the classroom itself has benefited EI development especially through self-regulation, self-awareness, self-motivation, social awareness and relationship management related to e-learning activities (Furger, 2014; Pappas, 2015). Therefore, it is apparent that the creating an emotionally sound e-learning environment is critical (Akbiyik, 2010; Allen, 2007).

Emotion and e-Learning

The relationship between emotions and computers was first penned by Rosalind Piccard in 1997 and is called "Affective Computing". It defined a field of computing that relates to, arises from, or influences emotions. Piccard (1997) established that emotions in computing not only affects the cognitive process but also has major impact on information processing and communication skills of the user. Emotional design applies the same concept where attractive and relevant multimedia stimulus are used to influence students' emotion (Um, Plass, Hayward, & Homer, 2011) thus foster positive learning outcomes emotionally and cognitively (Dong, 2010; Ghali & Frasson, 2010; Khairudin, Givi, Wan Shahrazad, Nasir & Halim, 2011; Um & Plass, 2009). In this context, multimedia as a stimuli have been found to be a suitable method

in inducing emotions in multimedia-based learning in comparison to using instructions (Chaffar & Frasson, 2004; Dong, 2010; Plass, Heidig, Hayward, Homer, & Um, 2013; Teixeira, Vinhas, Reis, & Oliveira, 2009) as it helps promote positive human computer interaction (HCI) (Knautz, 2012; Mahlke, 2005).

Multimedia elements such as text, graphic art, sound, animation, and video (Parhar, 2003) simulates various human senses (Neo, Neo, & Yap, 2008) which in return defines their aesthetic perception (Hekkert, 2006). The use of aesthetics in designing learning tools have gained a solid place in the academic circles (Tractinsky, 2013) and concurrently in e-learning development (Parizotto-Ribeiro & Hammond, 2005; Tharangie, Kumara, Jayasinghe, Marasinghe, & Yamada, 2008). It is the core of emotional design (Miller, Veletsianos, & Hooper, 2006), which is the primary focus of this study. Emphasising emotions in the design and development of e-learning tools are crucial (Charoenpit & Ohkura, 2013) especially now as we approach a new era of teaching and learning with technology. In the next section, research gaps in the area of emotional design in multimedia-based learning are discussed.

1.3 Problem Statement

The great problems of education are social and moral nature and have nothing to do with dazzling new technologies.

Neil Postman

Graduates from polytechnic institutions in 2011, contributed 50 percent of the nation's unemployment of technical graduates because they lack ICT skills, ethics, confidence and workplace adaption (Ahmad, Asri, Suhaili, & Jaslina, 2013). Inadequate soft skills

and unemployment were found to be linked to emotional issues such as anxiety and self-motivation related to polytechnic engineering students learning capabilities (Mohd. Effendi & Ahmad Zamri Khairani, 2013). Firstly, engineering education in Malaysian polytechnics have been found to be un-engaging and negatively affected students' motivation and happiness (emotions) (Safiah Omar et al., 2013). It was reported that a majority of polytechnic students (electrical engineering students) found that the e-learning materials used were unsatisfactory, not up to their likings and unattractive with boring contents (Subramaniam, Norazah, & Krishnan, 2013).

Consequently, to develop and design the contents of the courseware for this study, the course EE503-IC Fabrication and Packaging Technology was selected. The reason behind the selection is based upon: (a) the syllabus highlighted that the delivery of information for the topic 'Silicon and wafer preparation' should be implement through interactive lectures and videos (Ministry of Higher Education of Malaysia, 2011c, p.11) therefore, as highlighted in the curriculum (Isman, Abanmy, Hussein, and Al Saadany, 2012); (b) a survey (Appendix A) done on 30 students from the December 2012 session concluded that more than 50 percent of the respondents selected the topic as a difficult topic; (c) based on the quiz results from three semesters, students performed the poorest for this topic especially for the December 2012 and June 2013 session. Hence, based on these three reasons, there was a need to develop an e-learning tool for this topic, which is concurrently the first objective of this study.

Secondly, as the development of the e-learning system requires the integration of multimedia elements, thus the discussion focused on the choice and selection of elements that will be able to promote meaningful learning. There is a research gap on

how multimedia influences emotions (Heidig, Müller, & Reichelt, 2015; Saadé & Kira, 2009) and how students' individuality effects this relationship (Moneta & Kekkonen-Moneta, 2007). Emotionality in the context of human computer interaction (HCI) is new (Whang & Lim, 2008; Zeng, Pantic, Roisman, & Huang, 2009) and was a largely neglected field in e-learning (Afzal & Robinson, 2010; Leutner, 2014). Nevertheless, it was suggested that one possible solution of exploring emotions is by understanding how multimedia aesthetics affects these emotions (Dong, 2007). Aesthetics deals with the attractiveness of an object (Norman, 2004). Therefore, it relates to likability, satisfaction and motivation when interacting with the learning tool (Dong, 2010). However, there is insufficient literature on the effects of aesthetics in multimedia learning (Heidig et al., 2015) which is the basis of research on emotional design in multimedia learning. Emotional design has been successfully implemented in product design and its application has just been extended to multimedia aesthetics in e-learning (Mayer & Estrella, 2014). However, most research on aesthetics and emotional inductions in multimedia focuses on the impact of inducing positive emotions (Heidig et al., 2015; Plass et al., 2013) and therefore neglected exploring the effect of induced negative emotions through negative aesthetics (Dong, 2007; Tractinsky, 2013) especially in multimedia-based learning (Dong, 2007; Heidig et al., 2015). This is therefore the second objective of this study.

In addition, Leutner (2014) also explains that there seems to be a shift from just investigating cognitive aspects (prior knowledge and learning preference) towards incorporating non–cognitive traits (emotions and motivations) as also highlighted by the Cognitive Affective Theory of Learning with Media (CATLM). CATLM, which is an expansion of Cognitive Theory of Multimedia Learning (CTML), integrates

motivational and meta-cognitive factors that mediates multimedia learning (Plass et al., 2013). Therefore, underlining the motive of emotional design in multimedia learning which is to investigate designs that satisfies, motivates and improves learning outcomes hence the third objective of the study. It was also highlighted that there is a research gap on how emotions effected learning outcomes especially in engineering education in Malaysia (Tahira Anwar, Maizam, Mohd. Jahaya, & Zainal Abidin, 2014).

Leutner (2014) also identified EI as an overall emotional trait that may affect e-learning. EI is a soft skill that is not only important in the working field (Najib, 2012; Noriah, Siti Rahayah, Izham, & Salleh, 2009) but has significant benefits in academic growth (Fayombo, 2012; Ogundokun & Adeyemo, 2010). In the context of e-learning, Han and Johnson (2012) claim that research on emotions, EI and how it effects students' online learning experience is still under-explored. There is also insufficient research on the effect of traits EI on Malaysian tertiary education (Nur Sakinah & Nooreen, 2013). This includes the effects of EI in an e-learning environment and how it effects learning outcomes (Afzal & Robinson, 2010; Behnke & Greenan, 2011). Therefore, the role of EI in multimedia-based learning is investigated as the fourth objective and in emotionally designed coursewares (interaction effect) as the last objective of the study. In addition, this study also expands the understanding of emotional design to eastern countries and also to technical-based education such as engineering as suggested by Mayer and Estrella (2014) and Plass et al., (2013). Research on emotional design in multimedia-based learning has mainly focused on western countries such as Germany and United States of America and in the field of

sciences. Therefore, based on these research gaps, the objectives of this study were identified.

1.4 Research Objectives

The research objectives for this study are:

i. To design and develop coursewares to learn the concepts of silicon and wafer preparation for the Diploma of Electronics Engineering students in Malaysian Polytechnics.

ii. To design and develop three coursewares which theoretically integrates emotional design principles that either induces positive, neutral or negative emotions in learning the silicon and wafer preparation topic.

iii. To investigate the effects of these coursewares towards students learning achievement, intrinsic motivation and satisfaction.

iv. To investigate the effects of emotional intelligence towards achievement, intrinsic motivation and satisfaction when learning with these coursewares.

v. To investigate the interaction effects between the coursewares and emotional intelligence towards achievement, intrinsic motivation and satisfaction.

1.5 Research Questions

This study was designed to answer research questions based on three categories that were derived from the main and interaction effects of the independent variable (positive, neutral and negative multimedia design) and moderator variable (EI) towards the dependent variables. Leutner (2014) claimed that emotional research in multimedia learning is best explored based on cause and effect compared to

correlations. Therefore, this study was developed as a quantitative based Quasi-experimental study and the following research questions are in line:

A. The effects of the independent and moderator variable on achievement

i. Is there a significant difference in achievement score between students using the courseware designed to induce positive (PosD), neutral (NeuD) or negative (NegD) emotions?

ii. Is there a significant difference in achievement score between high emotional intelligence (HEI) students compared to low emotional intelligence (LEI) students when learning with a courseware?

iii. Is there a significant interaction effect between the design types and levels of EI on achievement score?

B. The effects of the independent and moderator variable on intrinsic motivation

i. Is there a significant difference in intrinsic motivation score between students using courseware designed as PosD, NeuD or NegD?

ii. Is there a significant difference in intrinsic motivation score between high emotional intelligence (HEI) students compared to low emotional intelligence (LEI) students when learning with a courseware?

iii. Is there a significant interaction effect between the design types and levels of EI on intrinsic motivation?

C. The effects of the independent and moderator variable on satisfaction

i. Is there a significant difference in satisfaction score between students using courseware designed as PosD, NeuD or NegD?

ii. Is there a significant difference in satisfaction score between high emotional intelligence (HEI) students compared to low emotional intelligence (LEI) students when learning with a courseware?

iii. Is there a significant interaction effect between the design types and levels of EI on satisfaction?

1.6 Research Hypotheses

Hypotheses are predicted statements by the researcher to define the relationships in their study (Creswell, 2012). The following are the research hypotheses for this study:

H_0A_i: There is no significant difference in achievement score between students using courseware designed to induce positive (PosD), neutral (NeuD) or negative (NegD) emotions.

H_0A_{ii} There is no significant difference in achievement score between high emotional intelligence (HEI) students compared to low emotional intelligence (LEI) students when learning with a courseware.

H_0A_{iii} There is no significant interaction effect between the design types and levels of emotional intelligence on achievement score.

H_0B_i: There is no significant difference in intrinsic motivation score between students using courseware designed to induce positive (PosD), neutral (NeuD) or negative (NegD) emotions.

H_0B_{ii} There is no significant difference in intrinsic motivation score between high emotional intelligence (HEI) students compared to low emotional intelligence (LEI) students when learning with a courseware.

H_0B_{iii} There is no significant interaction effect between the design types and levels of emotional intelligence on intrinsic motivation.

H_0C_i: There is no significant difference in satisfaction score between students using courseware designed to induce positive (PosD), neutral (NeuD) or negative (NegD) emotions.

H_0C_{ii} There is no significant difference in satisfaction score between high emotional intelligence (HEI) students compared to low emotional intelligence (LEI) students when learning with a courseware.

H_0C_{iii} There is no significant interaction effect between the design types and levels of emotional intelligence on satisfaction.

1.7 Theoretical Framework

The purpose of theories is to aid in identifying concepts relevant to the research problems so that there is a focus in identifying a solution. The theoretical framework of this study is built upon four main theories; Cognitive Theory of Multimedia Learning (CTML) (Mayer, 2001, 2009, 2011a), Model of Multimedia, Story Elements, and Emotions (Astleitner, 2004), Cognitive Appraisal Theory of Emotion (Lazarus, 1991) and Theory of Emotional Design (Norman, 2004). The graphical representation of the theoretical framework is illustrated in the Vern intersection in Figure 1.1.

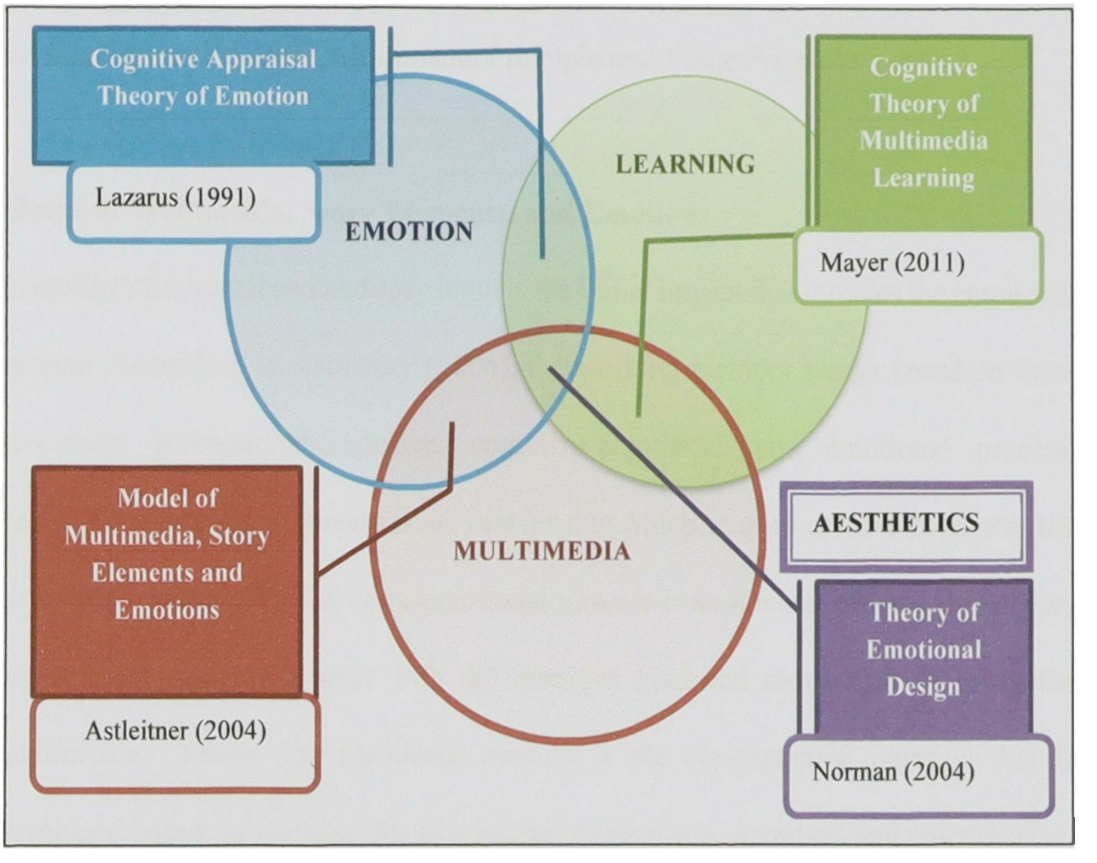

Figure 1.1: Graphical representation of the theoretical framework.

Cognitive Theory of Multimedia Learning

Cognitive Theory of Multimedia Learning (CTML) defines the relationship between multimedia elements and learning. Multimedia learning is learning that occurs from words and pictures that could either be from textbook, e-learning lessons with animation and narration (Mayer, 2009). Words could be presented either as screen text or as spoken text whereas pictures could either be static (photos and charts) or dynamic (videos and animations). Learning with multimedia occurs based on design techniques or principles that reduces extraneous processing by managing essential processing and fostering generative processing of the mind (Mayer, 2011a). The CTML principles applied in this study are Coherence Principle, Signalling Principle, Redundancy

Principle, Contiguity Principle, Segmentation Principle, Modality Principle, Personalisation Principle, Multimedia Principle and Voice Principle.

Model of Multimedia, Story Elements, and Emotions

In multimedia, visual and auditory input is the initial impact that initiates the emotional process. According to Astleitner (2004), the working memory works based on three processes; perceptional-cognitive, cognitive-emotional, and emotional process. Perceptional-cognitive process is the first level in which sensory arousal influences the cognitive process. The cognitive-emotional process is an internal process that occurs in the users mind and deals with the intended goal and motivation of using the multimedia. Lastly, the emotional process is the consequential emotion that is developed based on feelings due to appraisal of aesthetic, narration and enjoyment of using the multimedia. This model was used in this study to form the relationship between multimedia elements and emotions.

Cognitive Appraisal Theory of Emotion

Cognitive appraisal theory of emotion is sometimes referred to as the Lazarus theory and it defines emotions as the outcome of a person's appraisal on a situation (Nezlek, Vansteelandt, Van Mechelen, & Kuppens, 2008). According to Wirth and Schramm (2005), cognitive appraisal theory forms understanding on the psychology of emotions. There are various theories that explain how emotion initiates cognition however, the theory of Lazarus (1991) is a more general hypothesis that defines emotion from appraisal. People tend to appraise objects automatically (Demir, Desmet, & Hekkert, 2009) and similarly with situations that develops their emotional outcome

(Siemer, Mauss, & Gross, 2007). This theory implies that emotion is a product of cognition that is formed based on appraisal.

Theory of Emotional Design

According to Donald Norman's theory of emotional design, there is more to a product design than effectiveness and perception (Norman, 2004). He claims that every appealing design influences the user based on three levels; visceral, behaviour, and reflective. The first impression on the physical attributes of the product such as colour and smoothness is defined at the visceral level (Ho & Siu, 2009). Behavioural level is defined based on the usability and efficiency and lastly the reflective level is dependent on how a person relates to the product. Norman claims that users are more attracted to products that are attractive before considering functionality. Thus, suggesting the need for aesthetics in any product. In this study, aesthetic design is designing for visceral and experiential experience as suggested by Candi (2010). Integrating aesthetic value in the design of a multimedia learning system has potential to foster and promote positive emotions while learning (Dong, 2007; Um, 2008). This is the core purpose of the theory of emotional design as it links all major elements of this study (multimedia based e-learning, emotion, and cognition).

1.8 Research Framework

This study is divided into two parts: (a) the design and development of the courseware; (b) to investigate the effects of the independent variables on the dependent variables.

Design and development of the coursewares (treatment conditions)

The design and development of the coursewares are based on empirical studies on the type of multimedia elements that induce specific emotions (positive, neutral or negative). The contents of the multimedia tool are similar for all design but with variation in regards to colour, images and font type and size. The design and development of the coursewares are discussed in detail in Chapter 3.

Effects the IV and MV on the learning outcomes (dependent variable)

The independent variable in this study are represented by the coursewares namely positive, neutral and negative design. Whereas, the moderator variable is represented by two levels that is high and low EI. Lastly, the dependent variables, which are the learning outcomes, are measured based on achievement, intrinsic motivation and satisfaction. The justification in the selection of these variables and its levels are discussed:

i. **Independent variable.**

Emotions could be categorise based on valance (positive, neutral, negative), activation (excited, neutral, calm) and dominance (weak, neutral, strong) (Yan, Bracewell, & Ren, 2008). Thus, in this study valance is used to categorise emotions. Empirical studies in inducing emotions through multimedia learning such as by Heidig et al.,(2015), Mayer and Estrella (2014) and Um and Plass (2009) classified emotions as either positive, neutral or negative.

ii. **Dependent variable.**

- Achievement is measured to assess improvement in cognitive learning (Naidu, 2006). Norman (2004) described emotion and cognition as hand in hand, thus it is essential to include a cognitive assessment together with emotional assessments. Thus, in this study achievement is measured based on a 20-item objective posttest that was developed according to the EE503 syllabus.

- Intrinsic motivation is defined based on the theory that if a student enjoys an e-learning system, he or she will spend more time and effort with it (Saadé, Nebebe, & Mak, 2009) and perceive that they have improved after using the system (Eow et al., 2010; Youn, Chyung, Moll, & Berg, 2010). Research in emotional design focuses on emotion and motivational factors relevant to multimedia learning (Mayer & Estrella, 2014; Plass et al., 2013). Thus, in this study intrinsic motivation is measured based on Post-Experimental Intrinsic Motivation Inventory (IMI) (Deci & Ryan, 1985).

- Learning satisfaction is "students' joyful feelings or positive attitudes toward learning-associated activities" (Lee, 2008, p.45). Satisfaction has a strong effect on a student's intention of using an e-learning system (Liaw, 2008). Emotional design relates to satisfaction in using a product (Norman, 2004), thus learning satisfaction was selected as one of the learning outcome. Thus, in this study satisfaction is measured based on the E-learning Satisfaction (ELS) Inventory (Wang, 2003).

iii. **Moderator variable.**

Emotional intelligence (EI) is a skill that enables a person to manage emotions. In this study, it defines individuality of the sample through meta-cognitive characteristics. It is a skill that can be trained and developed in an educational setting and has proven to be beneficial towards learning and developing positive behaviour in the classroom (Saemah, Noriah, Zuria, & Ruslin, 2008). Thus, in this study EI is measured based on the Traits Emotional Intelligence Questionnaire – Short Form (TEIQue-SF) (Petrides & Furnham, 2006).

Based on these variables and theories, Figure 1.2 illustrates the research framework of this study. The framework represents the relationship between the fundamental theories as described in subtopic 1.7, instruction design (ID) theory (Gagne's Nine Events of Instructions), ID model (Frey and Sutton's Model for Developing Multimedia Learning Project) and the research variables. The four fundamental theories were applied to establish the foundation and relationships in regards to designing the courseware intended to induce emotions through multimedia aesthetics. The ID theory establishes the learning theory used for the purpose of knowledge transfer in the development of the courseware. Whereas, the ID model defines the procedures involved in the development of the courseware to ensure the learning objectives of the courseware are achievable. Lastly, the conceptual framework of the study which is represented by the variables (independent, moderator and dependent) highlights the relationship between the problem statement and research objectives.

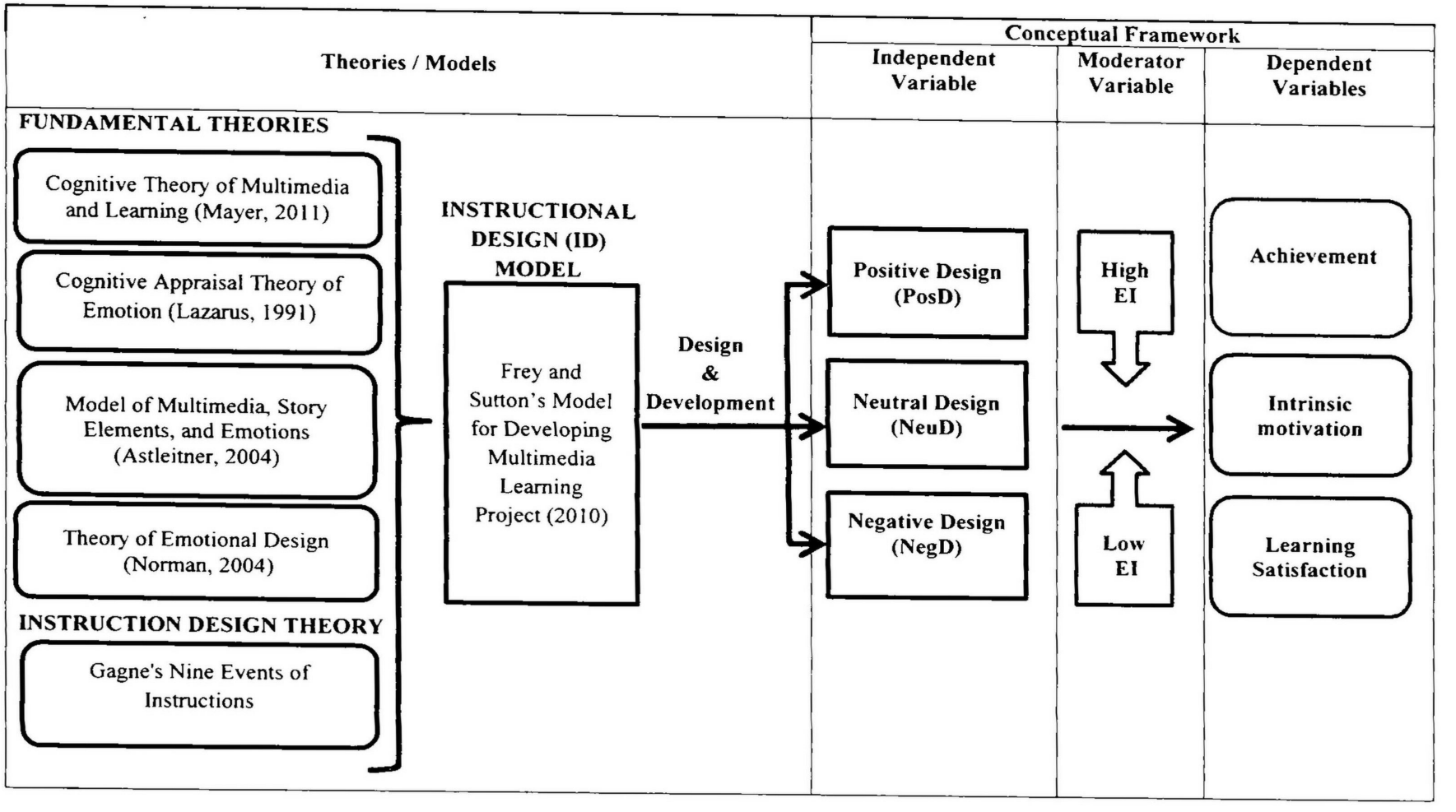

Figure 1.2: Graphical representation of the research framework of the study.

1.9 Significance of the Study

Firstly, there is no clear picture on how ICT and e-learning should be integrated in the Malaysian polytechnic system (Siti Noridah, 2012). However, due to national plans such as DePAN, the Malaysian polytechnic's curriculum has been amended to integrate interactive contents effective from 2011. Hence, e-contents were delivered to students through the learning management systems that are mostly non-interactive e-learning tools that consist of PowerPoint Slides, Word and Excel files and sometimes videos. It is a start, but is it satisfying and motivating to polytechnic engineering students that are mostly field independent learners (Ahmad Rizal & Mohd. Noor Hashim, 2011)? Does the type of design foster and promote positive emotional and cognitive outcome help students build confidence and competence in using these ICT tools?

To answer these questions, this study seeks to contribute to the understanding of the relationship between emotions, e-learning, emotional design in multimedia learning and EI for polytechnic engineering students. Emotional design in multimedia learning aims at fostering positive learning outcome cognitively and affectively. Empirical studies in this field by Dong (2010), Heidig et al. (2015), Mayer and Estrella (2014), Plass et al. (2013) and Um et al., (2011) have established that aesthetically pleasing visual design does improve learning outcome however, the findings were contradicting and mostly related to western respondents and biology based subjects. In addition, studies have mostly focused on comparing the effects of positive and neutral design; therefore neglecting the potential benefits of negative aesthetics in learning. In regards to the theoretical contribution of this study, the findings will add to the body of knowledge relating to CATLM (Roxana Moreno & Mayer, 2007). The CATLM theory

was applied by implementing emotional design as a motivational factor and EI as a meta-cognitive factor. This is also in accordance to Leutner's (2014) claims that there is a growing body of research relating to identifying how meta-cognitive traits such as openness, anxiety and conscientiousness influences motivations and emotions related to multimedia features. When student's motivation affects multimedia learning, identifying emotional factors that engage students in multimedia learning has been found to be critical (Leutner, 2014; Mayer, 2014). Additionally there is a need to identify and implement design strategies for an emotionally sensitive e-learning system (Lee, 2012a). According to Park, Knörzer, Plass, & Brünken (2015), emotional state is an important factor in understanding multimedia learning and should be considered in any future research. Therefore, this study investigates the effects of emotional design in regards to engineering based education in Malaysian polytechnic in improving the emotional adaption to e-learning tools and how it cognitively influence learning outcome especially through the integration of CATLM.

Concurrently, the effect of EI in multimedia learning and how aesthetics are perceived will also be highlighted in this study. Thus, it will streamline towards how emotional design and EI could possibly be a solution in regards to understanding how multimedia visual appeal influences polytechnic students' adaptation and learning outcome. Basically, e-learning helps develop EI (soft skills) and ICT skills by challenging students to cope with ICT innovation (Intel, 2012). Pappas (2015) added that e-learning developers should not just address learners' emotions while learning but also should look at how to develop students EI while learning online. Thus, by integrating EI and emotional design in the development of the courseware, this study will investigate the effects of polytechnic students' individuality in regards to achieving

positive learning outcome cognitively and affectively. This is crucial as one of the main issues highlighted in regards to unemployment among polytechnic graduates are lacking of adaptation skills relevant to online and personal skills.

From the practical contribution perspective, this study will be beneficial mainly to students, lecturers and polytechnic curriculum developers. The outcome of this research will explore the effects of EI and if it should be integrated into the polytechnic curriculum especially in the area of e-learning development. This study will set the foundation for more studies relating to exploring interface design strategies that will appeal to polytechnic engineering students especially with different levels of EI. Empirical research have found that EI influences how users perceive aesthetics, thus this study investigates this aspect especially in regards to engineering education. Therefore, the findings will be beneficial for the Centre for eLearning and Teaching of the Curriculum Development and Evaluation Section of the Department of Polytechnic Education. Hence, by understanding how visual design strategies influences learning outcome, the goals of the National Higher Education Action Plan Phase 2 (2011 - 2015) which is to promote and positively expose staffs, lecturers, students and stakeholders towards the culture of e-learning and the motivational power of emotion could be achieved. Lastly, this study fulfils Berry (2011) claim that to groom students for the times ahead, education should cover three main areas; develop intellectual competencies, foster socio-emotional skills and integrate technology in teaching and learning.