UNIVERSITI PUTRA MALAYSIA

PREDICTING TECHNOLOGY UTILISATION OF LEARNING MANAGEMENT SYSTEM AMONG MALAYSIAN POLYTECHNIC STUDENTS

NORHAFIZAH ISMAIL

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By

NORHAFIZAH BINTI ISMAIL

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

December 2017
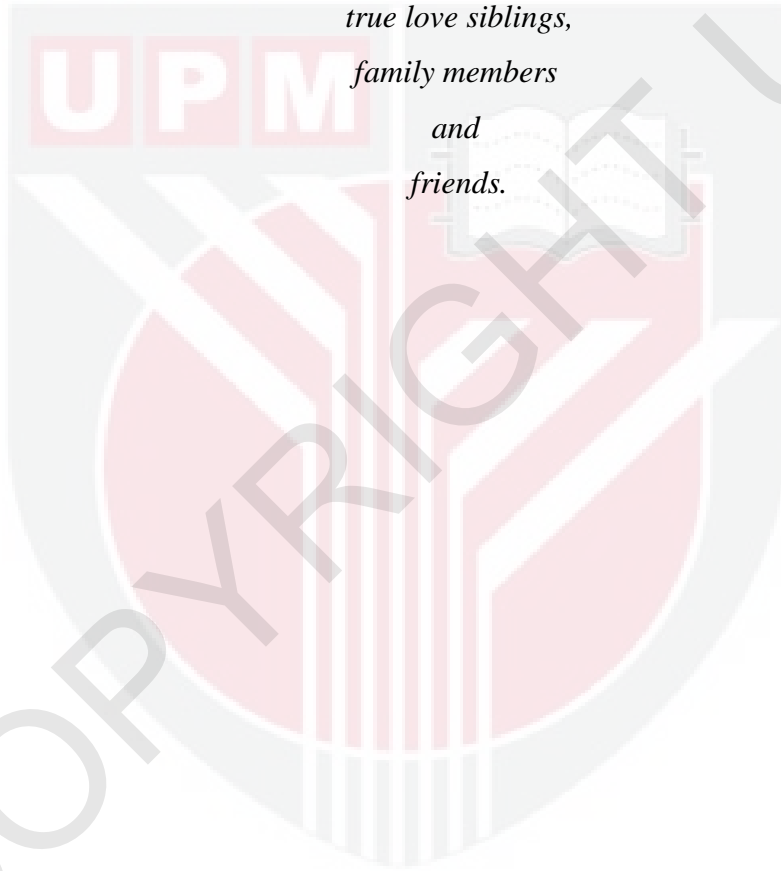
DEDICATION

Bismillahirrohmanirrohim

This endeavor is dedicated to Allah S.W.T , The Prophet Muhammad SAW,
my beloved late father, Allahyarham Hj Ismail Ahmad,
beloved mother, Hjh Hatimah Hadirun,
kind and supportive husband, Nazid Sarji,
sweet daughter, Nurnazlah Fatnin Nazid,
true love siblings,
family members
and
friends.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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Chairperson : Associate Professor Ahmad Fauzi Bin Mohd Ayub, PhD
Faculty : Educational Studies

The major purpose of the current study is to identify the predicting factors, mediators and moderators towards effective technology use of Curriculum Information Document Online System (CIDOS) Learning Management System (LMS) among full-time undergraduate diploma students of Engineering Department at Malaysian Polytechnics. The theories underpinning this study are Theory Reasoned Action (TRA), Technology Acceptance Model (TAM), Substitution, Augmentation, Modification and Redefinition (SAMR) model and Adaptive Structuration Theory (AST). There are six predicting factors involved; compatibility, application self-efficacy, subjective norm, technological complexity, perceived usefulness and perceived ease of use. Technology utilisation is a dependent variable which encompasses of consistency of use, as well as quality of use. Genders and level of integration are the moderators, meanwhile perceived usefulness and perceive ease of use are classified as mediators.

A pilot test was implemented on 100 undergraduate technical students of Politeknik Merlimau, Melaka (PMM) to measure the research instrument's reliability. The value of Cronbach' s alpha obtained ranged from 0.828 to 0.933. For the measurement model, Confirmatory Factor Analysis (CFA) was required to test the consistency of construct and determine construct validity. The present study was carried out on 372 second-year students from five polytechnics of Malaysia (Premier and Conventional) including Politeknik Ungku Omar (PUO), Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA), Politeknik Merlimau, Melaka (PMM), Politeknik Ibrahim Sultan (PIS) and Politeknik Port Dickson (PPD). The sampling technique used was two-stage cluster sampling.

The quantitative method with descriptive research was conducted by analysing the statistics of mean, standard deviation, percentage and frequency. The statistical analysis of Structural Equation Modelling (SEM), using AMOS Version 22, was utilised. Based on the measurement model testing, among the 10 paths, 9 were significant and only one was not. The 10 paths were: 1) compatibility positively effects perceived usefulness (β=.516, p<0.001); 2) application self-efficacy has no a significant effect on perceived usefulness (β=.105, p>0.05); 3) subjective norm positively effects perceived usefulness (β=.143, p<0.05); 4) technological complexity negatively effects perceived usefulness (β=-.165, p<0.01); 5) compatibility positively effects perceived ease of use (β=.322, p<0.001); 6) application self-efficacy positively effects perceived ease of use (β=.344, p<0.001); 7) subjective norm positively effects perceived ease of use (β=.158, p<0.01); 8) technological complexity negatively effects perceived ease of use (β=-.214, p<0.001); 9) perceived usefulness positively effects technology utilisation (β=.265, p<0.001); and 10) perceived ease of use positively effects technology utilisation (β=.343, p<0.001).

Based on the revised structural model, the main contribution for PU and PEOU was pertained to compatibility (β=.516, p<.001; β=.322, p<.001). The outcome of evaluation conceded that predictors TU could explain 67.7% of its variance. In the interim, the leading contribution was ASE (β=.344, p<.001) and followed by PEOU (β=.343, p<.001). The mediation test findings also revealed that among eight mediation tests, six were not supported (no mediation), and two met full mediation.

The findings of mediation test revealed that PU does not mediate the influence of C on PU; PU does not mediate the influence of ASE on TU; PU does not mediate the influence of SN on TU; PU does not mediate the influence of TC on TU; PEOU does not mediate the influence of C on TU; PEOU does mediate the influence of ASE on TU; PEOU does not mediate the influence of SN on TU and PEOU does mediate the influence of TC on TU. ASE fully mediates the influence of PEOU on TU and TC fully mediates the influence of PEOU on TU. Gender fully moderates the relationship between PU and TU since the standardized estimates for male is significant and female is not significant. Level of integration partially moderates the relationship PEOU and TU since the standardized estimates for Semester 3 and 4 are both significant.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

PERAMALAN PENGGUNAAN TEKNOLOGI SISTEM PENGURUSAN PEMBELAJARAN DALAM KALANGAN PELAJAR POLITEKNIK MALAYSIA

Oleh

NORHAFIZAH BINTI ISMAIL

Disember 2017

Pengerusi : Profesor Madya Ahmad Fauzi Bin Mohd Ayub, PhD
Fakulti : Pengajian Pendidikan

Tujuan utama kajian semasa ini untuk mengenalpasti faktor-faktor peramal, pengantara dan penyederhana terhadap penggunaan Sistem Pengurusan Pembelajaran bagi Sistem Dokumen Maklumat Kurikulum Atas Talian (CIDOS) dalam kalangan pelajar sepenuh masa diploma di Jabatan Kejuruteraan, Politeknik Malaysia. Teori-teori yang terkandung dalam kajian ini ialah Teori Tindakan Beralasan (TRA), Model Penerimaan Teknologi (TAM), Penggantian, Pengukuhan, Pengubahsuaian dan Pentakrifan Semula Model (SAMR) dan Teori Penstrukturan Penyesuaian (AST). Terdapat enam faktor-faktor peramal termasuk; kesesuaian, keberkesanan kendiri aplikasi, norma subjektif, kompleksiti teknologi, tanggapan kebergunaan dan tanggapan keselesaan penggunaan. Penggunaan teknologi ialah pembolehubah bersandar merangkumi penggunaan secara konsisten dan kualiti penggunaan. Jantina dan peringkat integrasi adalah penyederhana, manakala , tanggapan kebergunaan dan tanggapan keselesaan penggunaan dikelasifikasi sebagai pengantara.

Kajian rintis telah dijalankan ke atas 100 pelajar teknikal peringkat diploma di Politeknik Merlimau, Melaka (PMM) untuk mengukur kebolehpercayaan instrumen kajian. Nilai alpha Cronbach yang diperolehi daripada 0.828 hingga 0.933. Bagi pengukuran model, Analisis Faktor Pengesahan (CFA) diperlukan untuk menguji konsistensi konstruk and menentukan kesahan konstruk. Kajian semasa telah dijalankan ke atas 372 pelajar Tahun Dua daripada lima buah politeknik di Malaysia (Premier dan Konvensional) termasuk Politeknik Ungku Omar (PUO), Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA), Politeknik Merlimau, Melaka (PMM), Politeknik Ibrahim Sultan (PIS) dan Politeknik Port Dickson (PPD). Teknik persampelan yang digunakan adalah persampelan secara kelompok dua-peringkat.

Kaedah kuantitatif dengan kajian deskriptif telah dijalankan melalui analisis statistik min, sisihan piawai, peratus dan frekuensi. Analisis statistik Permodelan Persamaan Berstruktur (SEM), menggunakan AMOS Version 22, telah digunakan. Berdasarkan pengujian model pengukuran, daripada 10 laluan, 9 adalah signifikan dan 1 laluan tidak signifikan. Sepuluh laluan-laluan tersebut adalah: 1) kesesuaian memberi kesan signifikan secara positif terhadap tanggapan kebergunaan (β=.516, p<0.001); 2) keberkesanan kendiri aplikasi tidak memberi kesan signifikan secara positif terhadap tanggapan kebergunaan (β=.105, p>0.05); 3) norma subjektif memberi kesan signifikan secara positif terhadap tanggapan kebergunaan (β=.143, p<0.05); 4) kompleksiti teknologi memberi kesan signifikan secara negatif terhadap tanggapan kebergunaan (β=-.165, p<0.01); 5) kesesuaian memberi kesan signifikan secara positif terhadap tanggapan keselesaan penggunaan (β=.322, p<0.001); 6) keberkesanan kendiri aplikasi memberi kesan signifikan secara positif terhadap tanggapan keselesaan penggunaan (β=.344, p<0.001); 7) norma subjektif memberi kesan signifikan secara positif terhadap tanggapan keselesaan penggunaan (β=.158, p<0.01); 8) kompleksiti teknologi memberi kesan signifikan secara negatif terhadap tanggapan keselesaan penggunaan (β=-.214, p<0.001); 9) tanggapan kebergunaan memberi kesan signifikan secara positif terhadap penggunaan teknologi (β=.265, p<0.001); dan 10) tanggapan keselesaan penggunaan memberi kesan signifikan secara positif terhadap penggunaan teknologi (β=.343, p<0.001).

Berdasarkan model berstruktur yang disemak, sumbangan utama bagi PU dan PEOU telah dihasilkan oleh kesesuaian (β=.516, p<.001; β=.322, p<.001). Penilaian dapatan menunjukkan bahawa peramal-peramal TU telah menjelaskan 67.7% daripada nilai variannya. Di samping itu, sumbangan utama juga diperolehi daripada ASE (β=.344, p<.001) dan diikuti oleh PEOU (β=.343, p<.001). Keputusan pengujian pengantara juga mendapati daripada lapan ujian pengantara, enam adalah tidak menyokong (tiada pengantara), dan dua mempunyai pengantara secara penuh. Hasil keputusan ujian penyederhana mendapati bahawa PU tidak menjadi pengantara pengaruh C terhadap TU; PU tidak menjadi pengantara pengaruh ASE terhadap TU; PU tidak menjadi pengantara pengaruh SN terhadap TU; PU tidak menjadi pengantara pengaruh TC terhadap TU; PEOU tidak menjadi pengantara pengaruh C terhadap TU; PEOU menjadi pengantara pengaruh ASE terhadap TU; PEOU tidak menjadi pengantara pengaruh SN terhadap TU dan PEOU menjadi pengantara pengaruh TC terhadap TU. PEOU menjadi pengantara secara penuh pengaruh ASE terhadap TU dan PEOU menjadi pengantara secara penuh pengaruh TC terhadap TU. Jantina menjadi penyederhana secara penuh bagi hubungan antara PU dan TU kerana anggaran piawai bagi lelaki adalah signifikan dan perempuan adalah tidak signifikan. Peringkat integrasi menjadi penyederhana secara separa bagi hubungan antara PEOU dan TU kerana anggaran piawai bagi Semester 3 dan 4 adalah signifikan.

iv

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I certify that a Thesis Examination Committee has met on 20 December 2017 to conduct the final examination of Norhafizah binti Ismail on her thesis entitled "Predicting Technology Utilisation of Learning Management System among Malaysian Polytechnic Students" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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Date: 28 March 2018

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the Degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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Committee: _____

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LIST OF EQUATIONS

LIST OF ABBREVIATIONS

AGFI	Adjusted Goodness of Fit Indicator
ASE	Application Self-Efficacy
AST	Adaptive Structuration Theory
BC	Bias Corrected
BIPD	Bahagian Instruksional dan Pembelajaran Digital
BIU	Behaviour Intention Use
BL	Blended Learning
BLX	Blended Learning Index
BPK	Bahagian Pembangunan Kurikulum
BPP	Bahagian Peperiksaan dan Penilaian
C	Compatibility
CALC	Centre for the Advancement of Language Competence
CeL	College E-Learning System
CeLT	Center for e-Learning and Teaching
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CIDOS	Curriculum Information Document System
CMC	Computer Mediated Communication
CMS	Course Management System
COP	Community of Practice
CSE	Computer Self-Efficacy
DePAN	Dasar e-Pembelajaran Negara
DPCCE	Department of Polytechnic and Community College Education
ESL	English-as-a-Second-Language
ET/LS	Electronic Teaching Learning System
FC	Facilitations Conditions
FMS	File Management System
FOSEL	French on Online Specific Objectives
FtF	Face-to-Face
GDSS	Group Decision Support Systems
GFI	Goodness of Fit Indicator
GPS	Global Positioning System
GSS	Group Support Systems

HEIs	Higher Education Institutions
ICT	Information Communication Technology
IHL	Institution of Higher Learning
ILKA	Institut Latihan Kemahiran Awam
IS	Information Systems
JISC	Joint Information Systems Committee
JPP	Jabatan Pendidikan Politeknik
KMS	Knowledge Management System
KPT	Kementerian Pendidikan Tinggi
LMS	Learning Management System
METrO	Maximising Education & Training Opportunities
METU	Middle East Technical University
MOE	Ministry of Education
MOHE	Ministry of Higher Education
MI	Mobile Internet
MIS	Management Information Systems
MSC	Multimedia Super Corridor
MQA	Malaysian Qualification Agency
MTUN	Malaysian Technical University Network
NFI	Normed Fit Index
OS	Organisational Support
OSS	Open Source Systems
ODL	Open and Distance Learning
OER	Open Educational Resource
OLR	Online Library Reference
ORI	Open Resource Initiative
PAH	Pedagogy, Andragogy and Heutagogy
PBL	Problem-Based Learning
PC	Personal Computing
PE	Prior Experience
PEOU	Perceived Ease of Use
PKS	Politeknik Kuching Sarawak
PLO	Program Learning Outcome
PLS	Partial Least Square
PMJ	Politeknik Mersing Johor

PMK	Politeknik Melaka
PMM	Politeknik Merlimau Melaka
PMS	Politeknik Mukah Sarawak
PIS	Politeknik Ibrahim Sultan
PPD	Politeknik Port Dickson
PPIP	Pusat Penyelidikan dan Inovasi Politeknik
PSA	Politeknik Sultan Salahuddin Abdul Aziz Shah
PSE	Perceived Self-Efficacy
PSP	Politeknik Seberang Perai
PTSB	Politeknik Tuanku Sultanah Bahiyah, Kulim
PU	Public University
PU	Perceived Usefulness
PUO	Politeknik Ungku Omar
RMSEA	Root Mean Square Error of Approximation
SAMR	Substitution, Augmentation, Modification and Redefinition
SB	Smart White Board
SCL	Student Centered Learning
SCORM	Shareable Content Object Reference Model
SLT	Student Learning Time
SMS	Short Message Services
SN	Subjective Norm
SNSs	Social Network Sites
SNTs	Social Networking Technologies
SEM	Structural Equation Modeling
SIRIM	Standards and Industrial Research Institute of Malaysia
SPM	Sijil Pelajaran Malaysia
SQ	System Quality
TAM	Technology Acceptance Model
TC	Technological Complexity
TE	Task Equivocality
TLA	Teaching and Learning Activities
TLI	Tucker-Lewis Index
TML	Technology Mediated Learning
TPB	Theory Plan Behaviour
TRA	Theory of Reasoned Action

TTF	Task-Technology Fit	
TU	Technology Utilisation	
T&L	Teaching and Learning	
TVET	Technical, Vocational, Educational and Training	
UKM	Universiti Kebangsaan Malaysia	
UNESCO	United Nations Educational, Scientific and Cultural Organization	
UPM	Universiti Putra Malaysia	
URL	Uniform Resource Locator	
UTAUT	Unified Theory of Acceptance and Use of Technology	
UTM	Universiti Teknologi Malaysia	
UUM	Universiti Utara Malaysia	
VLE	Virtual Learning Environment	
WIMD	Wireless Internet via Mobile Device	
WWW	World Wide Web	

CHAPTER 1

INTRODUCTION

1.1   Background

In the current years, Information and Communication Technology (ICT) has grown tremendously that it requires the educational entities to apply instructional technology as a tool, specifically electronic tool (Roblyer & Doering, 2010). Similarly, effort to incorporate ICT in educational system is imperative (Fernandez, 2013). The facilities, including blogs, are vital learning platforms to stimulate techno-savvy learners and problem solving skills in collaborative environment (Kwok & Neo, 2015). Furthermore, students prefer to widely employ ICT facilities in Web 2.0 such as Twitter, Facebook, Prezi, Youtube, as well as WordPress, that promise clear instructional technology for pre-service teachers in the subsequent lecture mode (Hamdan, Din, Abdul Manaf, Mat Salleh, Kamsin, & Ismail, 2015). Hence, effort to incorporate instructional technology like training and support of policy makers, as alternative mechanisms in teaching and learning, is required to enhance ICT use effectively (Archer, Savage, Sanghera-Sidhu, Wood, Gottardo, & Chen, 2014).

The purpose of ICT and Web 2.0 is to provide significant potential on educational process by facilitating inquiry, literacies, publication and collaboration (Ferguson, Faulkner, Whitelock, & Sheehy, 2014). Complementary to these, the process of augmenting educational access and its features can be implemented through ICT. From the context of meaningful learning, Web 2.0 has been used to encourage active learning and give significant impacts in learning process (Hamdan *et al*., 2015). Previous research involving Web 2.0 has highlighted the experiences in evaluating the assignment and provided advantages and challenges to increase students' performance, literacy outcomes and learning concentration (Williams & Chinn, 2009). The perceived enjoyment in using Web 2.0 among participants has enthralled session of teaching internship in communication technology course (Kim & Jang, 2015). This experience has indicated improvement in students' motivation, as well as effectiveness in group work and technology integration competence in the existing curriculum. Hence, Web 2.0 tools are useful applications to produce excellent networking and strengthen collaborative efforts and meaningful experiences.

One of the well-known recognitions of ICT is as a mechanism to foster the strength, capability of teaching, as well as boost students' knowledge (Moses, Khambari, & Luan, 2008; Luan, Atan, & Sabudin, 2010; Afshari, Bakar, Luan, Samah, & Fooi, 2008). In order to bring significant transformation into learning surroundings,

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computer technology has performed as a tremendous and influential device. Obviously, this technology generates improvement, provides added value and inculcates students' motivation to pursue learning in educational environment (Fridin, 2014). ICT has been highlighted in the speech of the former Malaysian Education Minister, Tan Sri Muhyiddin Yassin, during the event of Digital Education Show Asia. As a responsible net citizen in Malaysia, digital literacy is vital as it involves ethical issues. In addition, the announcement made about the establishment of 7,000 additional WiMax Tower, together with 3,000 more in the near future, provides benefits to the schools that have 7 000 from 4G Virtual Learning Environment (VLE). This shows a positive influence in the arena of national education ICT.

The Learning Management System (LMS) delivery method was introduced in the early 1990s (Coates *et al*., 2005). Since the implementation, it has provided beneficial in an educational setting, with many educational institutions are taking the opportunity to increase the usage of the system (Islam, 2013). Likewise, the management team needs to plan various strategies when LMS is selected as one of the teaching delivery methods. In recent years, LMS becomes a preferred and famous application in Higher Education Institutions (HEIs) due to its high valuable implications (Álvarez, Martín, Fernández Castro, & Urretavizcaya, 2013; Dutta, Roy, & Seetharaman, 2013; Islam, 2013). Among other, LMS is used in hybrid learning surroundings to integrate collaborative and interactive learning activities (Dias & Diniz, 2014).

In addition, it is implemented with strong institutional support as well as sociocultural effort from various stakeholders. In order to access learning contents, web-based LMS is deployed (Nagy, 2016). In order to promote students' engagement, self-regulated and self-directed learning, attempting an effective communication management is required in distance learning setting. This management entails two components, namely, communication practice and communication tools (Kayode & Hashim, 2014). The first component involves communication practices via interactive tools and contents such as electronic mails, chats and video conferencing, quizzes, Problem-Based Learning (PBL) questions and response. Meanwhile, the latter entails LMS which performs as a communication tool, fosters students' autonomy, involvement, interactions and enthusiasm. Furthermore, new LMS systems have generated an active education, according to the read-write web.

In this context, some vital facilities such as chat, forum, wiki, downloading and uploading, e-portfolio and teamwork have been employed. The emergence of OSS (Open Source Systems) has changed the present situation and it continues to become commercialised system in an educational market (Babo & Azevedo, 2012; Jenkins *et al*., 2011; Arroway *et al*., 2010; Davis *et al*., 2009; Wheeler, 2004; Bradley *et al*., 2007). In Malaysia, the Ministry of Higher Education is committed in the implementation of new media technologies into academic activity. Among other, *Dasar e-Pembelajaran Negara* (DePAN) was introduced to provide quality and appropriate e-learning framework to develop world-class human capital, especially in

ICT and education services (DePAN, 2010). As a national e-learning policy, it was built to yield quality and flexible learning strategies among educational entities. Then again, it moulds the public and private university graduates to be competitive and collaborative in the global context.

In the past decade, Malaysia has spent more than RM6 billion on ICT including Smart Schools initiative (Abdullah, 2006; MSC, 2010a). The rest of the ICT programmes are related to Smart School's education courseware (Halim, Zain, Luan, & Atan, 2005), as well as instructor course and professional training (Shaharuddin & Abiddin, 2009). However, 80% of the instructors spend no more than an hour a week employing ICT (MOE, 2010). Furthermore, ICT is only used in academic session only for word-processing applications even though it has excellent potential to enhance the range of knowledge and thinking skills (UNESCO, 2012) and provide significant roles in the new technology integration in education (MOE, 2007a, 2007b; MOE, 2012a, 2012b; MSC, 2005 & MSC 2010a). In order to integrate ICT, the instructors ought to be assertive and not be complacent with the technology introduced in their teaching. For this purpose, they need to put a lot of effort to learn how to use the hardware and software required in the educational institution (Ali, Nor, Hamzah, & Alwi, 2009). Therefore, an outstanding integration of the new media technology in education is affected by institution's policy and instructors' knowledge and capability of this media tool (Ismail, 2015).

The implementation of ICT in the effort of enhancing learning quality across Malaysia has been started to provide virtual learning surrounding and internet access through 1BestariNet programme that includes 10,000 schools. Besides, it augments online excellent practices and contents such as video library of the best instructors delivering lessons for distance and self-paced education (DePAN, 2010). In Malaysia, there are three major ICT policies as highlighted by the Ministry of Education; ICT for all students, the role of ICT as educational tool and utilisation of ICT to enhance productivity, efficiency and effectiveness (UNESCO, 2003). Similarly, based on the Ninth Malaysia Plan in 2006-2010, the effort to bring the country into a division educational focal point was done in order to build smart public-private cooperation (Kaur *et al*., 2008, p. 1). Pre-service teachers need imperative skills to boost the quality of their delivery method and increase way of managing the information gained. The knowledge and skills can be grasped by utilising the ICT in such educational environment to obtain meaningful practice for career development (Baleghi-Zadeh, Ayub, Mahmud, & Daud, 2014).

In 1996, the first effort to introduce the LMS approach started with Malaysian Public Universities (Puteh, 2007). To begin with, the teaching and learning sessions were conducted with a few subjects. Nowadays, the strengthened strategies are still continued by Malaysian universities using their own management and approach (Ayub, Tarmizi, Jaafar, Ali, & Luan, 2010; Lee, Chan, Thanimalay, & Lim, 2012). In addition, the full participation of users in LMS, which entails specifically the interaction and communication between students and lectures, is important during the learning sessions. Motivating learners using an e-learning platform (SPeCTRUM) has since become a major factor. This participation is called co-participatory

activities (Ghavifekr & Mahmood, 2015). The intention of using SPeCTRUM as LMS requires a collaborative process to ensure continuous involvement. In order to assess technology success of LMS, Accuosti (2014) emphasised a few determining factors for effective educational technology utilisation in the recent research. These include teachers' requirements, technology materials and functions, students' needs and social environment.

1.2   LMS in Higher Education

The growth of Web 2.0 technology such as LMS Moodle under blended learning context provides promising rich education surroundings and influences the attitude of users' interaction (Dias & Diniz, 2013). Active learning surroundings in Web 2.0 encourage students to contribute ideas and provide quick responses of learning material. Although conventional learning methodology is still a major delivery format, many educational institutions have widely been equipped with the LMS application in the last few years. It performs as a platform of education, web portal, content management system and course management system (Piotrowski, 2010).

By using the LMS, educators have flexibility and convenience to produce online lecture materials for their students. Although this can be done regardless of the geographical areas and time factor, technique to release the materials should be carefully considered (Poon, 2013). From the context of HEI, a research on LMS projects by Lyashenko and Frolova (2014) revealed an effective and useful platform of intergenerational e-learning. Besides, it enhances higher education institution educators' ICT competency. The technology use in LMS projects stimulates the intergenerational learning collaboration as it provides training sessions and this proves that the product has the potential to become an outstanding virtual platform.

In the Malaysian context, institutions of higher learning are required to consider on the feasibility and compatibility of LMSs due to the fact that the educational system mainly involves in core business of teaching and learning (Embi, 2011; Embi, Hamat & Sulaiman, 2012). Similarly, HEI needs to narrow down the attention to elements of mechanical learning like assessment and technique of content delivery. The central theme of LMS specification needs to be clearly described as it is a vital part to energise and actuate creative learning and knowledge transfer. The content delivery of online courses in HEI using own computers (94.2%) and the network of campus wireless (63.7%) indicated as necessary of access to LMS method (Embi & Adun, 2010).

In 2009, LMS was used at Limkokwing University as an essential platform to convey learning materials, track the students' achievement and financial matters. Specification of LMS covers the use of electronic library in order to gain advance information in learning (Salem & Salem, 2015). Research conducted at Universiti Utara Malaysia (UUM) has indicated that LMS compatibility is essential for course

contents such as for retrieving and viewing, and continuous interactions. Nonetheless, support of helpdesks, stabilised linking to important hubs is still not commonly used among undergraduates (Sam, 2015). The e-learning acceptance and satisfaction studies at Universiti Teknologi Malaysia (UTM) encompass a virtual platform to upload notes, slides and learning tasks in order to activate e-discussion and knowledge-sharing activities in interactive surroundings (Masrom, 2007; Razak, 2010). More importantly, the type of instructional technology used has influenced the teaching and learning strategies in the LMS environment. Meanwhile, Polytechnic students preferred utilising ICT applications like online lectures, computer simulations, audio and video streaming, as well as Power Point presentations (Kumar, Muniandy, & Yahya, 2014).

The design of LMS, such as Blackboard and Moodle, was developed based on educational settings (Abdelhakim, & Shirmohammadi, 2008; Terawaki, 2009). It has major elements in decision support models that focus on internet functional and technical requirements. Black *et al*. (2007) identified LMS as appropriate and consistent products that cover universal mechanisms like e-quizzes, e-assessment, active interactions and association spaces. Furthermore, LMS implementation encourages the essential process of decision-making in peer organisations' case studies. As a conclusion, more efforts ought to be taken to stimulate wider adoption of ICT in the teaching and learning component.

LMS provides tools to communicate among users whether in or out of campus. Tools such as forum, e-assignment and e-content enhance the features to enthral active learning. Previous research by Salam, Mohamad, Bakar and Sui (2014) emphasised that Polytechnic students have good strength in visual-spatial and verbal-linguistic intelligences. Activities in LMS need to consider online multiple intelligence (MI) teaching activities. The issue focused on assisting educators to develop self-education materials to accomplish impressive Teaching and Learning (T&L) session will ensure consistent usage and continuous interactions between lecturers and students. Most importantly, the existing LMS services (Hamat, Embi, & Sulaiman, 2011; Pérez, Menéndez, Gutiérrez, Rosário, Alba, & Fernández, 2011) can be classified into two types. The first category is open-source, which can be downloaded freely by anyone. Meanwhile, commercial is the second category which normally comes with high cost (Perez *et al*., 2011). Malaysian Polytechnics have their own LMS known as CIDOS (Curriculum Information Document Online System). It was developed by the Department of Polytechnic Education to increase the number of users adopting this technology mediated learning. Nevertheless, several studies have indicated that educational entities are not consistently used and involvement in technologies and IT usage is still generally low (Chiu *et al*., 2005; Klobas & McGill, 2010; Osang, Abinwi, & Tsuma, 2015).

1.3   LMS Adoption

Technology adoption can be referred as a process of ICT mediated teaching and learning system acceptance among educational society (Wu & Liu, 2013). Similarly,

the process involves students, instructors, as well as teaching materials, during the academic sessions. Past researches have highlighted that cognitive style fairly moderates the implications of ease of use on technology adoption behaviour for analytical-typed subjects. In particular, it continues to deploy facilities such as discussion forum to foster interactive acquisition of knowledge and support the animation development as teaching tools (Chen & Li, 2010; Wu *et al.*, 2010).

The preference over advanced ICT has opened the potential of LMS adoption in education. It is exciting to apply innovation materials and techniques like game-based learning system (Paraskeva *et al.*, 2010) in an interesting environment and assist the flow of teaching and learning (Owston *et al.*, 2009). Hence, playfulness becomes a predictor of innovation technology use through interactions of human-computer (Owston *et al.*, 2009; Paraskeva *et al.*, 2010; Bertacchini *et al.*, 2012). Recent research of Islam (2013) revealed the findings of 48.2% users in education using mobile LMS. Meanwhile, almost 80% applied mobile devices. Technology devices are handy and easily grasped by youngsters. According to Eow, Wan Ali, Mahmud, and Baki (2009), children at the age of thirteen have already acquired knowledge about and experiences with digital media in their learning situation. In addition, engaging surroundings are noticeable factors in encouraging technology digital media use in LMS adoption.

However, non-users of mobile LMS have a different viewpoint. Complexity and resistance are factors of failure in adopting the mobile LMS (Wu, Wu, Chen, Kao, Lin, & Huang, 2012). In addition, instructors do not utilise the features of LMS much due to certain characteristics of instructor's interactions which entail time, knowledge, infrastructure, skills, interest and procedures (Hashim & Hisyam, 2006). The interactive innovations such as online instructional strategies, content, time, interest, facilities, knowledge and skills also determine the LMS adoption among students. In the context of teaching practices, the academic staff in Community College have been exposed to instructional design and recommendations to improve technology adoption in the classroom by the institution (Azlim, Amran, & Rusli, 2015). Nevertheless, the relevant infrastructures such as the internet, computer technology and technical foundation need to be provided appropriately.

The establishment of Department of Polytechnic and Community College Education (DPCCE) in 2004 has formed an imperative role to support government policies. It has been monitored by the Ministry of Higher Education (MOHE) to produce improved teaching and learning delivery and set up an impressive nation that is embedded in knowledge, culture and civilization in the context of higher education sector. After the transformation and re-branding of Technical Vocational Education Training (TVET), within five years beginning from 16th September 2009, two different departments have been established; Department of Polytechnic Education and Department of Community College Education. In this phase, the objectives were narrowed down to yield innovative and foster employability among graduates. The unit of Curriculum Department and Evaluation is responsible to perform as web-based solution and it was developed particularly for the needs of curriculum inventory, tools of educational and knowledge sharing (Ahmad *et al.*, 2010). Equally

pertinent is the facilities related to discussion forum, chat, uploading academic materials and monitoring students' progress. Meanwhile, the emergence of LMS, which is known as CIDOS in Malaysian Polytechnic, has influenced the strategies of teaching and learning. Recently, platform of CIDOS e-Learning Version 2.5 has assisted blended learning in the context of internet support at Politeknik Kuching Sarawak (PKS) (Harun, Majalis, & Mohamed, 2015).

In the same way, the mutual effort from the Polytechnic administration is crucial to enhance students' skills and knowledge with LMS adoption. A research conducted at Politeknik Ungku Omar (PUO) and Politeknik Seberang Perai (PSP) revealed only 51.8% of the respondents were employing CIDOS as the teaching and learning platform (Mohamad, Salam, & Bakar, 2014). Therefore, the success of LMS implementation and adoption is closely related with good time-management of academic staff in preparing teaching materials, supportive surroundings, proactive teamwork, collaborative efforts and user-friendly interface.

1.4   Statement of the Problem

Rapid rise of technology has altered the way people gain skills (Leonard, & Delacey, 2002). Adoption of LMS as universal web technology has transformed education with high solution package (Al-Busaidi, 2013; Hustad & Arntzen, 2013; Ward & Parr, 2010; Wall & Ahmed, 2008; Breiter, 2004). Nonetheless, it lacks management of course contents (Salem & Salem, 2015). Although users' attitude and environment (Asiri, Mahmud, Bakar & Mohd Ayub, 2012) emphasise progress of learning purposes, there is a lack in monitoring of LMS implementation (Aydin & McIsaac, 2004; Motaghian *et al*., 2013; Sahin, 2011). The ineffective levels of technology use (Adiguzel, 2010; Aksit, 2007), lack of attractive environment and quality system embeds troublesome (Liao & Liu, 2012). Moreover, Gwebu and Wang (2011), Jaschik, Lederman and Gallup (2014) and McGill, Klobas, and Renzi (2011) stated the limited use among instructors and lack of standard technology interfaces. The discontinuity of interactions prolongs inconsistency and decreases quality of use among students. Some lecturers failed to utilise it completely (Coskuncay & Ozkan, 2013; Graf *et al*., 2009; Fuller, Hardin, & Davison, 2006; Wang, & Wang, 2009). LMS endures from drawbacks of technology complexity including time consuming and lack of openness to adapt materials (Allen, 2011; Dodd & Antonenko, 2012; García-Peñalvo *et al*., 2011; Al Khalifa, 2010a).

Statistics indicates only 70% make it compulsory in their academic sessions (Embi, 2011) even though they have fostered it (Subramaniam *et al*., 2013). A lot of expenses is needed to equip with modern technology (Naveh, Tubin, & Pliskin, 2010; Islam, 2013) but it has not been used effectively and consistently. For instance, e-Learning@UTM, PutraLMS and College E-Learning System (CeL) are deployed to monitor university-broad courses, yet there are constraints to revise uploaded files and edit digital documents (Universiti Teknologi Malaysia, 2014; Universiti Putra Malaysia, 2014; Tunku Abdul Rahman University College, 2014). The actual problems within Malaysian context are inconsistency of use (Razali & Shahbodin, 2014; Zaihasrina, 2012) and difficulties to assess the quality of use of Learning

Management System (LMS) (CIDOS Users' Manual Version 2.5, 2015; Zainal Abidin, 2014). These problems yield constraints to technology utilisation among undergraduate engineering learners. The research gap relates to ineffective practice of LMS adoptions among Malaysian polytechnics' Year Two technical learners since the programmes are hands-on in essence. The main issues encompass factors of compatibility, application self-efficacy, subjective norm and technological complexity. Continuous participation is vital for students to achieve high skills (Nurul, Mohamad, Salam, & Bakar, 2014; Romli, 2013). CIDOS LMS Version 2.5 faces problem to detect the name of main instructors who handle the enrolled team-teaching classroom (CIDOS Users' Manual Version 2.5, 2015; Zainal Abidin, 2014). Moreover, it cannot load Shareable Content Object Reference (SCORM) content and perform back-up files for students transfer case (Razali & Shahbodin, 2014; Zainal Abidin, 2014). The quality of use in LMS still does not meet the targets set even though there are many courses supported by it. This is very worrying and the issue should be resolved in a more transparent way. The role of perceived usefulness (PU) and perceived ease of use (PEOU) as mediators as well as level of integration (LoI) and gender as moderators are other imperative issues require to embark in this study. Nonetheless, in depth investigation is required to identify the factors of LMS adoption among technical students in Malaysian Polytechnics. Technology Acceptance Model (TAM) which is based on Theory of Reason Action (TRA) yields a popular model is used to measure technology utilisation (Davis et al., 1989). As a guideline to integrate value of education via ICT, SAMR is selected to strengthen learning experience to gain the highest attainable (Puentedura, 2012). Adaptive Structuration Theory (AST) is another theory used to accommodate decision making towards IS utilisation (DeSanctis & Poole, 1994). Thus, it is pertinent to determine the factors that influence students' adoption of LMS to help administrators on broadening the practice of e-learning in Malaysian Polytechnic institutions.

1.5   Objectives of the Study

The objectives of this study are:

i. To determine the effects of compatibility, application self-efficacy, subjective norm and technology complexity on perceived usefulness among undergraduate technical students.

ii. To determine the effects of compatibility, application self-efficacy, subjective norm and technological complexity on perceived ease of use among undergraduate technical students.

iii. To determine the effects of perceived usefulness and perceived ease of use on technology utilisation among undergraduate technical students.

iv. To identify the role of perceived usefulness and perceived ease of use as mediators between LMS adoption and technology utilisation.

v. To identify the role of gender and level of integration as moderators on technology utilisation among undergraduate technical students.

vi. To develop a model to predict technology utilisation of LMS among undergraduate technical students.

1.6   Research Questions

Based on the purpose and objectives explained above, the specific research questions entailed are as follows:

i. What are the effects of compatibility, application self-efficacy, subjective norm and technology complexity, perceived usefulness, perceived ease of use and technology utilisation?

1.7   Research Hypotheses

Based on the research objectives, the related hypotheses are as follows:

Objective 1
To determine the effects of compatibility, application self-efficacy, subjective norm and   technology complexity on perceived usefulness among undergraduate technical students.

H_1: Compatibility (C) has a significant positive effect on perceived usefulness (PU).
H_2: Application Self-Efficacy (ASE) has a significant positive effect on perceived usefulness (PU).
H_3: Subjective Norm (SN) has a significant positive effect on perceived usefulness (PU).
H_4: Technological Complexity (TC) has a significant positive effect on perceived usefulness (PU).

Objective 2
To determine the effects of compatibility, application self-efficacy, subjective norm and technological complexity on perceived ease of use among undergraduate technical students.

H_5: Compatibility (C) has a significant positive effect on perceived ease of use (PEOU).

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H$_6$: Application Self-Efficacy (ASE) has a significant positive effect on perceived ease of use (PEOU).

H$_7$: Subjective Norm (SN) has a significant positive effect on perceived ease of use (PEOU).

H$_8$: Technological Complexity (TC) has a significant positive effect on perceived ease of use (PEOU).

Objective 3

To determine the effects of perceived usefulness and perceived ease of use on technology utilisation among undergraduate technical students

H$_9$: Perceived Usefulness (PU) has a significant positive effect on Technology Utilisation (TU).

H$_{10}$: Perceived Ease of Use (PEOU) has a significant positive effect on Technology Utilisation (TU).

Objective 4

To determine the roles of perceived usefulness and perceived ease of use as mediators between LMS adoption and technology utilisation

H$_{11}$: Perceived usefulness (PU) mediates the influence of Compatibility (C) on technology utilisation (TU)

H$_{12}$: Perceived usefulness (PU) mediates the influence of Application Self-Efficacy (ASE) on technology utilisation (TU)

H$_{13}$: Perceived usefulness (PU) mediates the influence of subjective norm (SN) on technology utilisation (TU)

H$_{14}$: Perceived usefulness (PU) mediates the influence of technological complexity (TC) on technology utilisation (TU)

H$_{15}$: Perceived ease of use (PEOU) mediates the influence of compatibility (C) on technology utilisation (TU)

H$_{16}$: Perceived ease of use (PEOU) mediates the influence of application self-efficacy (ASE) on technology utilisation (TU)

H$_{17}$: Perceived ease of use (PEOU) mediates Subject Norm (SN) on technology utilisation (TU)

H$_{18}$: Perceived ease of use (PEOU) mediates the influence of Technological Complexity (TC) on technology utilisation (TU)

Objective 5

To determine the roles of gender and level of integration as moderators for technology utilisation among undergraduate technical students

H$_{19}$: Gender moderates the influence of Perceived usefulness (PU) on technology utilisation (TU)

H$_{20}$: Level of Integration moderates the influence of Perceived ease of use (PEOU)

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on technology utilisation (TU).

Objective 6

To develop a model to predict the factors that can lead to technology utilisation of LMS among undergraduate technical students.

1.8 Scope, Delimitation and Limitations of the Study

There are different types of Polytechnic institutions, yet this study is scoped to determine the Premier and Conventional polytechnic institutions. In this situation, it was limited to Year Two undergraduate technical students from background of civil, electrical and mechanical engineering.

1.8.1 Delimitation

Initially, this study will collect data related to predicting the technology utilisation of LMS. Technical students use digital material, forum session and e-assessment via LMS, which refers to Curriculum Information Document Online System (CIDOS), during their learning sessions. The instructors of engineering courses will monitor their activities, embolden to keep engaging in the blended learning environment and examine their tasks which are to be completed within one academic semester.

Furthermore, the factors affecting LMS adoption and technology utilisation among undergraduate technical students will be measured. The elements of technology utilisation for the three courses consist of consistency of use and quality of use. Meanwhile, belief factors such as PU and PEOU are the mediators, as well as gender and integration, will also be determined in this research. Moreover, the institutions' population will entail 3,570 students in Premier and Conventional Malaysian Polytechnics that offer engineering courses at Politeknik Ungku Omar (PUO), Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA), Politeknik Merlimau Melaka (PMM), Politeknik Ibrahim Sultan (PIS) and Politeknik Port Dickson (PPD). The courses are enrolled by students in their second year of engineering studies.

1.8.2 Limitations

The first limitation of LMS adoption approach relates to core attributes of the study; in this context, the contributions of traditional classrooms, problem solving activities and coaching/mentoring among instructors and students in lively face-to-face teaching and learning format will be analysed. As the LMS approach allows the

educational entities to embed the mixture of lively face-to-face interactions, it also enables the online mode which encompasses the methods through synchronous virtual collaboration, asynchronous virtual collaboration and self-paced asynchronous. The online media types selected include the category of text, websites, audio files and video files. LMS is deployed as a medium of online learning in the process of developing mind to engage and keep updated with academic materials and announcement. Secondly, this study will measure only the technology utilisation of second year engineering students in the Southern, Centre and Northern Regional Malaysian Polytechnics. The justifications for choosing the engineering field include: (1) the technical institutions focus on yielding competent, innovative, transformative and diligent engineering graduates in the future; and (2) Polytechnics are in the effort to improve and transform the curriculum structure as well as encourage Malaysian Sijil Penilaian Malaysia (SPM) leavers to choose Polytechnics as the place for their tertiary technical education.

The two-stage cluster sampling procedure was used in this research, and five (5) polytechnics, (PUO, PSA, PPD, PMM and PIS) out of 34 Malaysian Polytechnics were selected for this purpose. The population was divided into isolate groups. Since it entails broadly distributed geographical locations, this sort of sampling was included all units in the subgroup. The first stage involved the selection of southern region institution simple random sampling, and the second stage encompassed the selection of year one technical courses students. This study was not being generalisable to all areas of engineering programmes, except for those at the Southern, Northern and Central Region Polytechnics in Malaysia.

1.9   Significance of the Study

This study entails two types of significance, which are theoretical and practical. From the dimension of the theoretical aspect, the study provide a better understanding of Technology Acceptance Model (TAM) which consists of perceived usefulness and perceived ease of use as the belief factors. LMS adoption encourages integration of technology in different stages based on the Substitution, Augmentation, Modification and Redefinition (SAMR) model. Consistency and quality of use inculcate continuous engagement in LMS learning activities. Thus, it reinforces the Adaptive Structuration Theory (AST) implication to generate active role in adapting and structuring a significant practice in educational institution. Meanwhile, the practical significance involves benefits and meaningful influences towards educational attributes such as students, lecturers, polytechnics, government and private sectors. It entails education technology improvement, flexibility in pedagogical and techniques of assessment, variety of content delivery, as well as experience, knowledge and skill transfer.

1.9.1 Theoretical Significance

The revolution and application of LMS as technology adoption in technical education institution give significant impacts to the delivery method of materials in teaching and learning. From the theoretical view, the methods of delivery and application of learning material as references are closely related to the practice of instructional design process. In this regard, the rapid emergence of technology in educational system has recently fostered knowledge enrichment (Davies, Hewege & Perera, 2013). With this development, it yields positive impact, particularly in assisting students' learning transfer, practising enhancement of Student Centred Learning (SCL) and self-exploratory to embolden learning engagement and effective technology use (Demirer, Bozoglan & Sahin, 2013). The recent discussions in technical institution of higher learning are on the implementation of LMS that entails the use of forum, digital material, e-content and e-assessment. Despite the fact that there are several studies carried out on technology adoption, various researches from diverse perspectives are still required. Nevertheless, some researchers have previously included students' performance and satisfaction of LMS adoption in their work. This study fills in the gap in the literature by researching on the consistency and quality of use with continuous usage of e-assessment, digital material and learning tools among diverse subjects taking technical courses. Hence, it is hoped to help knowledge enrichment through systematic monitoring in quality of use. More importantly, the elements of service, information and system implementation are important to ensure this enrichment can be done on LMS adoption in higher educational system.

Generally, most studies of technology adoption involved various subjects and the implementation of technology, utilisation and appropriateness that lead to enrichment of Technology Acceptance Model (TAM), Substitution, Augmentation, Modification and Redefinition (SAMR) Model and Adaptive Structuration Theory (AST). The theory encompasses knowledge which can be generated from the utilisation of technology. This enrichment includes cumulative understanding of transfer of experience that will become knowledge. Eventually, it is crucial to take into consideration active experimentation of knowledge application for continuous forthcoming usage.

Since it has been employed in certain institutions with the establishment of ICT infrastructure, it is necessary to investigate the strengths and consequences of LMS adoption approach embedded with predicting factors on effective technology use. It is imperative to measure the consistency of use, which basically comprises of continuous intention to employ LMS as technology adoption (Bhattacherjee, 2001). Thus, this research attempts to make theoretical contributions to the analysis of technology utilisation, specifically in terms of quality of use on desired attributes such as system, information and service (Fathema, Shannon, & Ross, 2015; Pituch & Lee, 2006; Roca *et al.*, 2006). The adoption of LMS also enhances features of usability, availability, reliability, adaptability and response time of LMS (Delone & Mclean, 2003).

It is hoped that the research will add to the body of knowledge on LMS adoption and implementation in various technical courses. In order to encourage effective learning via LMS among undergraduates, it is pertinent to take into consideration the functions, speed, features, contents and interaction capability of LMS. The value of LMS perceived quality of use will depict the knowledge, skill and transformation of technology adoption in online and face-to-face formats.

1.9.2   Practical Significance

Based on the existing element of related literature, efforts to encourage LMS adoption among Technical, Vocational, Educational and Training (TVET) institutions in Malaysia in relation to the consistency and quality of use are practically still few. Thus, they need to be investigated. The research should measure Malaysian Polytechnic students' perception of technology utilisation in their enrolled courses. With the rapid growth of technology and instructional system design implemented via LMS, this study focuses on effective technology use gained throughout the LMS adoption to predict factors with the additional belief factors acquired. From the research findings, this study will be beneficial to determining the facilitators' attempts and grasping the learners' interest in their learning materials. Hence, technology adoption will improve the teaching and learning delivery skills. The improvement is implemented through enrichment of digital materials and a variety of learning tools such as e-contents, forums, lecture notes and game-based activities. Moreover, the implementation of security features, unique access authorisation and specific learning object options produce a more systematic strategy in the instructional system design surrounding the LMS.

Recently, technology adoption provides dramatic impacts to the trends in learning environment and information technology of an educational system. The process of rethinking paradigm for LMS structures needs to take into account. It should enable modification of the ecosystem to embed diverse interactive educational events and improve facilitators' ICT tools for an outstanding achievement and satisfaction (Dias & Diniz, 2014).

This paradigm change will give positive chances to the new generation of learners in the effort to achieve excellent learning through the supported of digital presence, emboldened students negotiated projects with appropriate equipment and continuous educators' encouragement. It will give impacts on the institution of higher learning regardless of the courses, be it engineering or non-engineering course. The various methods used in accessing the learning materials allow for flexibility in the hybrid learning environments.

Based on the Malaysia Education Blue Print (2013), in order to scale up the quality of learning across Malaysia, the transformation shift is important. There are eleven shifts to transform the education system, and one of them is ICT usage. Thus, there is a need to maximise the use of ICT in education for distance and self-paced learning

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and encourage more customised learning. LMS adoption applies ICT tools and this approach has been supported by the Ministry of Higher Education (MOHE) to sustain learning in the mode of lifelong learning. Exploring technology adoption supports Open Distance Learning (ODL) among adult learners. It converges educational tools and media for maximum learning and impacts on learners' performance. Besides, it is inviting, different, exciting and fun that draws enthusiasm and learning outcome to be measured. Hence, the study is crucial as it is an attempt to indicate the learners' perceived technology use based on Adaptive Structuration Theory and SAMR integration of technology model.

Furthermore, the benefits cover the contribution to the mixture of technology for learning purposes. When time and technology of education progress with new ideas and avenues in educators' approach, it gives significant impact towards fruitful learning as re-engineering ways of teaching and learning. As can be observed, it accommodates the learner's role to his or her other life roles, and hence, development of meaningful education programmes is crucial. The study explores the deployment of LMS; this includes face-to-face and online delivery formats. Furthermore, the significance in educational technology may change the way teaching and learning are done such as from the traditional, web facilitated, blended or hybrid and online learning. Even though this may show the new pattern in obtaining learning materials, the transformational assessment in the curriculum ought to be made applicable and it needs to be reviewed from time to time. This is to ensure the quality of the graduates with excellent learning outcomes and the best practical way as their learning experiences, and so does the recognition or accreditation of programme offered from the certified agency such as Standards and Industrial Research Institute of Malaysia (SIRIM) or Malaysian Qualification Agency (MQA).

The challenge, however, is to ensure that learning supported with technology adoption is sufficiently addressed in striving towards a better valuable consistency of use for students. Therefore, the upgrading effort in teaching practices with consideration of technology is important. This study seeks to understand the current practices of LMS in Malaysian Polytechnic and the effects on productive technology use. It is hoped to yield some solutions and good input for *Jabatan Pendidikan Politeknik* (JPP) or Polytechnic Education Department to provide a more systematic and organised structure of an appropriate LMS implementation.

1.10   Definition of Terms

Definition of terms is required in order to define the important terms used in this study. The definition will differentiate between the meaning of terms in a general understanding context and the research context that is carried out. As such, several pertinent terms are perceived usefulness, perceived ease of use, LMS adoption, compatibility, application self-efficacy, subjective norm, technology complexity, technology utilisation and level of integration.

1.10.1 Perceived Usefulness

Perceived usefulness refers to the degree to which an instructor believes that using a system will enhance process and outcome in learning or job performance (Davis, 1993; Chang & Tung, 2008). This study specifies perceived usefulness as the degree to which technical undergraduate students trust that the deployment of CIDOS e-Learning platform will increase the effectiveness of technology used.

1.10.2 Perceived Ease of Use

Perceived ease of use is an indicator to evaluate the way a system's utility and easiness affects users' perception and intention to use the system (Davis, Bagozzi, & Warshaw, 1989). It is a common belief that the use of an application will help instructors and students to understand and manage their task easily. In this study, perceived ease of use is defined as the degree to which the technical undergraduate students accept that employing CIDOS e-Learning will help them handle their tasks easily.

1.10.3 Learning Management System (LMS) Adoption

Adoption of the LMS is an early implementation of a system by an educational institution. It starts with the application of online collaboration materials, utilisation of course video application and use of hand-held clickers to assist out-of class interactions (Porter, Graham, Spring, & Welch, 2014). In this study, LMS adoption is defined as the attitude of deploying educational technology system (known as CIDOS e-Learning), with a variety of uses in digital information sharing and features of LMS. It involves the use of e-content, e-assessment and discussion forum to enhance pedagogical method, access and flexibility in education.

1.10.4 Compatibility

Compatibility is a situation which adapts between educators' requirement of the system's characteristics and the work habits on behaviour intention to apply the application (Wu & Wang, 2005; Chang & Tung, 2008). It examines the impacts of user's values, prior experiences and requirements towards LMS deployment (Rogers, 1995). In this study, compatibility refers to a situation that assesses the effects of technical undergraduate students' values, prior experiences and needs towards consistent use of CIDOS e-Learning.

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1.10.5 Application Self-Efficacy

Application self-efficacy captures an individual's attributes that influence his or her intention to use a system (Coskuncay & Ozkan, 2013). In other words, it describes the individual's characteristics that influence the instructors' judgment and evaluation process about the capability of LMS usage (Karaiskos, 2009). In this study, application self-efficacy is defined as attitude of evaluating the implications of technical undergraduate students' perception on the skilful, self-confidence, interaction, effectiveness and capabilities of using CIDOS e-Learning.

1.10.6 Subjective Norm

Subjective norm is perceived as social difficulties in the implementation of a particular attitude and the desire to satisfy individual pressures and constraints (Hyde & White, 2009). It refers to the evaluation of the implications of other's view on the decision to perform certain behaviours according to related recommendations (Coskuncay & Ozkan, 2013). In the present study, subjective norm relates to the degree to which a student perceives the requests of those involved, such as the instructors, course mates and polytechnic authorities, on the decision to employ CIDOS e-Learning.

1.10.7 Technological Complexity

Thompson, Higgins and Howell (1991) regarded technological complexity as the level to which technology is perceived as relatively difficult to understand and apply. It involves the process of evaluating viewpoints on the influence of system complexity on the intention of instructors and students (Teo, 2009). In this study, technological complexity refers to technical undergraduate students' level to which technology is perceived as relatively difficult to apply in CIDOS e-Learning.

1.10.8 Technology Utilisation

Technology utilisation is a practice which entails instructors and learners to self-manage digital materials via employing computer platform, updating information and using online applications and technology gadgets to perform task easily and achieve the required targets (Akkoyunlu & Soylu, 2008; Bonk & Graham, 2006). In this study, technology utilisation refers to technical undergraduate students' consistency and quality of CIDOS e-Learning employment in the context of system, information and service of the LMS.

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1.10.8.1. Consistency of use

Consistency of use is an organised way of LMS technology employment in the context of interface and system design applicability, interoperability, simplicity of delivery administration, adaptive of interaction as well as user accessibility (Fathema & Sutton, 2013; Kim & Leet, 2008; Weaver *et al.,* 2008;). In this study, consistency of use refers to technical undergraduate students' usage of CIDOS e-Learning frequently, consistently and appropriately for academic purposes based on worthwhile and accessible features.

1.10.8.2 Quality of use

Quality of use is a character of technology utilisation that encourage educators to allow concentration to the learner's motives and alternatives to use system (Ibrahim, Yusoff, Khalil & Jaafar, 2011). The quality use of blog, social bookmarking tool, media sharing tools fosters educational entities to gain effective and productive education (Popescu, 2014). The predictive factors of technology use involve end users' support, quality utilisation and productivity (Van Aswegen, Huisman & Taylor, 2014). In this study, quality of use refers to vital traits of CIDOS e-Learning usage among undergraduate technical students which entail system, information and service to yield productivity, secure and impressive for better learning suitability of technologies.

Information

Information is ascertained an input to the knowledge valuation establishment mechanism. It is assumed by Nonaka (1994) that information refers to messages stream to create knowledge based on the strength of responsibility and beliefs. The correct information retrieved determines the information quality in the process of knowledge transformation. Information requires good accessibility and simplicity to ensure tools' ease of use are implemented (Pauleen, Agnihotri & Troutt, 2009). In this study, information refers to capability of CIDOS e-Learning to provide relevant, easy to understand, obvious, current content, sufficient and accurate instruction to technical undergraduate students during period of LMS employment in their studies.

Service

Service is a continuous support which embeds as interaction characteristic in learning technology device and system to enhance the practice of student-centred learning, collaborative as well as effective communication (Pilgrim *et al*., 2012). The quick response support eases the smoothness of technology service (Roca *et al*., 2006), infuses digital classroom to foster more multifaceted, exciting and variety for lifelong personalized learning (Ahmed & Nasser, 2015). In this study, service refers to facilities of CIDOS e-Learning that support quality of use in technology utilisation among undergraduate technical students based on the elements of simple

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accessibility, communication, reliable, convenient and quick response when failure occurred.

System

System brings out decisive arrangement to the expansion process, which, in turn, boosts the performance of the design, quality of use and eases more expected outcomes (Huisman & Iivari, 2006). Pituch & Lee (2006) highlighted system ascertains optimum learning tools with various multimedia course materials and suitable regardless of place and learning session. In this study, system refers to CIDOS e-Learning yields flexibility in the aspects of time, location, multimedia forms in the course content and sufficient roles to assist teaching and learning session. System relates to reliability which enables user to obtain reasonable response time as well as interactive communication in technology utilisation.

1.10.9 Level of Integration

Level of integration refers to the four stages of SAMR model originally introduced by Puentedura (2006). It is based on the assumption that suitability of technology adoption can essentially illustrate the character of educational activity to suit the specific targets (Melhuish & Falloon, 2010). The levels are substitution, augmentation, modification and redefinition (SAMR). In this study, level of integration covers four levels in SAMR model to determine CIDOS e-Learning's technology integration among undergraduate technical students.

Substitution

Substitution is a first level in SAMR model as level of enhancement and attempt to replace manual methods with ICT-based approaches (Jude, Kajura & Birevu, 2014). Technology employment by educational attributes in this level involves an explicit replacement for non-digital option with no functional alteration (Puentedura, 2006). In this study, substitution entails ICT use as direct tools among undergraduate technical students while employing CIDOS e-Learning for enrolled and blended course content with no practical change.

Augmentation

Augmentation refers as enhancement level which usage of digital tool in an existing technology provides a functional alteration (Puentedura, 2012; Schrock, 2014). This second level has more flexible of education chances regardless of place (Gikas & Grant, 2013) and apps used as supplement (Ahmed & Nasser, 2015). In this study, augmentation involves ICT use as direct tools among undergraduate technical

students while employing CIDOS e-Learning for enrolled and blended course content with functional development.

Modification

Modification refers as transformation level which allows an important task redesign using technology to entirely alter the approach in which learning materials are conveyed (Puentedura, 2010). The third level in SAMR model admits technology gadgets applied to create short video (Jacobs-Israel & Moorefield-Lang, 2013). In this study, modification involves redesigning process that is embedded with technology to encourage undergraduate technical students to create activities, explore and infuse CIDOS e-Learning tools and other applications such as blogs, videos, Google docs and digital library to accomplish learning targets.

Redefinition

Redefinition is a fourth level in SAMR model which functions are related to transformation process. In these levels, adjustment or re-description of educational activities implemented is attainable by the utilisation of digital technologies to contribute new assignment, learning skill and improved learning setting (Driver, 2012; Selwyn, 2010). In this study, redefinition is defined as a process level of creating a new task and educational experience with functions of technology application. For example, the uses of group discussion facility, social media, open educational resources, mobile device, online assessment tools and video conferencing among undergraduate technical students.

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LIST OF PUBLICATIONS

A. Book Chapter

1. Borderless Open Access Education

Ismail, N., Mohd Ayub, A.F., Md Yunus, A.S., & Ab. Jalil, H., (2016). Harmonisation of blended learning design in true practice and allocated courses via CIDOS LMS to nurture teaching and learning engagement. In A. Ideris, R. Varatharajoo, F. Romli, A. Bakar, A. Arokiasamy, (Eds), *Borderless Open Access Education.* (pp. 370-382). Selangor, Malaysia: Universiti Putra Malaysia Press.

2. Computer Application for Polytechnic Syllabus

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B. Journal Papers
1. Malaysian Journal of Distance Education (MJDE)

Ismail, N., Wan Ali, W. Z., Md Yunus, A.S., & Mohd Ayub, A.F. (2014). The effects of blended learning methods on educational achievement and the development of online material in a Curriculum Information Document Online System (CIDOS) for computer application courses. *Malaysian Journal of Distance Education*, *16*(2), 59–82.

2. International Journal of Education and Training (InjET)

Ismail, N., Wan Ali, W. Z., Md Yunus, A.S., & Mohd Ayub, A.F. (2016). Harmonization of active learning: A driver of nurturing engineering learner's motivation? *International Journal of Education and Training* (InjET) (Special Issue), December: 1-15.

3. Advanced Science Letters

Ismail, N., Mohd Ayub, A.F., Md Yunus, A.S., & Ab. Jalil, H. (2017). Utilising CIDOS LMS in technical higher education: The influence of compatibility roles on consistency of use. *Advanced Science Letters, American Scientific Publishers, 23*(8), 7783–7787.

4. Journal of Technical Education and Training (Under progress)

Ismail, N., Mohd Ayub, A.F., & Sarji, N. (2017). Emblematic practice of CIDOS LMS: A Say-so or mythos? *Journal of Technical Education and Training (JTET).*

C. Conference Presentation

1. Social Science Post Graduate International Seminar (SSPIS)

Ismail, N., Wan Ali, W. Z., Md Yunus, A.S., Mohd Ayub, A.F. (2014). Effect of blended method on learning achievement and development of online material in Curriculum Information Document Online System (CIDOS) for computer application course. In *proceedings of the Social Sciences Postgraduate International Seminar* (pp. 336-353). Pusat Pengajian Sains Kemasyarakatan. Universiti Sains Malaysia, Pulau Pinang, Malaysia, 21 October 2014.

2. 4th World Congress on Technical Vocational Education Training (TVET)

Ismail, N., & Ali, W. (2014). The impact of computer literacy skill via Learning Management System (LMS) on an effective learning practice. In *proceedings of the 4th World Congress on TVET* (pp. 404-417). Advanced Centre for Technical and Vocational Education *(*ACTiVE). Universiti Tun Hussein Onn Malaysia. Melaka, Malaysia, 5-6 November 2014.

3. Graduate Research in Education Conference (GREduc)

Ismail, N., Wan Ali., W.Z., Md Yunus, A.S., & Mohd Ayub, A. F. (2014). The impact of problem based learning in Numerical Methods on learners' academic performance. In *proceedings of the Graduate Research in Education Conference (GREduc)* (pp. 604–618). Faculty of Educational Studies. Universiti Putra Malaysia, 21 December 2014.

4. 3rd International Conference on Educational Research and Practice (ICERP)

Ismail, N., Wan Ali, W. Z., Md Yunus, A.S., & Mohd Ayub, A.F. (2015). Active learning approach for Engineering Mathematics 3 course to encourage student's motivation. In *proceedins of the 3rd International Conference on Educational Research and Practice (ICERP)* (pp.107-121). Putrajaya, Malaysia, 25-26 August 2015.

5. The Association of Southeast Asian Institutions of Higher Learning (ASAIHL)

Ismail, N., Mohd Ayub, A.F., Md Yunus, A.S., & Ab. Jalil, H. (2016). Harmonisation of blended learning design in true practice and allocated courses via CIDOS LMS to nurture teaching and learning engagement. In *proceedings of the ASAIHL Conference.* (pp. 43-48). Putrajaya, Malaysia, 4-6 December 2016.

6. International Conference of Business and Social Science (ICOBSS)

Ismail, N., Mohd Ayub, A.F., Md Yunus, A.S., & Ab. Jalil, H. (2017). Utilising CIDOS LMS in technical higher education: The influence of compatibility roles on consistency of use, In *proceedings of the International Conference of Business and Social Science (ICOBSS).* (pp.22-30). Melaka, Malaysia, 28 February – 1 March 2017.

D. E-Learning Competition

1. Category: Learning Management System (Silver medal)

Ismail, N., Mohd Ayub, A.F., & Sarji, N. (2017). Emblematic practice of CIDOS LMS: A Say-so or mythos? In *E-Learning Competition and Carnival (ELC 2017), LMS Category.* Booth No. 32. Resource Centre and Teaching Technology, Universiti Teknikal Malaysia, Melaka, 27 July 2017.

2. Category: Teaching and Learning Material (Bronze medal)

Ismail, N., Mohd Ayub, A.F., Md Yunus, A.S., & Abd. Jalil, H. (2017). CIDOS LMS adoption: A multi-stage cluster analysis. In *Hari Inovasi (HInovasi 2017), LMS Category.* Booth No. 104. Faculty of Education, Universiti Kebangsaan Malaysia, Bangi, 11 July 2017.

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