TECHNOLOGY INTEGRATION AND PEDAGOGICAL INNOVATIONS IN MALAYSIAN HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

The gap between massive educational technology investments and the expected return in enhancing teaching and learning is a global education agenda. Education reform waves have called for a wider review of pedagogical innovations in education systems around the world. The primary purpose of this study was to examine the relationships between technology integration practises and pedagogical innovations in the contexts of Malaysian higher education institutions. In this study, technology integration practice was the independent variable whereas pedagogical innovation was the dependent variable. Demographic profiles specified by six indicators were chosen as moderating variables. A total of 248 faculty members from six Tier 5 higher education institutions in Malaysia participated in this study with a response rate of 40.6%. Three of the higher education institution institutions are public universities and the remaining three are private universities. This study adopted a simple random sampling procedure of data collection using questionnaire administered through assistant faculty registrars and also through online survey. Data collected was first analysed for descriptive such as mean, standard deviation and percentage. This was followed by inferential statistics such as *t*-test, one-way ANOVA, UNIVARIATE, Pearson Correlation tests, and regression analyses to examine the relationships among the variables. The fidelity levels of technology integration practices were examined using an adapted innovative configuration component map. Seventy percent of the subjects had high fidelity level of technology integration practises. Pedagogical innovation was examined using an adapted instrument based on the SITES-M2 findings. It was revealed that subjects had pedagogical innovativeness that was above emergent but not meeting minimum score of being innovative. Subjects' demographic profile had no significant effect on technology integration and pedagogical innovations. Organisation and faculty's beliefs were found to exert mild positive effect on subjects' technology integration and pedagogical innovations. Multiple linear regression analysis revealed the direct relationship between technology integration and pedagogical innovations. Hierarchical regression analysis further revealed the enhancement of relationship with the presence of mediating variables for the independent and dependant variables. From the findings of this study, a relationship model for technology integration as the main predictor for faculty member's pedagogical innovations was proposed. Supportive plans and policies that form the strategies of technology integration within the faculty were found to be a positive mediator that enhanced the relationship between technology integration and pedagogical innovations. Universities had different pedagogical profiles based on ownership and there should be a national policy for technology driven education. This study concluded with a model of relationship for technology integration and pedagogical innovations that paved ways for further research in technology integration and pedagogical innovations in Malaysian higher education institutions.

ABSTRAK

Pengintegrasian Teknologi dan Innovasi Pedagogi di Kalangan Institusi Pengajian Tinggi Malaysia

Jurang di antara pelaburan teknologi pendidikan dan pemulangan dari segi keberkesanan pengajaran dan pembelajaran adalah amat ketara di seluruh dunia. Pelbagai gelombang reformasi pendidikan telah menyeru para pendidik dalam pelbagai system pendidikan untuk menilai takat inovasi pedagogi masing-masing. Kajian dalam bidang inovasi pedagogi adalah merupakan isu pendidikan yang amat kompleks. Tujuan utama kajian ini adalah untuk menilai hubungkait di antara kepengunaan pengintegrasian teknologi dan inovasi pedagogi di kalangan ahli akademik institusi pengajian tinggi di Malaysia. Dalam kajian ini sebanyak enam buah institusi pengajian tinggi yang bertaraf Tier 5 telah dipilih. Pengintegrasi teknologi merupakan pembolehubah bebas dan inovasi pedagogi adalah pembolehubah bersandar. Latar belakang subjek ataupun demografik yang terdiri daripada enam ciri-ciri merupakan moderator ubah dalam kajian ini. Subjek dan interaksi dengan persekitaran mereka telah juga dikaji sebagai pengantar ubah untuk kesan terhadap hubungkait di antara dua variabel kajian. Subjek dalam kajian ini terdiri daripada 248 ahli fakulti dari enam institusi pengajian tinggi di Malaysia. Kadar respon adalaha 40.6%. Kajian in telah melibatkan para ahli fakulti seramai 611 orang, dari pangkat tutor kepada professor. Tiga daripada institusi pengajian tinggi adalah merupakan universiti awam, manakala tiga yang lain adalah unviersiti swasta. Data daripada kajian dianalisi dengan mengikut statistik descriptif dan inferensi. Ujian deskriptif adalah seperti min, sisihan piawai and peratusan. Ujian inferensi adalah *t*-test, one-way ANOVA, UNIVARIATE, *Pearson Correlation* dan *regression* untuk menganalisa hubungkait antara kesemua pembolehubah. Ujian m*ultiple linear regression* telah dijalankan untuk menentukan

hubungkait antara pengubah bebas and pengubah bersandar. Ujian *hierarchical regression* pula memberikan gambaran keseluruhan pengubah bebas dan pengubah bersandar dengan kehadiran pengantar ubah. Tahap fideliti dalam pengintegrasi teknologi subjek telah diukur dengan instrumen *innovative configuration component map* yang telah diubahsuaikan. Kajian ini telah menggunakan cara persampelan rawak ringkas. Soalkaji telah diagihkan melalui penolong pendaftar fakulti dan juga secara *online*. Di kalangan 248 subjek, hampir 70% mempunyai tahap integrasi teknologi yang tinggi. Inovasi pedagogi telah dinilai menggunkan instrumen SITES-M2 yang telah diubahsuai. Dapatan kajian menunjukkan secara umumnya, ahli fakulti mempunyai tahap inovasi pedagogi di antara '*emergent*' dan '*inovative*'. Ini bermaksud juga para akademik belum lagi mempunyai tahap inovasi pedagogi yang tinggi. Moderator ubah seperti demografik adalah didapati tidak memberi kesan kepada hubungkait antara pengingtegrasi teknologi dan inovasi pedagogi. Manakala pengantara ubah yang digelar organisasi dan percayaan kendiri adalah didapati mempunyai korelasi positif yang sederhana dan lemah dalam kajian ini. Cuma satu sahaja pengantara ubah, iaitu "pelan dan polisi yang menyumbang kepada strategi pengintegrasi teknologi di dalam fakulti", merupakan pengantara ubah positif kepada hubungkait di antara pengintegrasi teknologi dan inovasi pedagogi. Universiti menunjukkan profil inovasi pedagogi mengikut jenis kepunyaan swasta dan awam. Hasil kajian ini mengesahkan perlunya diujudkan satu polisi kebangsaan berkenaan pengunaan teknologi dalam pendidikan. Kajian ini juga menghasilkan satu model hubungkait antara pengintegrasi teknologi dan inovasi pedagogi yang boleh dibawa kepada kajian lanjutan berkenaan pengintegrasi teknologi dan inovasi pedagogi khususnya di kalangan unviersiti Malaysia.

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LIST OF SYMBOLS AND ABBREVIATIONS

AACTE	American Association of Colleges for Teacher Education
ANOVA	Analysis of Variance
CFA	Confirmatory factor analysis
CK	Content Knowledge
CoSN	Consortium for School Networking
df	Degrees of Freedom
DoDEA	Department of Defense Education Activity
EFA	Exploratory factor analysis
F	*F*-ratio
HEIs	Higher Education Institutions
ICCM	Innovation Configuration Component Map
ICT	Information Communication Technology
IEA	International Association for the Evaluation of Educational Achievement
ILS	Integrated Learning system
ILSCM	Integrated Learning System Configuration Matrix
ISTE	International Society for Technology in Education
M	Mean
MQA	Malaysia Qualification Agency
MIT	Massachusetts Institute of Technology
MoHE	Ministry of Higher Education
n	Sample size
NCATE	National Council for Accreditation of Teacher Education
NETS	National Education Technology Standards
NMC	New Media Consortium
NSE	National Science Education
OCW	Open Courseware Initiative

OECD	Organisation for the Economic Co-operation and Development
p	Probability
PLEs	Personal learning environments
PT3	Preparing Tomorrow's Teachers to Use Technology
PKML	Pedagogical Knowledge for meaningful learning
SCDEs	Schools, Colleges and Education Departments of Education
SD	Standard Deviation
SEM	Structural Equation Modelling
SITES-M2	Second Information Technology in Education Study Module 2
TISCM	Technology Implementation Standards Configuration Matrix
TK	Technological Knowledge
TPK	Technological and Pedagogical Knowledge
TPACK	Technological Pedagogical Content Knowledge

CHAPTER 1

INTRODUCTION

1.1 Overview

The higher education system around the globe is undergoing a paradigm shift due to changes in students' needs, societal expectations, and technological advancement. Students in the twenty first century prefer to learn with technology; society demands that employees are techno-savvy life-long learners who constantly reinvent their skills set; and the myriad of technology that extends the reach of learners segment, especially the returning students commonly referred to as lifelong learners.

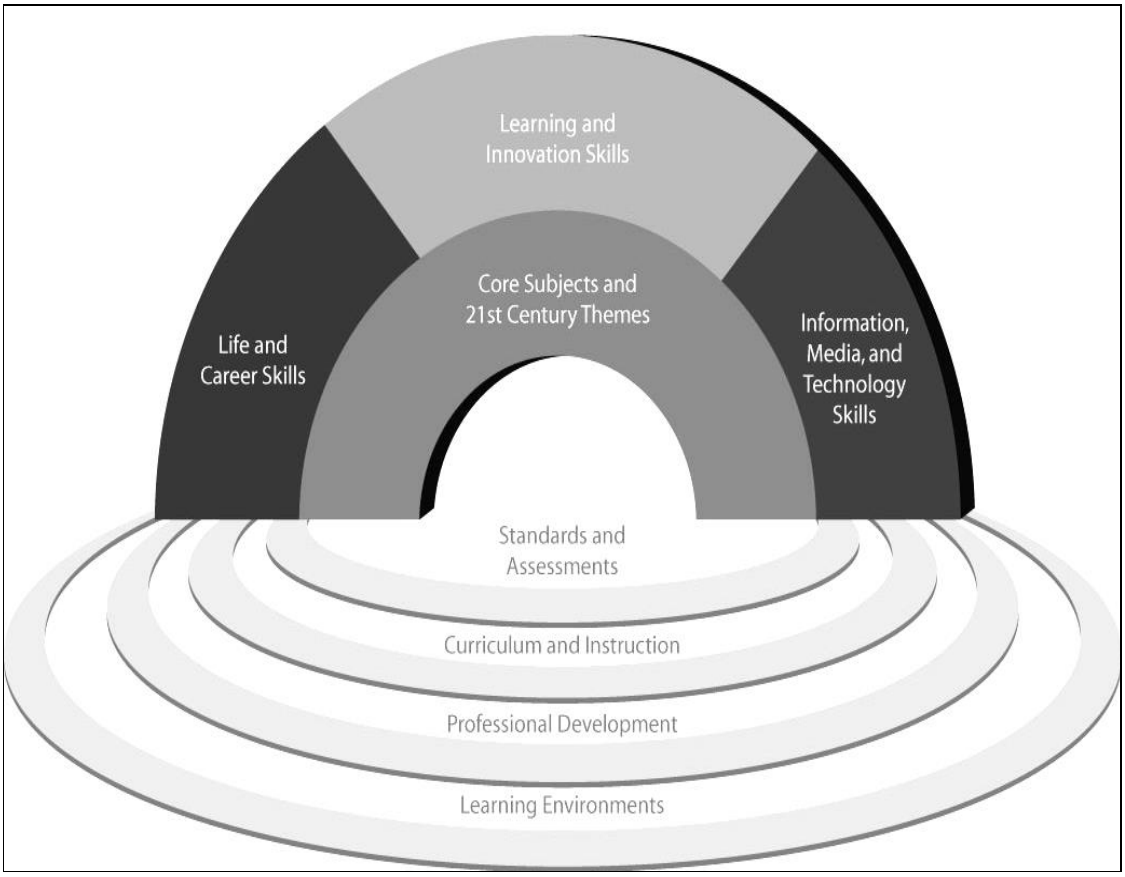
With billions invested to integrate technology into higher education, one of the most pressing issues faced by many higher education institutions (HEIs) is how technology integration influences pedagogical practices, assessment and course content design (The Guardian, 2012). Traditional universities around the world are paying increasing attention to reform students learning experience that will fully develop their abilities (Harvard Magazine, 2011).

According to their book "*Disrupting Classroom: How Disruptive Innovation will Change the Way the World Learns*", Christensen, Horn and Johnson (2011) pinpointed that schools are struggling to improve themselves to meet the demands of society. Educators around the world are facing a dilemma of how to best leverage technology: to improve learning that produces better results or change their business model to widening access to education. Learners of the twenty first century are looking for education experiences that are different from those in the twentieth century (Altbach, Reisberg, & Rumbley, 2009; Christensen, Horn, & Johnson, 2011b; CISCO

Systems, 2008). One of the primary reasons is that the twenty first century learners are more intrinsically driven in their academic pursuits and the role of technology for education needs to be re-examined (Christensen et al., 2011b). The gravity for education is no longer teacher-centred but shifted to student-centred. There is a wide acceptance of diverse learners profile since the theory of multiple intelligences in 1983 (Gardner, 2011). Students constantly seek to learn through accessing, synthesising, and communicating information effectively on technology platforms such as Web 2.0. Collaboration across multiple disciplines in borderless cultural diversities also constantly shapes the goals of educational pursuits.

In the United States, a major education reform started in the first decade of the twenty first century. There is greater emphasis on technology literacy through the Partnership for twenty first Century Skills (P21) framework (Trilling & Fadel, 2009). This framework defines twenty first century skills as: “a blend of content knowledge, specific skills, expertise, and literacies necessary to succeed in work and life” (Trilling & Fadel, 2009: 173). The twenty first century skills encompasses: (i) life and career skills; (ii) learning and innovation skills; (iii) information, media, and technology skills; and, (iv) core subject mastery and familiarity with interdisciplinary themes. The acquisition of these skills requires learning outcomes to be aligned through: (i) standards and assessments; (ii) curriculum and instruction; (iii) professional development; and, (iv) learning environments (Figure 1.1).

Innovation in technology has changed the way in which HEIs have operated during the past two decades. Computer-based teaching, distance learning, and on-line learning are some of the technology platforms used to deliver teaching and learning beyond the traditional classroom environment (Bullock, 2011; Garrison & Kanuka, 2004; Khan, 2012).



Source: Trilling and Fadel (2009, p. 173)

Figure 1.1 Partnership for Twenty First Century Skills (P21) Framework

In 2002, there was a heightened international on-going research effort to identify and describe emerging technologies in education and this resulted in the formation of a consortium called New Media Consortium (NMC) Horizon Project. This consortium works closely with the International Society for Technology in Education (ISTE) and the Consortium for School Networking (CoSN). In the third report released in 2011, NMC has called for global awareness on the six critical technologies that will be adopted in time frames of one to five years.

These innovative technologies are:

(a) Cloud computing

The "cloud" refers to the vast collections of networked computers, typically housed in regionally distributed and redundant data centres that comprise the totality of the internet.

(b) Mobiles

This refers to the increasingly "always-connected" devices which are not restricted to text messages and phone conversations but the constant access to the content and social tapestries of the internet.

(c) Game-based learning

Games developed for education enhance role-playing, collaborative problem solving, and stimulate experiences that are recognised for having broad applicability across a wide range of disciplines.

(d) Open content

This is an international movement that not only means information is shared but also includes instructional practice and experiences. It was started by Massachusetts Institute of Technology's (MIT) Open Courseware Initiative (OCW). Students are learning with their teachers through partnership where skills related to finding, evaluating, interpreting and repurposing of resources are constantly developed.

(e) Learning analytics

This refers to the real time analysis of the wealth of information about students' day to day academic activities in a way that allows education institutions to better evaluate students' achievement.

(f) Personal learning environments (PLEs)

PLEs enable students to determine the style and pace they learn using technology. Digital portfolios of students, give student a record of their learning that they can carry through the various stages of their educational pursuits.

In view of the massive wave of education reform taking place in the K-12 system since three decades ago, HEIs should be of no exception into rethinking their core business activities model. While responding to the changing technology landscape and liberalisation of markets, HEIs also compete for students, research grants, funds and international academic rankings (Altbach et al., 2009; Newman & Couturier, 2001). The phenomena of massification, internationalisation, marketisation, and diversification have been successful in attracting more students in some countries. Many countries have earmarked education as their emerging economic engine, and strive to become an education hub (Knight, 2011; Morshidi, Ahmad Abdul Razak, & Yew Lie Koo, 2011). This has inevitably led to intensified competition among HEIs.

Many HEIs have responded to the change, through innovative strategies that offer wider access to higher education for more diverse student population such as working adults and geographically disadvantaged students. On-line learning, distance learning, and on-line distance learning are some of the common modes of course delivery leveraging on technology. Classroom boundaries and structures are now re-defined through an information architecture system that is built on technology integration which transcends space and time zones. Much contemporary research has reported the challenges faced in addressing the changing profile of learners through equipping more trainee teachers with twenty first century skills (Hatlevik & Arnseth, 2012).

Technology integration means incorporating technology and technology-based practices into all aspects of teaching and learning specifically, incorporating appropriate technology in learning objectives, lesson planning, and assessment of learning outcomes (Whachira & Keegwe, 2011). In higher education, technology integration in classrooms enables a more effective delivery of the curriculum while expanding market reach. Many HEIs are now actually offering more diversified student services using on-line customer services tools while addressing the need for operation efficiency and revenue generation (Cobb, 2012).

Some HEIs have adopted technology to be the centre-piece of their strategic plans, providing a convincing road map to expand market access, improving their students' completion rates, and reducing operating costs (Cobb, 2012; Segrera, 2010). In terms of enhancing campus experiences, there is a plethora of technology-enabled platforms such as on-line courses, learning-management systems, administrative portals, and wireless infrastructure (Jones & Lau, 2012).

Since the launch of Web 2.0 in 2007, a lot of classroom pedagogical practices have gone on-line (Anderson, 2007; Dubetz, Barreto, Deiros, Kakareka, Brown, & Ewald, 2008; Roper, 2006). Web 2.0 hosts a wide array of social media networking tools as depicted in Table 1.1. These collective technological tools have changed the way information has been is accessed and created. Social networking tools have also significantly changed how people communicate through an open architecture of community, namely, to interact, create, co-create, add-value for users and information sharing (Anderson, 2007; Mejias, 2006). At the same time, technology could offer personalised learning experience to its users. This phenomenon of pervasive access to broadband internet connectivity and communication services has created many new forms of relationships and patterns of communication and learning, including higher education institutions (Bullock, 2011; McLoughlin & Lee, 2008). The types of technology affordances in Web 2.0 are as shown in the Table 1.1 below:

Table 1.1

Types of Web 2.0 Social Platforms and Applications

Type of Web 2.0 Social Platform Category	Application
Multi-player online gaming environments/virtual worlds	Multi-users Dungeons (MUDs); Massively-Multiplayer Online Games (MMOGs) such as Second Life, Active Worlds, World of Warcraft, Everquest
Discourse Facilitation Systems	Synchronous: instant messaging (IM, e.g. Windows Live Messenger, AOL Instant Messenger, Yahoo Instant Messenger, Google Chat, ICQ, Skype; Chat Asynchronous: Email; bulletin Boards; discussion boards; moderated commenting systems (e.g. K5, Slashdot, Plastic)
Product Development Systems	Sourceforge; Savane; LiberSource
Peer-to-peer file sharing systems	BitTorrent; Gnutella; Napster; Limewire; Kazaa; Morpheus; eMule; iMesh
Selling/purchasing management systems	eBay
Learning management systems	Blackboard/WebCT; ANGEL; Moodle; LRN; Sakai; ATutor; Claroline; Dokeos
Relationship Management Systems	MySpace; Friendster; Facebook; Faceparty; Orkut; eHarmony; Bebo
Syndication systems Distributed Classification systems (“folksonomies”)	List-Servs; RSS aggregators Social bookmarking: del.icio.us; Digg; Furl Social cataloguing (books): LibraryThing; neighborrow; Shelfari (Music): RateYourMusic.com; Discogs; YouTube (movies/DVDs): Flixster; DVDSpot; DVD Aficionado (Scholarly citations): BibSonomu; Bibster; refbase; CiteULike; Connotea Other: Flickr

Source: Adapted from Anderson (2007), Mejias (2006), and Bullock (2011)

On the other hand, there is a heightened concern on how technology has changed the way teaching and learning is conducted in classrooms (Cuban, 2001; Papert, 1993). Technology integration was perceived to improve teaching and learning in education institutions. This form of pedagogical innovations is often interpreted as a new form of classroom practices that are enabled by technology. Pedagogical innovations are also commonly understood as non-traditional methods of teaching and learning. Nevertheless, there seems to be a lack of substantial evidence on exemplary pedagogical innovations and its relationship with technology integration, especially in the higher education system.

As more and more computers are built into the classroom, technology integration was postulated to bring about pedagogical innovation that will greatly improve schools and students' performance. To some extent, technology integration has been dubbed as a kind of disruptive innovation that change the way learners learn in a non-traditional way.

At the turn of the twenty first century, the International Association for the Evaluation of Educational Achievement (IEA), a global research network representing 100 countries, started examining what is happening in the classrooms around the world. One of the most impactful study is the international comparative study on pedagogical innovation called "Second Information Technology in Education Study Module 2" (SITES-M2) which has defined pedagogical innovation as a collection of educational practices that fulfil the following four criteria (Nancy Law, Angela Chow, & Allan H K Yuen, 2005a):

(a) There was evidence of significant changes in the roles of teachers and students, the goals of curriculum, the assessment practices, and/or the educational materials or infrastructure

(b) Technology played a substantial role in the practice

(c) There was evidence of measurable positive outcomes, and

(d) The practice was sustainable and transferable

Some of the exemplary pedagogical practices and profiles are reported by Law, Yuen and Fox (2011). Law et al. (2011) further stressed that although computers are very common, pedagogical practices in the classroom have largely remained traditional in most countries and education systems.

Besides increasing accessibility to education, technology supports the teaching and learning process through the various online tools and ICTs. With the advanced mobile application technology and internet access, learning can take place anytime and anywhere. Many traditional campus-based HEIs are also changing their focus through leveraging on this borderless learning through the concept of blended learning.

Blending learning can be defined as "*the thoughtful integration of classroom face-to-face learning (synchronous) experiences with on-line learning (asynchronous) experiences*" (Garrison and Kanuka, 2004; 96). It brings transformative potential to universities seeking to extend their market reach and promote lifelong learning. The asynchronous learning typically offers students and lecturers an opportunity to interact via on-line communication through threaded discussion. When students and teachers are interacting with external interested parties such as industry experts, borderless learning spaces are created. The virtual learners engaging on an educational discourse are commonly referred to as community of learners (Garrison & Kanuka, 2004) and network society (Castells, 2000).

Despite huge technology dollars being spent to integrate technology into teaching and learning at education settings, research on the impact of technology in transforming pedagogical practices is limited and its actual benefits less known to its various stakeholders. Despite the current generation of students being digital natives, researchers have highlighted that this group of students are in fact not properly equipped to use technology that enhances learning (Bennett & Maton, 2010). School results have not improved significantly too (Christensen et al., 2011b). Similarly, studies in higher education institutions stress on the missing puzzles in achieving innovative pedagogy through technology (Bennett, Bishop, Dalgarno, Kennedy, & Waycott, 2012).

1.2 Background of the Study

Pedagogical innovation is a central issue to the global educational innovations movement. Integration of technology can be a means to support pedagogical innovations. Consequently, such innovation would enhance the quality of higher education. Higher education institutions around the world are spending billions of dollars to integrate technology into enhancing the quality of pedagogical practices. In Malaysia, many higher education institutions have adopted a similar approach. In outlining the National Higher Education Action Plan 2007-2010 (2007), the Ministry of Higher Education stressed that the "development of quality human capital will be intensified. The approach must be holistic and emphasise the development of knowledge, skills, intellectual capital in fields such as science, technology and entrepreneurship" (National Higher Education Action Plan 2007-2010, 2007).

The most common terminology of technology integration and pedagogical innovations in Malaysian HEIs is defined within the context of ICT such as e-learning implementation through learning management system (AIM, 2009; Mohd Amin, 2011). the continuous effort to achieve 80% of technology integration among Malaysian HEIs, report on status, trends and challenges has revealed that there is an urgent need to devise a national e-learning policy that will guide all HEIs to acculturate e-learning rapidly (Mohd Amin, 2011).

Educational reform efforts have consistently supported student-centred practices as the most effective instruction to prepare students for the twenty first century (Biggs, 2003; Voogt, 2008). These reform efforts are based on a new definition of "good teaching," that is, teaching that revolves around student-centred practices and that leverage relevant information and communications tools (ICT) and resources as meaningful pedagogical tools. Implementing a new definition of effective teaching requires changes in teacher knowledge, teacher beliefs , and teacher culture in all educational settings (Ertmer, 2005; Khan, 2012). On the other hand, the young learners though born as digital natives, are actually not using technology with the right approach to enhance their learning (Bennett & Maton, 2010).

Despite the pervasive integration of technology into pedagogical practices in the classroom, many teachers and educators are merely using ICT as a supplementary tool in the education process. Many teachers use ICT as a means of communication, information retrieval, calculations, production tasks such as writing, presenting and tabulations, learning tasks, student assessment, monitoring and planning (Law et al., 2005). In the context of higher education, Law's et.al (2005) and Kozma's (2003) observations may be highly relevant. Monitoring of e-learning impact on the delivery methods of academic staff was also found to be a low priority among Malaysian HEIs (Mohd Amin, 2011).

The integration of technology in higher education institutions promotes active learning. The "digital natives" learners of the twenty first century are seeking education experiences that enable them to access information, synthesise and communicate ideas "anytime anywhere". These learners are highly technology savvy.

The role of faculty is no longer restricted to that of being content experts. Students no longer rely on lecturers and textbooks as the sole source of knowledge. They can access more up-to-date information on a field of knowledge within seconds from alternative on-line media tools. This has changed the role of faculty from ‘sage on stage” to “guide by the side” (Dysthe & Webler, 2010). Faculty are now partners of learning in collaboration with their students (Bullock, 2011; Garrison & Kanuka, 2004).

The pervasive use of technology in pedagogical practices has also posed many challenges to faculty in every higher education system around the world (Clift, Mullen, Levin, & Larson, 2001). Learning management is now entirely built on e-platforms while students are constantly seeking new experiences in their learning. Technology integration has resulted in an open borderless educational environment. Faculty has to adapt to this paradigm shift in order to face this innovation. Continuous professional development of faculty could ease their anxiety on technology and help to overcome barriers in adoption. Despite these, education institutions have yet to improve student examination grades and students’ motivation to learn (Christensen, Horn, Cladera, & Soares, 2011a).

Pragmatic and constructivist learning have become more prominent through the emergence of the internet and its associated technologies (Dysthe & Webler, 2010; Hedberg & Freebody, 2007). Technology is an enabler for authentic learning as the presence of communication, visualization, simulation and interaction greatly enhances the experiences of learning (Lombardi, 2007). Although it has been said that the traditional university will be rendered obsolete by information technology, distance education and other technology-induced innovation (Segrera, 2010), there remains sceptics on how far technology integration has greatly changed the teaching and learning practices in the classroom (Kozma, 2003; Law, Yuen, & Fox, 2011b). Papert (1993) pointed out that time travellers from the 19^{th} century could step into a contemporary classroom and know at a glance where they were, as pedagogies have not changed much. Contemporary research has also revealed the ‘slowness’ of the education system to adapt to the fast paced technological advancement (Cowan, 2012; Zhong & Shen, 2002).

There are apparent inevitable shifts in the views of the purposes of education due to a growing emphasis on leveraging to the collection of technologies, such as ICT to meet the demand of new educational approaches and pedagogies that foster lifelong learning (Fischer & Konomi, 2005). The demise of the traditional university will not take place any time soon but there has been a profound relationship between employing new ICTs and enhancement of the teaching and learning experience.

Technological advancement is taking place in almost every kind of industry and it is often a catalyst to academic transformation in the twenty first century (Flynn & Vredevoogd, 2010; Hedberg & Freebody, 2007; Hiltz & Turoff, 2005). The internet has truly revolutionised how knowledge is communicated. In the world's most developed economies, the presence of ICTs has expanded exponentially and touched virtually all dimensions of the higher education enterprise. E-mail and on-line social networking spaces have offered alternative avenues for academic collaboration and joint research.

In most developing countries, technologies are often considered the key to increasing access to higher education. For example, through ICT, distance education now represents an area of enormous potential for higher education systems around the world as it can enable access to higher education by working adults without being bounded by geographical and time constraints (Altbach et al., 2009).

In the SITES-M2 study, although Malaysia was not part of the study, the reported educational and organisation contexts are relevant. It was also highlighted that understanding the organisation and faculty’s beliefs within the contexts of the education settings are critical to the sustainability of the innovations (Owston, 2003).

This duo of organisation and faculty's beliefs have been referred to as first order and second order barriers by Ertmer (1999, 2005).

Based on the findings of SITES-M2, there are five major contextual factors that influence the success of technology integration for pedagogical innovations. The five factors are: (a) education institution background, (b) the education institution leadership's commitment, (c) education institution strategies, (d) government and community support, and (e) education institution ICT infrastructure. In addition to that many technology integration studies have highlighted that the leadership of an institution is a critical factor to the success of technology integration.

While international efforts to study and map pedagogical innovations have been conducted in just the past two decades, the scope of these studies was limited to K-12 and K-16 educational settings (Evans, Whitehouse, & Gooch, 2012; Kozma, 2003; Law et al., 2005a). There seems to be a paucity of data on pedagogical innovation in HEIs. Although there are many findings that show technology actually improves learning (Garrison & Kanuka, 2004; Kettunen, 2011; Orlando, 2011), research on innovative pedagogical practices in HEIs is very limited (Kozma, 2003; Law et al., 2005a). One of the major reasons that account for the lack of research in this specific area is the difficulty of using a standard instrument to measure innovative pedagogical practices among different countries and education systems. This was supported by the researchers of SITES-M2 studies. More effort is needed to focus on country-specific education system. In Malaysia, there has been a heightened action research activity on e-learning and web-based assessment (Hamsiah Mohd & Raja Maznah, 2010; Ghavifekr & Hussin, 2011).

In Malaysia, the Ministry of Higher Education (MoHE) has set an ambitious target to make the country an education hub by 2020. It is envisaged that by 2020 there would be around 200,000 international students studying in Malaysian higher education institutions (National Higher Education Action Plan 2007-2010, 2007). In 2007, the MoHE launched the National Higher Education Strategic Plan that listed seven strategic thrusts:- widening access and increasing equity; improving the quality of teaching and learning; enhancing research and innovation; strengthening higher education institutions; intensifying internationalization; inculcating life-long learning; and reinforcing the delivery systems of the MoHE.

The seven strategic thrusts can be achieved through technology integration. In terms of the first thrust, widening access and increasing equity, MoHE has granted license to eight private universities to provide on-line undergraduate and postgraduate programmes. Besides massive investments in ICT infrastructure and expansion of geographical presence, students from diverse backgrounds are also supported by multiple assistance schemes such as study loan and grants.

The National Higher Education Strategic Plan has also acknowledged the significant role played by private HEIs in providing opportunities for post-secondary tertiary education (MoHE, 2007). The National Higher Education Strategic Plan projected that enrolment at tertiary level for the 17–23 age cohort would increase from 29 % in 2003 to 40 % in 2010, and further to 50 % by 2020. This is to enable the percentage of workforce with tertiary qualifications in the country to increase from 20 % in 2005 to 27 % in 2010, and further to 33 % by 2020, thereby increasing the skill level of the workforce. To enhance the attractiveness of higher education experiences in Malaysia, MoHE is also gradually liberalising the higher education industry by inviting more foreign universities to set up their campuses (Altbach et al., 2009; Knight, 2011; Morshidi et al., 2011).

Technology integration in HEIs could lead to pedagogical innovations that enhance student-centred and constructivist learning. As a result, the quality of teaching and learning can be significantly improved while countries can achieve greater economic competitiveness through education dollars.

1.3 Statement of the Problem

Throughout the global higher education systems, there is a general consensus that investment in technology to support educational goals attainment has been in the billions (Harvard Magazine, 2012). There is also a growing concern on how far technology has improved the quality of education to meet the changing landscape of job industries and demographic of HEIs students.

The massive investments and commitment to transform education at all levels in the past two decades have warranted the evaluation on how technology has improved educational goals attainment and widening access (Khan, 2012). There are various strategies that have been proposed to improve teaching and learning in the HEIs using the various tools of online technology (Orlando, 2011). Technology integration such as online learning through the application of the suites of learning management systems, has been propagated to be the solution to the constructivist concept of learning (Biggs, 2003). Technology has also been widely used to provide more authentic learning contexts in providing real time solutions that benefit the community and societies where the HEIs interact with (Kettunen, 2011).

However, the actual benefits of technology to education remain a highly debateable subject since the day computer was widely used in classrooms throughout the world. Cuban (2001) has expressed concern over the phenomenon of “being oversold and underused” that specifically refers to the fact that despite more computers being made available in the classrooms, teachers’ pedagogical practices have not changed much. This has raised much scepticism on the value of spending millions in bringing educational technology into the classrooms. There appears to be an unexplained gap between technology integration and pedagogical innovations among teachers and faculty members (Cuban, 2001; Papert, 1993).

The benefits of technology integration to improve efficiency and effectiveness of institutional management, and increasing competitiveness of graduates to meet work demands are very clear. However, leveraging on technology to improve the attainment of educational goals remains a global educational agenda. Have the technology really improved the pedagogical practices in the classrooms that this can be considered a form of innovations? Or are education institutions around the world just merely following the trend of technology without seriously examining how technology could improve teaching and learning? Many earlier studies have also highlighted the process of integration technology as a systemic change process. This change process is considered an innovation adoption (Hall & Hord, 2001; Rogers, 1995) which is not a linear process. The presence of barriers in HEIs can affect the success of technology integration (Ertmer, 2005). The study on technology integration and pedagogical innovations involves a systematic analysis of a change process (Owston, 2007; Owston, 2003; Yuen, Lee, & Law, 2009). The presence of barriers within the contexts of the organization and its members need to be further examined. Factors such as organisational leadership support and faculty members' background should also be examined in this context.

Past research has shown that there is a relationship between technology integration and innovative pedagogical practices (Bransford, Brown, & Cocking, 2000; Liu, 2011; Wenglinsky, 1998). The World Bank, UNESCO, Organisation for Economic Co-operation and Development (OECD), and the European Commission have advocated the use of technology to improve educational change and to promote lifelong education.

The international pedagogical innovations studies, SITES-M2 for K-12 education by Law et al. (2005) and Kozma (2003) revealed that there are some exemplary innovative pedagogical practices that have been implemented among some schools in the 28 education systems they studied. The researchers also stressed that pedagogical innovation is a very complex education research agenda. The ecological metaphor of pedagogical innovation study has proposed six dimensions of pedagogical innovations from the SITES-M2 surveys (Law et al., 2005). The six dimensions of indicators of pedagogical innovations are: (a) learning objectives, (b) teacher's role, (c) student's role, (d) complexity and sophistication of the ICT used, (e) the extent to which the classrooms are connected with the outside world through external participants, and (f) multiplicity of learning outcomes exhibited. Each of the six dimensions has five levels of innovativeness, ranging from "traditional" as the least innovative to "most innovative" practices in the dimension. The effort by researchers to understand pedagogical innovations brought by technology integration in so far has not yielded conclusive evidence.

Empirical research findings on supporting technology integration as having direct impact on pedagogical innovations vary widely and there are contradicting findings. Bennett and Maton (2010) pointed out that the 'digital natives' generation are constantly immersed in digital technologies. Simultaneously, many education systems are progressively fulfilling such needs. However, some education systems are at advantage as using technology in education is not an important agenda due to scarce resources. There is one obvious blind-spot for the highly proliferated use of technology in education, which is the lack of evidence of how technology can actually bring about pedagogical innovations. Technology integration and its associated benefits to education, often gain widespread popularity on the basis of claims rather than evidence (Bennett & Maton, 2010; Cuban, 2001). Recent research has shown flaws in the argument that the current generation of technology users are self-starters of highly adept technology users (Bennett et al., 2012; Prensky, 2001). For HEIs, these gaps provide valuable insights into students' experiences and how their learning could best be supported through their alma maters. Hence, the faculty members' view of pedagogical innovations using technology as one of the enablers is crucial to answering the calls for constructivist and pragmatic learning (Christensen et al., 2011b).

There is a need for additional research at institutional, national and regional education systems (Willis, Thompson, & Sadera, 1999). Although there is evidence that shows technology is being used by more faculties, the diffusion of technological innovations for teaching and learning has not been widespread, nor has IT become deeply integrated into the curriculum (Ghavifekr & Hussin, 2011; Kozma, 2003; Owston, 2007; Owston, 2003).

Technology integration has been frequently reported as a lever to improve teaching and learning in educational settings (Hiltz & Turoff, 2005; Keengwe, Onchwari, & Wachira, 2009; Hamsiah Mohd & Raja Maznah, 2010; Wachira & Keengwe, 2011). While there seems to be many benefits in integrating technology into pedagogical practices, research on educational innovations among HEIs in Malaysia is still at its early stage. Many research findings have also highlighted the interplay of demographic profiles, environmental and subject's underlying pedagogical beliefs, in the relationship between technology integration and pedagogical innovations.

In the Malaysian context, there has been an intense effort to call for drafting of a national policy for e-learning (Mohd Amin, 2011). Therefore, it is timely to find out how technology integration practices of faculty members in HEIs are related to pedagogical innovations. It is anticipated that there will be positive direct relationship while the demographic and organisation and faculty's beliefs will exert some degree of influence to the relationship. The data from this study could be interpreted and a relationship model for technology integration and pedagogical innovations would ultimately be proposed.

1.4 Objectives of the Study

Based on the speculations derived from the research problems, the primary purpose of this study is to examine how technology integration has changed pedagogical practices among HEIs in Malaysia. This study also seeks to identify to what extent the organisation and faculty's beliefs, as well as faculty's background exert effects on technology integration and pedagogical practices in the higher education institutions. Ultimately, this study seeks to examine the relationship among technology integration, organisation and faculty's belief and pedagogical innovations in Malaysian HEIs.

Specifically, the study seeks to examine the five main research objectives in this study:

(a) Technology integration practices (independent variable) among the HEIs using an Innovation Configuration Component Map (ICCM) instrument.

(b) The relationship between technology integration practices with organisation and faculty's beliefs (mediating variable) and demographic background variables (moderating variable).

(c) Innovativeness of pedagogical practices (dependant variable) in HEIs based on the SITES-M2 six pedagogical innovations dimensions.

(d) The relationship between pedagogical innovations with organisation and faculty's beliefs (mediating variable) and demographic background variables (moderating variable).

(e) The relationship among demographic background, and organisation and faculty's beliefs variables on technology integration and pedagogical innovations

This study attempts to understand the current state of technology integration practices of faculty members of Tier 5 HEIs in Malaysia and their associated pedagogical innovations. Tier 5 HEIs are also recognised as universities that are research-intensive and their pedagogical practises are closest to the set benchmark of the ministry of higher education. The interplay of demographics, organisation and faculty's beliefs on technology integration are also examined in the current research contexts.

1.5 Research Questions

The study seeks to answer the five main research objectives as outlined in section 1.4. The research questions by main research objectives of this study are as follows:

(a) Technology integration practices (independent variable) among the HEIs using an Innovation Configuration Component Map (ICCM) instrument.

1. What are the fidelity profiles of technology integration practices among the subjects of this study?

(b) The relationship between technology integration practices with organisation and faculty's beliefs (mediating variable) and demographic background variables (moderating variable).

2. Is there a significant relationship between technology integration practices and demographic characteristics?
3. Is there a significant relationship between technology integration practices and organisation and faculty's beliefs?

(c) Innovativeness of pedagogical practices (dependant variable) in HEIs based on the SITES-M2 six pedagogical innovations dimensions.

4. What are the profiles of pedagogical innovativeness among the HEIs subjects?

(d) The relationship between pedagogical innovations with organisation and faculty's beliefs (mediating variable) and demographic background variables (moderating variable).

5. Is there a significant relationship between pedagogical innovativeness profile and demographic variables?
6. Is there a significant relationship between pedagogical innovativeness profile and organisation and faculty's beliefs?

(e) The relationship among demographic background, and organisation and faculty's beliefs variables on technology integration and pedagogical innovations

7. Does technology integration practices based on ICCM score, a significant predictor to pedagogical innovativeness?
8. Is the proposed model of technology integration practices based on ICCM score as a significant predictor to pedagogical innovativeness valid?

All subsequent report writing is presented and analysed according to the flow of these eight research questions.

1.6 Significance of the Study

Research on how technology integration has changed pedagogical practices in higher education is relatively new in Malaysia. In essence, this study will contribute to the general body of knowledge on the relationship between technology integration and pedagogical innovations. This study will provide the stakeholders of higher education the critical lens to evaluate how effectively technology has been integrated among HEIs.

The current challenges faced by educators and government are less about investing technology dollars into their education setups but how technology will really benefit the students. Effective teaching and learning requires innovative pedagogical skills which is multi-dimensional in nature. Technology is just one dimension of the entire innovation in pedagogies although it is the most commonly used indicator (Christensen & Raynor, 2003; Harvard Magazine, 2011, 2012).

A review of literature showed that a lot of investments have been pumped in to equip HEIs with modern ICTs. Unfortunately, many faculty are not effectively integrating technology into their pedagogical practices and some are even not sure of how they can use technology effectively (Cuban, 2001; O'Connor, 2012; Rice & Miller, 2001). On the other hand, HEIs are required to envision new and innovative pedagogical practices in their learning platforms that transcend classrooms through technology integration. The study has also identified organisational and faculty barriers that HEIs face in integrating technology into desired innovative pedagogical practices. Findings on organisational and faculty's beliefs will be crucial for HIEs leaders to identify possible pitfalls during planning, executing and evaluating a technology integration project.

According to the SITES-M2 international findings, the six dimensions of pedagogical innovations can be further extrapolated to present an idea of the level of innovativeness of the faculty, the classroom setting, the school and the education institution of the study. An innovation profile of pedagogical practices in each of the HEIs is constructed based on the scores of the six dimensions. In addition, this innovation profile of the study population and ownership (public and private) of HEIs is presented.

At the country level, this study will contribute to the international research findings on technology integration and its influence on pedagogical practices in HEIs globally. There are some preliminary studies that have reported the use of ICT in delivering teaching and learning in HEIs in Malaysia following the establishment of e-learning universities since 2000 (Elwood & MacLean, 2012; Ng, 2011). These studies focused mainly on the implementation strategy of e-learning. There is less emphasis on the execution process such as the adoption of innovation, the associated effects on pedagogical practices, and barriers to adoption. Most of the reports have highlighted how the newly established non-traditional universities offer programmes through the hybrid and blended mode such as e-learning portals that are commonly known as learning management systems. While the traditional campus-based universities are also becoming more responsive to the technological advancement, the need to understand how faculty members of HEIs in Malaysia are leveraging on technology integration to achieve pedagogical innovations is timely.

With the increasing emphasis on the liberalisation of higher education industry, and especially in Malaysia's quest to become an education hub in South East Asia (Knight, 2011; Morshidi et al., 2011) this study will also provide the interested stakeholders the critical lens to enhance the competitiveness of the country's education system through technology integration. The K-12 education system around the globe is progressing at a rapid pace due to globalisation and associated technological advancement. There is a marked effort by the Malaysian government to align the country's secondary education system to resonate the changes brought by technology and international trends such as the P21 framework (Trilling, 2009). Similarly, the Malaysian HEIs are expected to align themselves through the National Higher Education Strategic Plan (MoHE, 2007; AIM, 2009) to further enhance the quality and efficiency of their delivery systems. Hence this study will provide critical insights into how adaptive Malaysian HEIs are to leverage on technology integration that resulted in innovative pedagogical practices.

At the international level, the present the K-12 school system in the US and its equivalent in many developed countries have experienced an exponential growth in technology integration. There is a plethora of literature documenting technology integration and its effects on pedagogical innovation (Kozma, 2003), pre-service teachers training programmes (Ertmer, 2005), in-service teachers adoption (Evans et al., 2012), and the interplay of a number of variables. However, most of the studies have been conducted on selected best practices in education among 28 OECD countries (Kozma, 2003). It was reported that there are no two countries having an identical philosophy and idealism of education. Hence, this study of technology integration and pedagogical innovations will contribute significantly to the understanding on Malaysian HEIs taking into consideration the unique peculiarities of a country's education system (Kozma, 2003). The Malaysian HEIs might require a different approach to elicit innovative pedagogical practices through technology integration.

This study on examining the relationship between technology integration and pedagogical innovativeness is timely as the results will enhance the current body of knowledge in a similar field. This study seeks to evaluate the extent to which organisation and faculty beliefs influence the relationship between technology integration and pedagogical innovations. The findings that are based on the six dimensions of pedagogical innovations would, reveal the current state of pedagogical innovations among HEIs in Malaysia. It could serve as a useful guide to the various stakeholders of HEIs specifically in terms of investment in technology to improve on teaching and learning. In addition to that, another significant purpose of the study is to establish a relationship model of technology integration and pedagogical innovations that could be used as an evaluation guide for HEIs in Malaysia to enhance effectiveness of technology integration in delivering pedagogical innovations.

1.7 Operational Definitions

The following terms used in the study are conceptually and operationally defined as follows:

(a) Higher Educational Institutions (HEIs)

This refers to universities that are allowed to confer pre-university, diploma, degree and postgraduate-level qualifications. Some of these universities could also be offering joint programmes through various institution-institution or government-government academic collaborations with partner universities. Higher education institutions also refer to both public and private universities established in Malaysia. It excludes universities that offer online academic programmes.

(b) Technology integration

This refers to a complex mix of hardware and software embedded in various educational contexts: on and off campus. Often, technological tools used by faculty and students in a technologically integrated environment are inclusive but not limited to course web sites such as learning management systems, PowerPoint, discussion boards, e-mail, library reserves, and use of the Web for research.

(c) Pedagogical innovations

This refers to teaching and learning practices that allow for two-way, dynamic communication between the lecturers and learners as well as among the learners, and there is possible involvement of topic experts and practicing professionals outside the HEIs. The group sharing similar intellectual discourse have teaching and learning transactions that take place either in synchronous (face-to-face) or asynchronous (on-line) environment.

(d) Organisation and faculty's beliefs

It is measured using an instrument formulated by the researcher based on the findings of Ertmer (1999) and Owston (2003). Organisation and faculty's beliefs would refer to the earlier findings of Ertmer (1999, 2005) of first order and second order barriers. The term "organisation and faculty's beliefs" also refers to the mediating variables of this study. There are ten variables presented in this study and further presented as first and second order barriers in chapters 4 and 5.

(e) Tier 5 HEIs

Tier 5 HEIs are universities that are excellent in teaching and research under the Rating System for Malaysian Higher Education (SETARA) report (MQA, 2012). This rating system has been developed by Malaysian Qualification Agency (MQA) and endorsed by the Ministry of Higher Education Malaysia (MoHE). This is a biennial report first started in 2009. In this study all the HEIs were classified under the Tier 5 of the rating report for 2011. The SETARA rating is based on 25 criteria, captured through 82 indicators covering three generic dimensions of input, process and output to access the quality of teaching and learning of HEIs in Malaysia. A Tier 5 rating means the HEI scored a minimum performance rating of: 70% to 79.9% based on the twelve areas of academic performance audit conducted in 2009 by the MQA and an independent panel. Based on the performance rating between 70% and 79.9%, Tier 5 universities were reported as "excellent in teaching and learning at undergraduate level of study" (MQA, 2012). Tier 5 universities are being provided with many grants for enhancing teaching and learning as well as research and discovery by the government of Malaysia.

1.8 Assumptions of the Study

This study has identified six Tier 5 HEIs based on the Malaysian Qualification Agency (MQA) SETARA 2011 report. The SETARA rating system for Malaysian Higher Education Institutions is a biennial report commissioned by the Ministry of Higher Education Malaysia to evaluate the quality of teaching and learning of universities and university colleges in Malaysia. There are three generic indicators of HEIs performance used in this ranking system, namely, input, process and output (MQA, 2012).

The HEIs selected in this research possess the following characteristics:

(a) Established as traditional, campus-based HEIs that confer qualifications in undergraduate and postgraduate levels of study.

(b) The HEIs regardless of their funding source (public or private) persistently endeavour to achieve the highest level of technology integration and pedagogical innovations.

(c) The faculty of the HEIs, though diverse in their background, are aware of the presence of technology in their daily routine.

1.9 Limitations of the Study

The instrument used in this study was adapted from various established findings based on qualitative research using case studies. This is the first time an attempt is made to examine the relationship between and among the dependant and independent variables defined in the contexts of HEIs. This study was conducted with the consent from the Ministry of Higher Education Malaysia as well as the HEIs selected by the researcher. There are six HEIs participating in this study. Therefore, findings from this study should not be assumed to be reflective of other HEIs’ state of technology integration and pedagogical innovations in the country. In order to focus on a homogenous group and to eliminate extraneous influences as much as possible, the study was restricted to include only full-time faculty members.

The instrument designed in this study contained four sections, namely, (a) demographic profile, (b) technology integration practices based on ICCM as an independent variable, (c) pedagogical innovativeness based on the six dimensions of pedagogical innovations of SITE M2 instruments as dependant variable, and (d) organisation and faculty's beliefs as mediating variables. The Technological Pedagogical Content Knowledge (TPACK) framework of evaluating the dynamics among technological, pedagogical and content knowledge as proposed by Mishra and Koehler (2006) could not be applied in this study due to time factor. The TPACK framework requires researchers to evaluate the specific knowledge of subjects on the mastery of technology integration, pedagogical and subject knowledge (Mishra & Koehler, 2006).

The extent to which technology integration has significantly improved pedagogical innovations in higher education has lack of support from empirical findings. This study seeks to examine the proposed model of relationship among technology integration, organisation and faculty's beliefs, and pedagogical innovations.

1.10 Summary

The unprecedented rate of technological advance in all facets of life has led to the urgency of education stakeholders around the world to review how to best use technology to teach. Many studies have highlighted that the current roles of technology integration in addressing the pedagogical practices remains a gap in education research. There are contradictory findings of technology integration as solutions to unleashing the great promise of learner centred and pragmatic pedagogies as a form of pedagogical innovations.

This study aims to answer the current research findings gap between technology integration practices and pedagogical innovations. The influence of demographic and organisation and faculty's beliefs are also examined in the relationship between technology integration and pedagogical innovations. This study ultimately seeks to evaluate the predictive significance of technology integration practices on pedagogical innovations.

In the following section, Chapter 2 Literature Review, the current published findings and reports from the various perspectives of the independent, dependent, mediating and moderating variables are examined in greater details. The diffusion theory for innovation adoption and theoretical model of Concern Based Adoption Model (CBAM) are explained in details. The conceptual framework of this study is presented at the end of Chapter 2.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Overview

The purpose of this study is to investigate technology integration practices and its relationship with pedagogical innovations among faculty members of HEIs in Malaysia. Technology integration practices were evaluated using an innovative configuration component map (ICCM) that comprises of six dimensions technology integration components. The ICCM yielded a total score that subsequently determined the fidelity levels of subjects in this study. Pedagogical innovations were measured based on the established six dimensions used in the SITES-M2 study. The moderating effects of six demographic variables, gender, age, faculty's discipline, teaching experience, highest level of academic qualification attained, and academic position held, are investigated. The mediating effects of ten variables collectively called organisation and faculty's beliefs are examined. The overall relationship among the four main variable groupings in this study is examined.

This chapter presents the review of related empirical studies in the literature pertaining to the conceptualisation of this study. The sources of literature cited in this study comprised of government reports, research publications, thesis from local and international context, professional books, academic journals and relevant periodic review databases. The flow of this chapter starts with relevant theory and current relationship model relevant to technology integration and pedagogical innovations. The current studies on evaluation of technology integration practices are identified and discussed in detail. Similarly, the contemporary studies related to pedagogical innovations based on exemplary studies are also presented. Findings are compared, contrasted and reviewed. This is then followed by highlighting factors that have been reported to have implicated the efforts of technology integration for pedagogical innovations. From the convergence of these empirical studies, the theoretical framework and the relevant theories are reviewed. This chapter concludes with an overview of the conceptual framework proposed in this study and a summary of this chapter.

2.2 Introduction

Traditional approaches of teaching utilize one-way communication media such as textbooks, lectures, and videotapes. Such learning approaches are considered passive learning where teachers are the centres of all learning. Technology such as ICT has shifted the roles adopted by higher education institutions, lecturers, and students. Through technology, the pedagogies and boundaries of learning and teaching are removed as new forms of learning come into the actual scenario of a typical classroom. Learning is now student-centred and customisable (Christensen et al., 2011a; Lombardi, 2007).

Pedagogical innovations can be described as instruction delivery that allows for two-way, dynamic communication between the instructor and learners, as well as among the learners in the learning communities, field experts, and practicing professionals (Kettunen, 2011). One of the key enablers of innovative pedagogy is the presence of technology that drives innovation through real-time communications among learners that share common intellectual interests. This group of community of learners (Garrison & Kanuka, 2004) is also commonly referred to as collaborative learners that constantly share knowledge through activities that transcend institutional boundaries of semesters, majors, and required courses (Flynn & Vredevoogd, 2010). Innovation through technology offers greater flexible delivery of instruction that makes the learning environment more learner-centred and less institution or instructor-centred (Sullivan & Baren, 1997).

According to Biggs (2003), traditional teaching methods such as the lecture, tutorial and private individual study do not provide much support for the development of the skills required for higher-level learning processes. In order for learning to be meaningful, students must want to learn in which they have to be motivated and engaged learners. This approach is called constructive alignment based on Jean Piaget's theory of constructive learning (Biggs, 2003). This shift to student-centred learning is liberating and the quality of teaching can be enhanced by aligning objectives, teaching styles and assessment tasks.

Another important change in the higher education landscape is that teaching and decision-making in higher education have become more centrally controlled and subject to the economic and managerial considerations than they used to be. Students are now more diverse in demographic: age, experience, socio-economic status and cultural background. There is no one all-purpose best method of teaching to fit this diversity. Technology has become the corner stone of many new transformation endeavours of HEIs.

Biggs (2003) also stressed that the role of the teacher is to engage students in activities that are more likely to lead to quality learning within the constraints of their resources. However, over emphasizing the use of ICT as tools to deliver quality teaching instead of pedagogical practices could lead to teaching as mere knowledge transmission instead of enhancing learning experience. Education technology can only provide an alternative to conventional methods of teaching and assessment in higher education. In researching the processes by which discipline or domain specific knowledge is converted or pedagogised to constitute institution knowledge and teaching practices, theoretical models are crucial to educational research during a period variously described as the knowledge society and informational society (Castells, 2000; Leadbeater, 2006).

2.3 Theory and Theoretical Concept Relevant to the Study

Technology integration in educational settings is an innovation adoption process. The study of innovation adoption involves a thorough understanding of the systemic change as described by the Roger's theory of diffusion (1995) and Hall and Hord's (2001) Concern-Based Adoption Model (CBAM). The following sections will describe these in further details.

2.3.1 Innovation Adoption and Rogers' Theory of Diffusion

The theory of diffusion of Rogers (1995) describes the profile of the innovation adopters (from early adopters to laggards) and critical factors that facilitate innovation adoption. Rogers first proposed this theory for the agricultural innovation practices in the United States where innovation adoption of corn seeds became popular in the 1930s. Rogers' diffusion theory for innovation adoption was used extensively in the studies of innovation adoption in communications and technology adoption related studies. This diffusion theory is widely regarded as pro-innovation as it assumes that an innovation should be diffused and adopted by all members of a social system, and that it should be diffused as quickly as possible, and the innovation should be neither re-invented nor rejected.

The theory of innovation diffusion of Rogers (1995) has been applied to many studies of technological innovations such as business, agriculture, healthcare, industrial and higher education (Crooks, Yang, & Duemer, 2003; Dubetz et al., 2008). Rogers stressed that 'diffusion is the process by which an innovation is communicated through certain channels over time among the members in a social system' (Roger, 1995, p. 5).

Within this paradigm of innovation system, communication becomes a process where subjects share information with each other in order to reach a mutual understanding. When the use of technology as a teaching tool is viewed as an innovation, one of the variables that must be understood is the social process in which individuals tend to adopt or reject as a result of conversations with others (Hall and Hord, 2001).

An innovation is defined as "any idea, practice or material artefact perceived by the potential market to be new" (Rogers, 1995, p. 5). The diffusion of an innovation throughout society varies by attributes of the innovation and by the innovativeness of adopters. An individual is said to be innovative if he or she is relatively early in adopting new ideas as compared to other members in a social system. Rogers (1995) identified five categories of innovation adopters: (i) Innovators; (ii) Early adopters; (iii) Early majority; (iv) Late majority, and (v) Laggards. These categories of adopters in the social system could be represented by Figure 2.1. There are typically five groups of adopters in this theory.

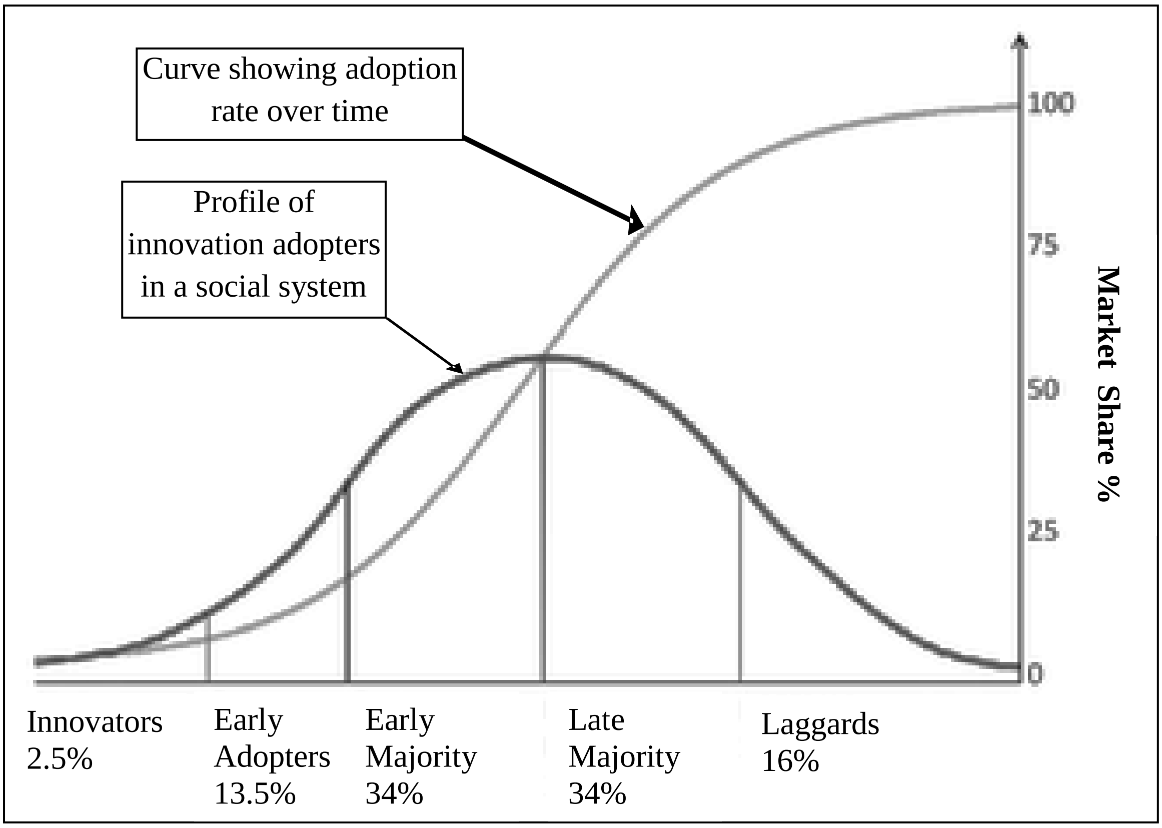
(a) The "innovators" are described as active seekers of information about new ideas and are better able to cope with higher levels of uncertainty than those in other categories. They are typically the visionary leaders and imaginative innovators.

(b) The 'early adopters" are members who once see the benefits of the adoption of an innovation quickly chanced on the innovations. They are easily motivated without much persuasion as long as there are tangible benefits to the innovation adoption.

(c) The "early majority" are members who are comfortable with moderately progressive ideas and always require hard truth and evidence to win over in innovation adoption. They are usually cost sensitive and risk averse.

(d) The "late majority" are conservative pragmatists who dislike inconsistency and changes but do not want to be left out in the upcoming norm when the innovation is adopted widely.

(e) The "laggards" are typically those who resist all new ideas and see high risks in every move when new innovation is adopted widely. With high level of personal control and support, they will ultimately adopt the innovation.



Source: adapted from Rogers (1995, p.5)

Figure 2.1 The Innovation Adoption Curve

There are five characteristics of an innovation that explain the innovation's rate of adoption as follows:

(a) Relative advantage

The degree to which an innovation is perceived as better than the idea it supersedes. The degree of relative advantage may be measured in economic terms, but social prestige, convenience and satisfaction are also important factors. What does matter is whether an individual perceives the innovation as advantageous. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be.

(b) Compatibility

It refers to the degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of potential adopters. An idea that is incompatible with the values and norms of a social system will not be adopted as rapidly as an innovation that is compatible. The adoption of an incompatible innovation often requires the prior adoption of a new value system which is a slow process.

(c) Complexity

This refers to the degree to which an innovation is perceived as difficult to understand and use. Some innovations are readily understood by most members of a social system; other may be more complicated and will be adopted more slowly.

(d) Trialability

This refers to the degree to which an innovation may be experimented with, on a limited basis. New ideas that can be tried on the instalment plan will generally be adopted more quickly than innovations that are not divisible. An innovation that is trialable represents less uncertainty to the individual who is considering it for adoption as it is possible to learn by doing.

(e) Observability

It is the degree to which the results of an innovation are visible to others. The easier it is for individuals to see the results of an innovation, the more likely they are to adopt it. Such visibility stimulates peer discussion of a new idea as friends and neighbours of an adopter often request innovation-evaluation information about it.

Innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability and less complexity will be adopted more easily than other innovations (Rogers, 1995, p.16).

Innovations could be further categorised by the behavioural change required in order to adopt the innovation. For this, there are three types of innovations that enter society. First, the continuous innovation which requires relatively minor changes in behaviour. Second, a dynamic yet continuous innovation which requires a moderate change in important behaviour in the system. Third, the discontinuous innovation which requires major changes in behaviour (Rogers, 1995).

When the three types of innovations are used to analyse individuals in an innovation system, it is apparent that the perceived newness of an idea for an individual that determines whether an innovation is truly an innovation to that individual in the system. Therefore the state of an innovation reflects the behaviour of an individual adopter at the time of adoption within the system. For example, if a faculty member does not use technology at all in daily life, the use of technology as a teaching tool may be viewed as a discontinuous innovation because it causes a major change in behaviour. On the other hand, if a faculty member uses technology consistently in daily life, but has not yet adopted technology per se in the teaching and pedagogy practices, it may be viewed as a continuous innovation. Rogers' theory states that innovation is a diffusion process itself that takes place in the population of a group where the innovation is being investigated. Regardless of industry or organisation where an innovation is taking place, different innovations diffuse at different rate of successful adoption when it is implemented (Rogers, 1995).

The rate of adoption of an innovation refers to the relative speed with which an innovation is adopted by members of a social system. This is the time dimension of any study of diffusion of innovations. When the number of individuals adopting a new idea is plotted on a cumulative frequency basis over time, the resulting distribution is an S-shaped curve (Figure 2.1). Initially, only a few individuals adopt the innovation in each time period and they are called the innovators. But soon, the diffusion curve begins to climb, as more and more individuals adopt in each succeeding time period. Eventually the trajectory of adoption begins to level off, as fewer and fewer individuals remain who have not yet adopted the innovation. Finally, the S-shaped curve reaches its symptote and the diffusion process is finally completed.

Rogers' diffusion of innovations has its limitation of applicability in technology integration in a social system. A common criticism is that this theory implied a pro-innovation bias. This pro-innovation bias is described as the expectation that an innovation should be diffused and adopted by all members of a social system, that it should be diffused as quickly as possible and that the innovation should be neither re-invented (Rogers, 1995).

Technology integration in HEIs involves a systemic change process that is often referred to as transformation. In order to achieve the intended organisational outcomes through technology integration, HEIs need to evaluate the readiness of the organisation and a clear innovation implementation plan is a must. Understanding the organisation and faculty's beliefs on integration technology into pedagogical practices in HEIs play a crucial role in technology integration endeavour.

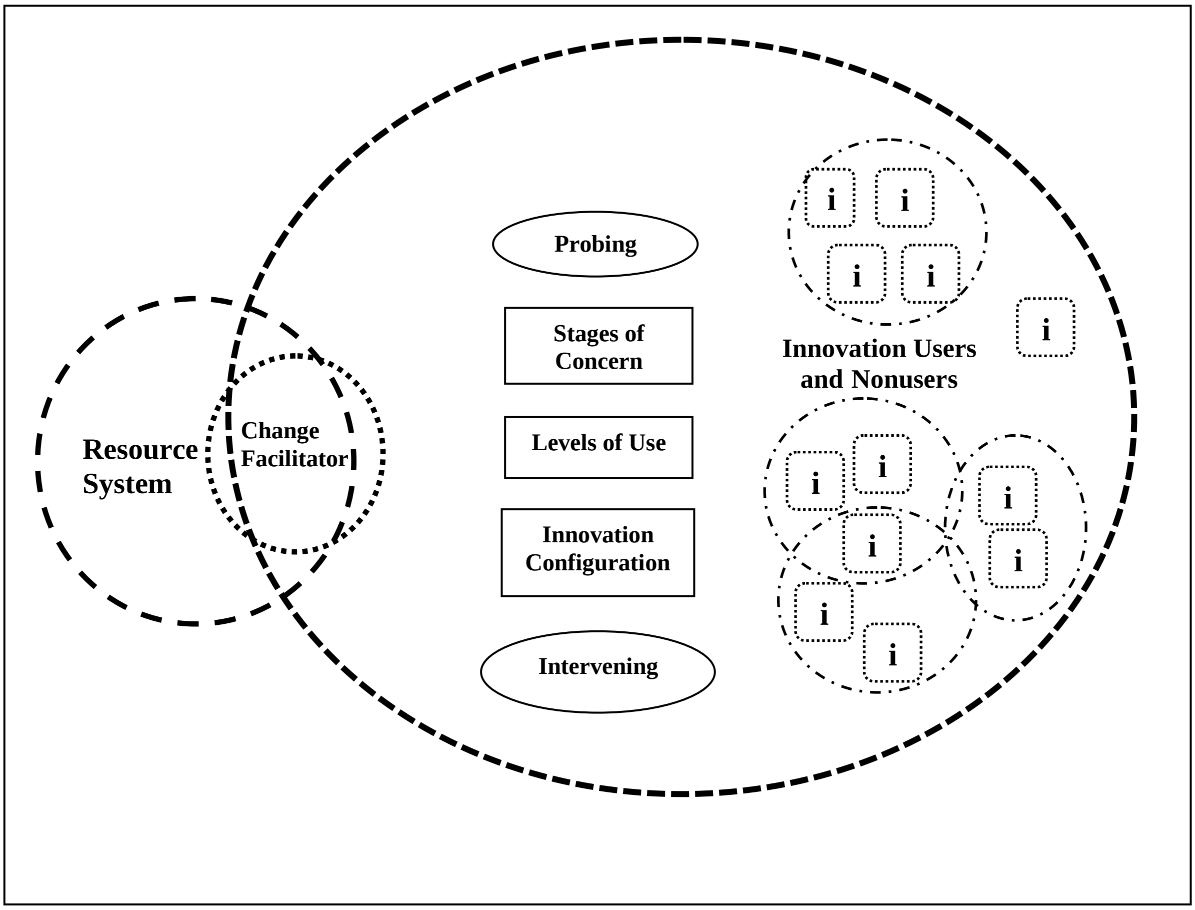
Roger's diffusion theory is widely used in many innovation adoption studies in communications, technology and healthcare research. In the HEI, this theory could be applied to a longitudinal study on specific teaching and learning innovation practices such as the use of learning management system (LMS) that complements the traditional face-to-face approach. However this is not the focus of this study. This study did not look at the profiles of technology integration adoption among the faculty members, as technology adoption across the HEIs sector in Malaysia is an institutional driven priority. In other words, HEIs are autonomous in equipping their faculty members with up-to-date technology skills and deciding on their technology agenda priorities. All the HEIs selected in this study, nevertheless have impressive teaching and learning infrastructure that made them rated as "excellent" universities in Malaysia.

The research focus mirrored the international agenda which is more towards the relationship between technology integration and the associated pedagogical practices. Therefore Rogers' theory of diffusion would enable the findings of this study to be explained from the perspectives of faculty members' current state of beliefs which is related to their groupings of innovation adopters. This theory could explain the mediating effects of the ten variables for organisation and faculty's beliefs (Section D of questionnaire). The mediator variables in this study also explains the states of how faculty members see the various supports needs and their personal beliefs that influenced their technology integration and pedagogical innovativeness.

2.3.2 Change Process and the Concerned-Based Adoption Model (CBAM)

The general critique that Rogers diffusion theory is pro-innovation bias is supported by Hall and Hord's (2001) Concerned-Based Adoption Model (CBAM). Technology integration by faculty members is an individual innovation adoption decision. According to Rogers' (1995) theory of diffusion, the profile of the innovation adopters, from early adopters to laggards, is of pro-innovation. This means the innovation adoption should be diffused and adopted by all members of a social system as quickly as possible. It is also assumed that the innovation that is diffusing throughout the social system should neither be re-invented nor rejected. This has led to common criticism on this theory that it is pro-innovation bias.

This fundamental weakness in Rogers' diffusion theory is circumvented by grounding innovation adoption research on innovation diffusion in the Concerns-Based Adoption Model (CBAM) (Hall & Hord, 2001). The CBAM is a systematic model used to monitor actual adoption patterns and re-invented uses of the innovation. This model includes: (i) a probing stage where the system is examined of its state of innovation, (ii) a three-diagnostic tools to monitor adoption of an innovation and potentially influence the adoption of an innovation: stages of concern (SoC), levels of use (LoU) and innovation configurations (IC), and (iii) the intervention stage where the resulting information can be used to match resources with the needs of the users and thus provide interventions (Figure 2.2). Surrounding this system are the environmental factors which are the resource system that is not restricted to school, district, community, state, federal and global forces that influence the change process in any setting. In this model, it is postulated that for an innovation to take place, the presence of a change facilitator/agent is critical to the success of innovation adoption (Hall & Hord, 1987; Hall, Hord, & Hirsh, 2010).



Source: adapted from Hall and Hord (1987, p.12)

Figure 2.2 The Concerns-Based Adoption Model

CBAM has three diagnostic tools to monitor innovation: Stages of Concern Questionnaire (SoCQ), Levels of Use (LoU) and ICCM, which are explained in details in three sections.

(a) Stages of Concerns

Hall and Hord (2001) address the importance of understanding feelings and perceptions about the innovation. The change process can be sorted and classified as "concerns". There is a developmental pattern to how individual feelings and perceptions evolve as the change process unfolds which they have named the stages of concern. Through research, Hall and Hord (2001) identified a set of seven specific categories of concerns depicted in Table 2.1.

Table 2.1

Stages of Concern about the innovation

Stage	Stage Label Name	Definition of Stage
6	Refocusing	The focus is on the exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing form of the innovation.
5	Collaboration	The focus is on coordination and cooperation with others regarding use of the innovation.
4	Consequence	Attention focuses on impact of the innovation on clients in his or her immediate sphere of influence. The focus is on relevance of the innovation for clients, evaluation of outcome including performance and competencies and changes needed to increase client outcomes.
3	Management	Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organising, managing, scheduling and time demands are utmost importance.
2	Personal	Individual is uncertain about the demands of the innovation, his or her inadequacy to meet those demands, and his or her role with the innovation. This includes analysis of his or her role in relation to the reward structure of the organisation, decision making and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the programme for self and colleagues may also be reflected.
1	Informational	A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be unworried about himself or herself in relation to the innovation. He or she is interested in substantive aspects of the innovation in a selfless manner, such general characteristics, effects and requirements for use.
0	Awareness	Little concern about or involvement with the innovation is indicated.

Source: adapted from Hall and Hord (2001, p.63)

The seven stages of concern could be measured using the Stages of Concern Questionnaire (SoCQ) which is a 35-item questionnaire that has strong reliability estimates (test or retest reliabilities range from .65 to .86) and internal consistency (alpha-coefficients range from .64 to .83) (Hall and Hord, 2001, p. 68). This SoCQ was constructed to apply to all educational innovations.

For the reason that the focus of this research is on innovation in pedagogical practices brought by technology integration, the detailed content and interpretability of SoCQ is not examined.

(b) Level of Use (LoU)

The SoCQ addresses the affective side of change: people's reactions, feelings, perceptions and attitudes. Levels of Use (LoU) refer to behaviours and portrays how individuals act with respect to a specific change. There are eight levels of use developed by Hall and Hord as the second diagnostic dimension of the CBAM instrument. Each level is described in detail in Table 2.2.

Table 2.2

Levels of Use of the Innovation

Type of User	Level	Level Label Name	Definition
Users	VI	Renewal	State in which the user re-evaluates the quality of the use of the innovation, seeks major modifications of or alternatives to present innovation to achieve increased impact on clients, examines new developments in the field and explores new goals for self and the system.
	V	Integration	State in which the user is combining own efforts to use the innovation with related activities of colleagues to achieve a collective impact on clients within their common sphere of influence.
	IVB	Refinement	State in which the user varies the use of the innovation to increase the impact on clients within immediate sphere of influence. Variations are based on knowledge of both short and long-term consequences for clients.
	IVA	Routine	Use of the innovation is stabilised. Few if any changes are being made in on-going use. Little preparation or thought is being given to improving innovation use or its consequences.
	III	Mechanical Use	State in which the user focuses most effort on the short-term, day to day use of the innovation with little time for reflection. Changes in use are made more to meet user needs than client needs. The user is primarily engaged in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.
Non-users	II	Preparation	State in which the user if preparing for first use of the innovation.
	I	Orientation	State in which the user has recently acquired or is acquiring information about the innovation and or has recently explored or is exploring its value orientation and its demands upon user and user system.
	0	Non-use	State in which the user has little or no knowledge of the innovation, no involvement with the innovation, and is doing nothing toward becoming involved.

Source: adapted from Hall and Hord (2001, p.82)

For the reason that the focus of this research is on innovation in pedagogical practices brought by technology integration, the detailed content and interpretability of SoCQ and LoU shall not be the scope of discussion here.

(c) Innovation Configuration Map (ICM)

The challenging situation in which educators are not sure about what they are to do often occur during implementation of an innovation. This is in part due to the fact that innovation developers could have difficulties in visualising the extent to which their innovation can be adapted. In addition to that, there is always uncertainty in that change facilitators and educators do not have clear images and descriptions about what kind of benefits could be the results of the implemented innovation. To address these challenges, Hall and Hord (2001, p. 41) developed a process and tool that can be used to visualise and assess the different configurations that are likely to be found for any particular innovation. They called this process Innovation Configuration Mapping and the resultant tool called an Innovation Configuration Map (IC Map). The IC Map composed of "word picture" descriptions of the different operational forms of an innovation or change based on components of an innovation that is implemented.

The basic premises underlying the CBAM model in examining technology integration in schools and higher education environment are:

(a) Change is a process not an event

(b) Understanding the change process in organisations requires an understanding of what happens to individuals as they are involved in the change

(c) For the individual, change is a highly personal experience

(d) For the individual, change entails developmental growth in terms of feelings about and skill in using the innovation, and

(e) Information about the change process collected on an on-going basis can be used to facilitate the management and implementation of the change process.

The CBAM model was recently applied in a study on faculty members' perceptions on the quality management system (QMS) ISO 9001:2008 implementation process in a public HEI in Malaysia (Tan, Haron, Yahya, Dhalan, Goh & Ashaari, 2011). This study mapped the Stages of Concern (SoC) faced by the entire department of postgraduate business school staff members while the QMS was being implemented. SoC was found to predict up to 45.6% of variance in the levels of use (LoU) of the QMS. It was also reported that though there were many concerns among the subjects, demographic profile of a staff member predicted up to 34% of the variance in the LoU of QMS. This study revealed that CBAM could be used to evaluate the underlying concerns of teachers during an innovation adoption. However, innovation adoption in the case of QMS implementation that aimed to improve quality of HEI services requires a longitudinal systemic change evaluation rather than a one-off assessment.

In essence, facilitation of innovation adoption requires continuous and systemic interventions that could be effectively managed using the IC Map in the CBAM model. Many studies on measuring outcomes of an innovation adoption such as technology integration have reported the use of IC Map (Javeri & Persichitte, 2007; Kozma, 2003; Law et al., 2011b).

This IC Map has been adopted in SITES-M2 studies reported in Europe, Hong Kong and Israel (Kozma, 2003; Law et al., 2005a; Mioduser, Nachmias, Tubin, & Forkosh-Baruch, 2003). The following section will discuss the adapted IC Map in evaluating the levels of innovativeness of technology integration practices in higher education as reported by (Javeri & Persichitte, 2007).

The study on technology integration in higher education involves systematic analysis of the innovation adoption as a change process (Ensminger, 2005). There was a study on technological development in Malaysia as a case study of innovation adoption (Lai, 2006). In this study to evaluate technological development in Malaysia, there were four perspectives of analysis: (i) measurement, (ii) impact, (iii) diffusion, and, (iv) policy. This study was conducted as a meta-analysis of the manufacturing industry in Malaysia with a focus on small and medium enterprises (SMEs). One of the major findings of this study was that there was a significant correlation between investment in ICT and growth in the productivity of the SMEs and GDP of the country. Although the higher education sector was excluded from this study, there has been greater emphasis on HEIs investment on integrating technologies into many facets of higher education.

A study that investigated the adoption of technology among technical educators in Malaysia has highlighted the presence of significant barriers (Mat Rashid, 2006). In this study, it was reported that gender played a significant moderating role in a faculty member's knowledge and satisfaction in technology use. In addition to that, faculty members were found to be most comfortable using technology applications that they were familiar with, such as the internet, word processing and presentation software. This study has again stressed that the HEI management should address the presence of common barriers among adopters and that technological and pedagogical supports are crucial to ensure successful implementation of technology (Mat Rashid, 2006).

In 2011, a study on e-learning adoption by Open and Distance Learning (ODL) organisations in Malaysia was reported (Ghavifekr & Hussin, 2011). It reiterated that innovation adoption such as use of e-learning by faculty members is a managing system change process. Clear management strategies and policies that are properly planned, organised, guided and monitored, are crucial to ensure a successful implementation.

Hence, a similar evaluation of the degree of relationship between technology integration and pedagogical innovations among HEIs from the perspective of strategy and management is timely (Raja Maznah & Abdul Halim, 2012). Organisation and faculty's beliefs should also be taken into consideration as many research findings have established its correlation with innovations implementation.

2.3.3 Technology Integration and the Innovation Configuration Component Map (ICCM)

This fundamental weakness in Rogers' diffusion theory is circumvented by grounding innovation adoption research on innovation diffusion in the Concerns-Based Adoption Model (CBAM) (Hall & Hord, 2001) as reported by (Javeri & Persichitte, 2007). This ICCM was developed to provide vivid descriptions of different uses and forms of technology integration.

An ICCM is composed of: (i) components (major features of the innovation), (ii) variations (different ways in which components may be operationalized), and (iii) configurations (operational patterns that result from selection and use of different innovation component variations) (Javeri & Persichitte, 2007). This ICCM tool has also fulfilled Heck et al.'s (1981) concept of innovation configurations where the use of innovation configuration components should emphasise concrete and tangible operational forms of the innovation. Therefore, fulfilling the concept of innovation configurations has increased the reliability and validity of information about the use of innovation. In addition to that this ICCM not only can be used to capture the adopter categories, the Rogers' pro-innovation bias is also addressed (Hall & Hord, 2001; Hall, Wallace, & Dossett, 1973). The ICCM allows measurement of innovation adoption in many forms: rejection, discontinuance, and re-invention; all are frequent occurrences during the diffusion and adoption of an innovation (Javeri & Persichitte, 2007).

This ICCM has also been developed and used widely in most pre-service teacher training programmes and education faculty in the United States to evaluate the status of technology integration. In addition to that, the ICCM can also be used to identify barriers among the members during the innovation implementation process. The ICCM could serve as baseline data on implementing technology integration in pedagogy practices (Ensminger, 2005; Shufflebotham, 2004).

2.3.4 Importance of Technological, Pedagogical and Content Knowledge Alignment and the Technological Pedagogical Content Knowledge (TPACK) Model

The global effort of training of teachers to be effective technology-enabled educators has remained as international research agenda for decades. In the 1980s, Shulman (1986) proposed a framework to address the pressing need to train teachers differently. This framework has three categories of knowledge critical to training new teachers: (i) teacher knowledge of the subject called content knowledge (CK), (ii) knowledge of teaching methods and classroom management strategies, collectively called pedagogical knowledge (PK), and (iii) knowledge of teaching specific content to specific learners in specific contexts called pedagogical content knowledge (PCK) (Shulman, 1986).

In 1987, Shulman (1987) further refined and described four additional categories of knowledge, comprising the following:

(a) knowledge of the materials for instruction, including visual materials and media (curricular knowledge);

(b) knowledge of the characteristics of the learners, including their subject-related preconceptions (learner knowledge);

(c) knowledge of educational contexts, including classrooms, schools, district, and beyond (context knowledge); and

(d) knowledge of educational goals and beliefs.

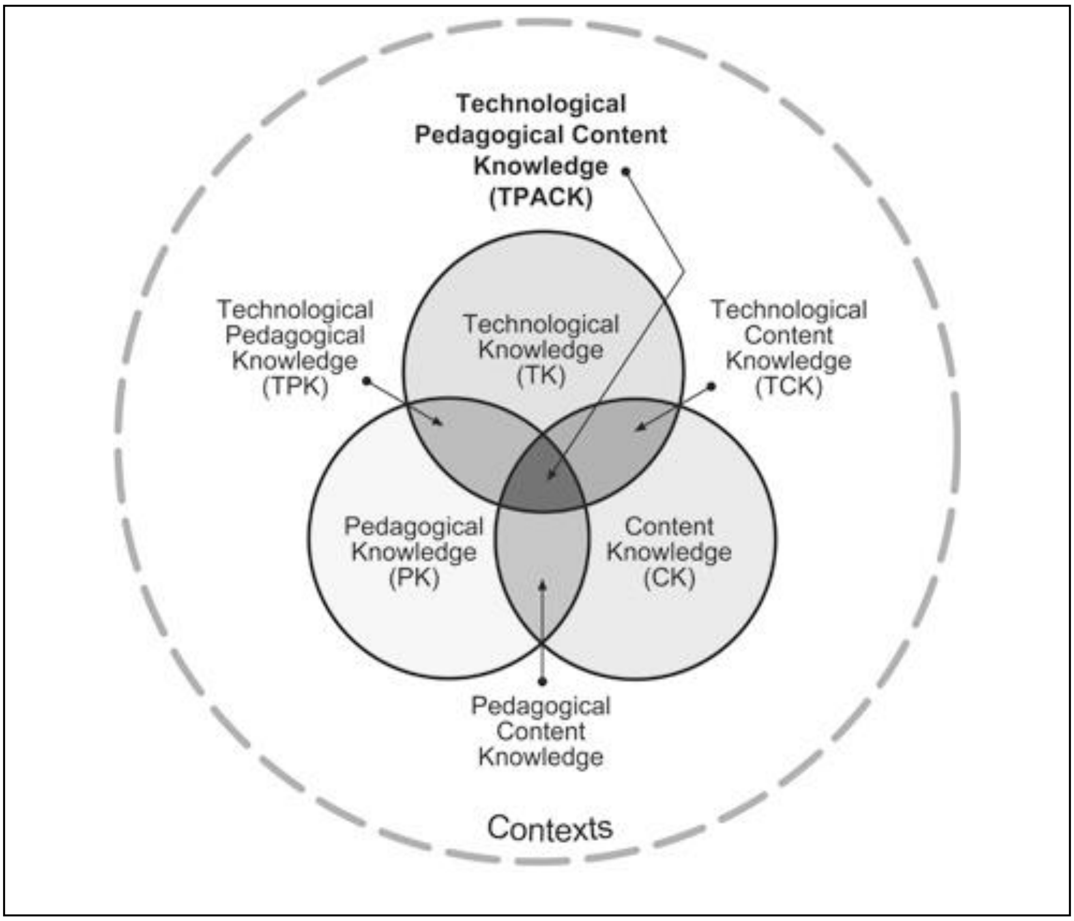
The role of technology in education was not the main concern in this framework (Shulman, 1987). This has somehow raised queries among teacher educators, in-service teachers and pre-service teachers if technology's role deserves a more critical re-examination (Fajet, Bello, Leftwich, Mesler, & Shaver, 2005). In some instances, teachers and students could deliberately ignored technology in their pedagogical practices.

At the beginning of the twenty first century, many educators realised the impact of technological advancement on education. With the declaration of Partnership for twenty first Century Skills (P21), there was a greater emphasis on technology's role in education. There was a general consensus that good teaching encompasses the presence of relevant technological tools for the right purpose of learning. Many frameworks related to effective teaching based on technological, pedagogical and content knowledge were proposed (American Association of Colleges for Teacher Education, 2008; Angeli & Valanides, 2009; Trilling, 2009). According to Angeli and Valanides (2009), these models are all grounded on the principle that effective technology integration thrives on a consideration of the interactions between technology, content, and pedagogy.

Most countries' education systems are now premised on empowering teachers with technology skills that could allow teachers to integrate technology to all education settings.

The progressive advancement of technology is permeating all levels of societies, hence the technology skills of educators in their pedagogical practice has a direct effect on students' learning. Technology integration in teaching does not bring innovative pedagogical practices into the classroom unless and until educators have the knowledge of technology, content knowledge and pedagogical knowledge.

Mishra and Koehler (2006) proposed a framework that emphasises the need for balanced technological, pedagogical and content knowledge (TPACK). This framework (Figure 2.5) supports that an educationist's knowledge for technology, pedagogy and content of subject are of equal importance in conducting courses through non-traditional modes such as blended learning/hybrid and online (Koehler & Mishra, 2005). This framework helps teacher educators and researchers to better understand the complexity of the knowledge required for effective technology integration in K-12 curriculum of USA through the P21 initiatives (Partnership for twenty first Century Skills, 2009). When one area of the TPACK framework is transformed, it is likely that the other two areas will be affected and hence any change in pedagogical practice will see the change in types of technology applied and delivery of content (Bullock, 2011; Foulger, Amrein-Beardsley, & Toth, 2011).



Source: adapted from (Foulger et al., 2011)

Figure 2.3 The TPACK framework of Mishra and Koehler (2006)

The challenge faced by many education researchers, policy makers, leaders and faculty of higher education is how technology integration has brought about innovative pedagogical practices in classrooms and the national education systems.

The TPACK framework is gaining importance in the contemporary research on advancing education in line with the twenty first century education framework. In this study, due to time factor and various demographic profiles of subjects, the conceptual framework was not exhaustive enough to examine the relevance of TPACK. However, it is recommended for future research to further test and validate this TPACK framework to be applied in clearly defined scope of education technology research, such as longitudinal study on trainee teachers within the specific discipline (Mishra & Koehler, 2006).

2.4 Previous Research on Technology Integration and Pedagogical Innovations

There is much research conducted in the K-12 school systems involving international organisations such as technology solution providers (CISCO Systems, 2008) and the Organisation for Economic Co-operation and Development (OECD, 2008). Empirical findings by education researchers are discussed in the following sections.

Empirical findings on technology integration are first examined through Christensen's (2002) experimental study on effects of technology integration training on the attitudes of teachers and students towards using technology in the classroom. It is highlighted that technology integration improves learning motivation of students and teachers' technology anxieties increase with students' technology competencies. However, a simultaneous study in 2002 by Zhong and Shen stressed that there was no real pedagogical innovations although computers were so widely used in classrooms. The international scale study on technology integration in 28 OECD countries as reported in the SITES-M2 by Kozma (2003), adopted the case study approach of investigation. Kozma (2003) managed to identify exemplary innovative technology leaders among teachers in the selected schools in the 28 OECD countries. However, they also revealed further that research on technology integration faces high level of complexity due to diverse national and cultural contexts. A study conducted by Mehra & Monika (2007) had also further pointed out that integration of technology outweighed many challenges faced by the institution and it should not be treated as a straight forward process. Demographic background of the institution such as duration of establishment of an education institution was reported to influence faculty technology integration. This was further ascertained by Su's (2009) findings on organisational and personal barriers as the most critical factors to overcome as to enhance further positive results of technology integration. Bullock (2011) stressed that by using a reflective online learning journal he could trace his students' learning in real time though there seemed to be information overload. An important finding by Bullock is that the connection, communication and relationship among the learners and teachers are critical to ensure that technology integration will yield maximum benefits to the entire community of learners. Chai et al. (2011) tested the TPACK framework on a group of pre-service teachers. It was concluded that TPACK should be used in a research context that is homogenous and highly uniform in pedagogical, content and technological knowledge. Technology integration was reported to elicit positive pedagogical innovation but the two were not linearly correlated according to the findings by Liu (2011). Ertmer, Sadaf and Ertmer (2011) have alarmed educational leaders that over-dependency on technology integration will hamper the achievement of critical thinking skills among learners. It was stressed that technology alone does not help students to learn but the level of questions asked by the teacher in the environment of learners was more crucial for pedagogical innovations. The latest findings by Krauskopf et al. (2012) have further revealed that online technology such as YouTube does not elicit pedagogical innovations if the teachers do not have the basic mental model of pedagogy. A report published by the Malaysian ministry of higher education on status, trend and challenges faced in e-learning implementation will provide the latest information on local perspective of this study (Mohd Amin, 2011).

2.4.1 Previous Research on Technology Integration

Christensen (2002) conducted an experimental study on the effects of technology integration education on the attitudes of teachers and students. In this study, technology integration education means training on incorporating technology into teachers' classroom practices. Christensen (2002) was keen to find out if there is a relationship between technology integration education and teachers' attitude towards teaching. Also, the second purpose of the study was to investigate if positive teacher attitudes will foster positive student attitudes towards technology. A total of three elementary schools in north Texas were selected: one school as the treatment school and the other two as control schools. Subjects recruited for the treatment school were 60 teachers and 900 students.

In the first phase of this study, data on the attitude of teachers from all schools was collected using the Teachers' Attitudes Towards Computers Questionnaire (TAC Ver. 2.21). This is a refined 16-factor structure questionnaire with an internal consistency of .75 to .96. This Likert scale tool has seven constructs: (i) Computer Attitude Survey-Anxiety (CASA); (ii) Computer Attitude Survey-Confidence (CASC); (iii) Computer Attitude Survey-Liking (CASL); (iv) Computer Confidence Construct; Young Children's Computer Inventory (YCCI): (v) Importance (I); (vi) Enjoyment (E); (vii) Anxiety (A). The total score reliability for constructs (i) to (iv) was .95. The reliability score of constructs (v) to (vii) were between .81 and .91.

In the experimental school group, a skills checklist and stages of adoption form were also administered to the teachers to prepare them for teaching with technology. A training needs-assessment instrument was also administered to this group of teachers. These data assisted in designing appropriate technology instruction training sessions. The teachers' attitude profiles were gathered in three testing periods: September, January, and May.

Students in the experimental school completed the YCCI, a 59-item Likert scale with paired comparison items, questionnaire. This questionnaire measures six learning dispositions: (i) Computer Importance; (ii) Computer Enjoyment; (iii)

Motivation/Persistence; (iv) Study Habits; (v) Empathy; and (vi) Creative Tendencies (Knezek & Miyashita, 1993).

In the control schools, the teachers received normal district-level technology in-service training which was different from the experimental school.

The results showed that teachers in the experimental group had reported improved attitude toward technology integration consistently over the three testing periods. There was also a significant effect of technology training on: (i) teacher's use of technology (β = .20, $p < .02$), and (ii) student's perception of the importance of technology (β = .32, $p < .003$). This is consistent with many reports published throughout the last three decades that training is crucial for successful technology integration (Rubinyi, 1989; Russell, 1995) and faculty members' underlying pedagogical beliefs (Ertmer, 1999; Mehra & Monika, 2007; Owston, 2007).

This study to evaluate the relationship between technology integration education and teachers' attitude towards teaching revealed an interesting finding. Students' increased computer efficiency has led to higher teachers' anxiety level. This warrants further study on a bigger scale of survey among teachers and students to identify if students' role as learners has a significant effect on technology integration in higher education.

Although the study was conducted in the school setting, the findings are relevant to academicians in higher educational institutions where faculty members' perception of technology and pedagogical practices (Mehra & Monika, 2007), and leadership and administrative role of a university are crucial in implementing change (Garrison & Kanuka, 2004).

Training for academicians, similar to teachers' training in the integration of technology, is crucial to achieving effective technology investment and integration in higher education. Faculty members' use of technology in pedagogical practices will directly influence students' perception of using the technology and hence greater alignment of expectations on learning could be achieved. It would be very costly for higher education institutions to ignore the importance of technology training while expecting students to absorb the skills like an osmosis process.

Higher education institutions are responding to the increasing importance of learning technologies in producing graduates for the twenty first century. Technology integration in higher education is a lever to this systemic change. It should start with careful planning with an understanding of the underlying institutional culture and values. Adequate technology education and training will reduce resistance towards changes brought by technology integration. Implementing change through technology integration is often regarded as an innovation adoption process (Rogers, 1995; Hall and Hord, 2001). Addressing anxiety among academicians and helping them to cope through communication and training are vital to the success of technology integration. Training will change academicians' perception and attitude towards technology, and elicit positive adoption among students.

In another study, Zhong and Shen (2002) examined the changes brought by technology integration into teaching English in two high schools in China via a case study research method. The subjects consist of two teachers: one was teaching a junior 2 class (Year 9) and the other was teaching a senior 1 class (Year 11). However, the two teachers were teaching the same subject called English as Foreign Language (EFL) using multimedia. The research was carried out using the observation method that focuses on the three aspects of language pedagogy: approach, design and procedure (Richards & Rodgers, 1986).

The findings of the study showed that despite an increased computer integration in teaching of language, technologically induced pedagogy was absent. Teachers still strongly remained as the knowledge transmitters and as the sage in the ecology of technologically integrated language classroom.

The researchers found that there are other factors that influence pedagogical practices in the classroom. This study concurs with Ballard and Clanchy (1984) and Biggs (1997) who reported that culture and attitude towards knowledge, perception of the role of teachers in the teaching and learning process, and pedagogical styles affects the educational process. Pedagogical innovations will only arise provided educational practitioners changed their philosophy of teaching and the associated pedagogical practices. This would then lead to more effective learning of language when integration of technology facilitates classroom interaction (Zhong & Shen, 2002).

The findings of this study are relevant to higher education institutions. In the constant pursuit of innovation, technology integration at higher education institutions will not be sufficient to bring about systemic change and improvement in student learning outcomes. Leaders of higher education institutions must also consider the underlying organisational culture, faculty members' philosophy of teaching and learning, attitude towards knowledge and change in achieving desired innovative pedagogical practices (Ballard & Clanchy, 1984; Law, 2009). This study has also highlighted the demographic background of faculty members as important factors to consider when deciding on technology choice and the associated delivery of pedagogical innovations.

Kozma (2003) examined how classrooms throughout the world are using technology to change the practices of teachers and students. This study also attempted to answer questions on how teachers from different regions were using technology to support instructional change. A total of 174 case studies from 28 participating countries were investigated by Kozma (2003). The cases were selected based on the following five criteria:

(a) There were significant changes in teaching, learning, or curricular practices.

(b) Technology played a significant role in supporting these changes.

(c) The changes resulted in positive outcomes for students and/teachers.

(d) The changes could be sustained and transferred.

(e) The changes were innovative, as defined by a national panel.

The criteria of selection were further refined to accommodate local contexts of participating countries. The panel consisted of researchers, teachers, school administrators, and policy makers. The average size of the panel in each country was eight. The panel reviewed the definition of innovative practices based on local context that are often related to social and cultural considerations, policy or statements related to ICT and education reform.

The data from each country was collected using standard instruments and protocols that were field tested in 17 of the countries and revised. Data collection included: interviews of administrators, teachers, students, and parents; classroom observations; and the analysis of documents, such as teacher lesson plans and samples of student work. The panel used a standard template to write up each case report based on the data collected in a 10-page narrative. The narrative contained school background information such as ICT support, national education policies, teacher and student practices and outcomes, types and uses of technology and their sustainability and transferability.

The narrative reports were further analysed in a two-step process by the international research team using mixed methods (Tashakkori & Teddlie, 1998). During Step 1, all the cases were read by the International Coordinating Committee (ICC) and cases were classified by variety of variables identified, and coded. Kozma

(2003) reported the similarities and differences in patterns of teacher, student and technology practices, and outcomes. Step 2 was discussed separately in another report. Cluster analysis was conducted to identify patterns of similarities and differences among the selected cases (k-means clustering: SAS FASTCLUS procedure).

This study identified 7 clusters, that is, (a) Information Management Cluster (a pattern of students searching for information); (b) Student Collaborative Research Cluster (a pattern of student activities that includes collaboration with other students in the class); (c) Teacher Collaboration Cluster (a pattern of teachers' collaboration with students, colleagues and outsiders); (d) Outside Communication Cluster (a pattern of use of e-mail, the Internet, conferencing software, or *listservs*); (e) Tutorial cluster (a pattern of practices in which teachers designed tutorial materials to drill and test students); (f) Tool Use Clusters (a pattern of students working together using a variety of productivity and multimedia tools to search for information and create products); and, (g) Product Creation Cluster (a pattern of students using a variety of productivity tools, Web, and multimedia resources to create products, while teachers created structure and guided students). The cluster analysis results were analysed among the participating countries.

The results of the study revealed that technology-supported innovative classroom practices in many countries have many common qualities. However, Kozma (2003) could not conclude the model for pedagogical innovations that could be used in all countries. Several years after the commencement of this international scale study, Law, Yuen and Fox (2011) reported and shared their findings further. As this study was conducted in various cultural backgrounds, in most cases, direct comparison of pedagogical practices was not possible. Hence a six dimensional concept of pedagogical innovations was proposed (Law et al., 2011). Many teachers are integrating technology into their teaching but just like more than a decade ago, good evidence of sustainable pedagogical innovations could not be established. It is apparent that technology has changed the role of teachers from the traditional sage to that of a guide by the side. Technology-based research projects and technology use to manage information has also had greater impacts on student learning than the traditional tutorial approach (Cowan, 2012). However, the model of relationship between technology integration and pedagogical innovations is inconclusive. Similarly, in the context of higher education, regardless of cultures and creeds, technology has also forced many academicians to re-think their role, practices and priorities in the delivery of courses.

In another study, Mehra and Monika (2007) examined the perceptions of faculty towards technology enabled constructivist pedagogy and traditional didactic pedagogy. Another purpose of the study was to evaluate the perceptions of the faculty on the impact of technology on the teaching process.

This study was conducted among faculty members from two Institutes offering Masters of Business Administration and Post Graduate Diploma in Business Administration. A total of 150 subjects participated in the study. The average age was 37.5 years. The subjects had an average of 12.5 years' experience as a faculty member. A questionnaire that consists of 36 items was administered.

A factor analysis was performed to find out the most important factors that determined the adoption of instructional technology tools for instruction. The three factors that emerged were technology intensive attributes, learning enhancement attributes and professional interaction. The component matrix revealed Eigen values of instructional technology more complex, instructional technology more intimidating, and instructional technology high administrative support with scores of .844, .780 and .551, respectively. The researchers grouped these as factor 1 and labelled these as technology intensive attributes.

The findings revealed that instructional technology is more systematic, more creative, and encourages more student involvement with scores of .719, .785 and .745, respectively. These components were grouped as factor 2 and labelled as learning enhancement attributes.

In addition to that, factor 3 comprised of components such as instructional technology lacks personal touch and is less time consuming, with scores of .735 and .853. This factor was labelled as professional interaction.

The results showed that faculty members' perception of effectiveness of technology in teaching and learning affects the adoption of technology. In addition to that, it was observed that internet and online databases were the most preferred ICT tools used by faculty members although they have access to many instructional tools. There was a significant correlation between an institution's duration of establishment and technology adoption by faculty (Mehra and Monika, 2007).

The adoption of technology by faculty members is not a linear process (Rogers, 1995). Typical to other industries that value innovations brought by technological integration, the higher education industry is of no exception. The effectiveness of technology integration in pedagogical practices is also dependent on other factors such as faculty's perceptions of the usefulness of the technology, readiness, willingness, and ability to adopt innovative technology in pedagogical practices. Hence, demographic background of faculty members should not be left out in studies relating technology integration with pedagogical innovations.

Su (2009) pointed out that a teacher's underlying value system concerning teaching and learning, is a barrier that is difficult to identify. On the other hand, Ertmer (1999) classified all the barriers into first-order and second-order barriers as to describe the external and internal barriers to teacher technology integration. First-order barriers are obstacles related to issues of adequate access to the technologies, training, and support during technology integration. Overcoming these first-order barriers does not necessarily indicate that technology integration will be successful and followed by the effective and innovative use of the technology.

Second-order barriers are those that are embedded in a teacher's philosophy of teaching and learning, which are more hidden and deeply rooted in daily practice (Ertmer 1999, 2005). These include a lack of vision or rationale for technology use, lack of relevance to the curriculum, and incompatibility with pedagogical practices.

Su (2009) also highlighted that old assumptions about teaching and learning is the most difficult barrier to overcome. Resistance to change during technology integration is often related to the deeply rooted, traditional, conservative pedagogical and psychological beliefs about teaching and learning.

Typically, these barriers will affect the diffusion process of the technology integration and the achievement of the intended goals. A systemic change in the entire education organisation is required to ensure the effectiveness of technology integration on pedagogical practices. This change is vital to overcome the identified barriers to technological integration.

In a systemic change due to technology integration as an innovation, fundamental changes in the environment of a HEI needs to take place. These include, (i) teaching and learning in the classroom that are using different pedagogical practices, (ii) criteria of learning assessment that reflects the change due to technological integration, (iii) administrative and social support in the environment of the new endeavour, (iv) continuous professional development for engaged teachers (Su, 2009).

Su's (2009) findings have some similarities with Ermter's (1999). Both reports highlighted that classroom activities, curriculum design, assessments, supportive environment and continuous training are all critical to effective technology integration.

In order to achieve the desired systemic change that will bolster the technology integration process, second order barriers are more challenging to be overcome. Teacher's attitudes, behaviours and beliefs towards technology integration are deeply rooted in their pedagogical and psychological values. Introducing technology into teaching often requires educators to implement the change process in stages (Hall & Hord, 2001; Rogers, 2003). This study has again, pointed out the importance of understanding the demographic background of faculty members for innovation adoption such as technology integration.

Higher education institutions worldwide are investing more in technology integration as their competitive strategy in widening their market reach and operations efficiency. The pedagogical practices would not become innovative without the alignment of faculty's technology skills and their curriculum design and pedagogical practices.

In a study to document and analyse his first two years of developing digital technologies, Bullock (2011) used an interesting self-study methodology to describe, interpret, and challenge excerpts from his personal teaching journal. Self-study methodology was used in this personal pedagogical transformation journey (LaBoskey, 2004). The subjects of this study consist of two groups of students: group 1, 60 students taking the Bachelor of Education programme; and group 2, seven students taking the Master of Arts or Master of Education programme.

The main research question in Bullock's study was on how he could provide productive learning experiences for his students using digital technologies on Web 2.0 platforms. This collection of digital technologies was perceived to offer the pedagogical potential of networked publics, and enable the notion of human collective intelligence in his courses.

He isolated data related to his experiences teaching the two courses from the larger dataset of his journal. He analysed the data using coding and constant comparison based on qualitative research (Patton, 2002). He then further analysed the data by searching for evidence of turning points in his thinking.

Bullock (2011) reported that he was merely teaching the mastery of digital technologies to his students in the first year. There was no connection between his understanding of the literature on informatics, digital technologies and education, and the ways he taught the courses. In the second year, he changed his approach and introduced blogging as a requirement for his course. He sought to develop a productive teaching-learning relationship through digital technology with his students. He found that students valued the online one-to-one conversation with him. Many students participated in the blogging. Blogging allowed him to create a shared space for analysis and reflection as well as developing closer communication and relationship building with his students.

In integrating technology into the HEIs, faculty should not assume that technology alone could bring about innovations in pedagogical practices. Organisation and faculty's barriers to be overcome and students' efficiency level of technology use should be taken into consideration. Technology integration in higher education would not lead to enhanced learning unless there is connection, communication, and relationship among the learners and academicians. The faculty members in HEIs are the corner stone to supporting students in meaningful learning. Understanding the relationship between technology integration and pedagogical innovations will ensure that HEI leaders are able to devise the most effective plans and strategies.

In a recent report on creating an effective framework to achieve meaningful learning through technology integration, Chai et al. (2011) have reported some new insights on the TPACK framework (Koehler & Mishra, 2005). They tested the

Technological Pedagogical Content Knowledge (TPACK) framework on a group of pre-service teachers in Singapore. TPACK has been regarded as a suitable framework to guide education trainers in mitigating the challenges faced in technology integration, especially ICT into classroom teaching and learning (Hewitt, 2008).

The TPACK framework was developed by Mishra and Koehler (2006) based on Shulman's (1986) pedagogical content knowledge (PCK) framework. TPACK has theorised as a seven-factor construct to describe teacher's integration of ICT in their teaching. However, this framework is still relatively young and further research is needed to further validate its applicability.

The subjects of this study consisted of 834 pre-service teachers at a teachers' college in Singapore. They were to be trained as primary school teachers and were selected during their study of a core ICT module in the July semester in 2009. In the first week of the course, an email explaining the purpose of the study and, as an invitation for voluntary participation was sent to the entire group. Subjects who consented to take part in the study could gain access to a web-survey that was linked via the email. This same web-survey was sent to the entire group of subjects at the end of the semester. The first survey has a response rate of 45% (N = 375) and the second with a response rate of 41 % (N = 343).

The survey instrument is a 46-item adapted from other instruments (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009; Thorndike, 2005). A 7-point Likert scale was employed to obtain feedback on the seven constructs:

(a) Technological Knowledge (TK) that measures knowledge of how to operate computers and relevant software.

(b) Pedagogical Knowledge for Meaningful Learning (PKML) that measures knowledge of how to plan instruction, deliver lessons, manage students and address individual differences.

(c) Content Knowledge (CK) that measures subject matter knowledge such as knowledge about languages, Mathematics and Sciences.

(d) Technological Content Knowledge (TCK) that measures knowledge of how content can be researched or represented through technology.

(e) Pedagogical Content Knowledge (PCK) that measures knowledge of how the subject is presented in a comprehensible manner.

(f) Technological Pedagogical Knowledge (TPK) that measures knowledge of how technology can facilitate pedagogical practices.

(g) Technological Pedagogical Content Knowledge (TPACK) that measures the overall knowledge of facilitating students' learning of a specific content through appropriate pedagogy and technology.

An exploratory factor analysis (EFA) was first performed on the pre-course data collected. Factors with Eigen values greater than 1 were retained. The identified factors were then further subjected to confirmatory factor analysis (CFA) using AMOS 18. T-tests and testing of the structural equation model were explored on the identified factors.

The EFA identified 5 factors (TK, CK, PKML, TPK, and TPACK) of the pre-course survey with *Cronbach's Alphas* of .86 and higher. Further CFA on post-course resulted in a 31-item as a suitable TPACK model in this study. It was also observed that pre-service teachers had a good understanding in the TPACK and that they were more prepared to integrate ICT into teaching. This study also concurred with earlier findings that engaging teachers in designing ICT integrated lessons is a helpful pedagogical training.

This model could be used as a guide to develop pre-service teachers' professional understanding on effective teaching through technology integration (Chai, Koh, Tsai, & Tan, 2011; Koehler, Mishra, & Yahya, 2007). There is a strong correlation between a pre-service teacher's basic knowledge about TK and PKML with new knowledge acquisition through the course undertaken. On the other hand, while initially pre-service teacher could perceive that CK does not correlate to the TPACK (Critical ratio of 1.10), the training course has fostered a stronger relationship between CK and TPACK (Critical ratio of 2.14).

In addition, Chai et al. have contributed to the advancement of technology integration into education research using the TPACK framework. The TPACK constructs were modified to match the study site context through the PKML. This study warrants the importance for education trainers to be sensitive to adapt the TPACK to the local context as better predictive tool to assist teachers in developing their professional skills using technology.

While innovative pedagogical practices could be achieved through engagement and training, the leaders and academicians from higher education institutions need a reliable tool in helping them to implement change. The TPACK framework is still at its early stage of testing and further research is needed to improve its reliability and generalizability as tool to integrate technology into pedagogical practices (Angeli & Valanides, 2009).

As technology continues to play its centre stage role in higher education, the visibility of potential resistance factors and ability to design effective plans to mitigate the situation is a challenge. The TPACK has been proposed to be the reliable framework in implementing technological integration. It is highlighted that the TPACK framework could further be applied by teachers and education administrators to highly contextualised situation of technology integration (Graham, 2011). The TPACK framework has been reported to be most effective to be used as the guiding framework in training pre-service teachers that a set of specific goals are clearly defined within specific learning environments of a subject (Chai et al., 2011).

In addition to that, teacher's role and design thinking aspects of technology integration are critical in ensuring technology integration is effectively implemented. This is also partly due to the fast-changing nature of technology and hence resulted in a lot of technology integration grand plans not bearing fruit in pedagogical innovations (Salmon, 2005). Leaders and stakeholders of higher education should devise smart implementation plans with informed risks and benefits. This could be achieved through deploying various strategic tools such as the TPACK and ICCM (Law et al. 2001) that measure implementation challenges and effects of the resulted change. In the midst of worldwide HEIs financial belt-tightening, responsible leaders of higher education need reliable tools to reduce the risk of over spending and maximise benefits on technology integration.

Teachers' pedagogical beliefs and technology integration are reported to be not linearly correlated (Liu, 2011). The study conducted by Liu (2011) examined the distribution of two types of pedagogical beliefs among elementary school teachers in Taiwan: student-centred and teacher-centred. It also further analysed how teachers' pedagogical beliefs influence their teaching practices in classrooms. Factors determining teachers' action to integrate technology and instruction were also identified.

A total of 1340 elementary school teachers were recruited from 517 schools spanning over 23 administrative constituencies. Each school received between five to 20 questionnaires depending on number of classes that had reported teachers implementing technology.

The 30-item questionnaire consisted of three main constructs:

(a) Teachers' pedagogical beliefs, measured using nine item pairs that contrasted student-centred and teacher-centred beliefs. *Kuder-Richardson* reliability of .74 was reported.

(b) Teaching activities that used technology, measured using five item pairs that contrasted teaching situations of constructivist-based and lecture-based. *Kuder-Richardson* reliability of .79 was reported.

(c) Factors associated with teacher's technology integration, measured using 30-item on a Likert 4-point scale.

Data from the 85 % returned questionnaires firstly analysed the relationship between teachers' pedagogical beliefs [construct(a)] and their teaching practices [construct (b)] using chi-square test. The results revealed that 79 % of all teachers held learner-centre belief. Among these teachers, only 28 % actually practised constructivist teaching activities using technology as opposed to 78 % who purely used the lecture method. Among the teachers who held teacher-centred belief, they were almost consistently practised lecture-based teaching.

Further analysis on the teachers' pedagogical beliefs and teaching practices in each of the factors of construct (c) using two-way ANOVA, was performed. Through correlation matrix, six factors with eigenvalues >1 were reported. Namely, teaching implementation; instructional design; individual mindset; external expectations; school support; and, student achievement. There was no interaction effects between the two independent variables observed for each factor (p > .05). This analysis showed that each factor influenced teacher's use of technology differently among the two types of pedagogical beliefs.

However, for the learner-centred teachers, two factors reported significant differences namely, "external expectations" (t = -2.717, p = .007 < .05), and "student achievement" (t = -3.405, p = .001 < .05). This means this group of teachers could be sensitive to their environment that comprised of principals, colleagues, and government as reported in earlier study.

This study reported that most Taiwanese teachers hold on to the pedagogical belief of learner-centred education. However, there were 72 % teachers who held learner-centred pedagogical belief actually implemented lecture-based teaching, not constructivist-based using technology. There is inconsistency between teachers' pedagogical beliefs and teaching practices. It also further implies that student achievement was a concern often associated with technology integration among teachers. This is particularly evident among the learner-centred teachers (Liu, 2011).

While many higher education institutions are embarking on their organisational renewal journey through technology integration, identifying factors affecting the success is crucial. Organisation's contextual factors such as leaders, colleagues, policy makers and other stakeholders will exert certain influence on academician's pedagogical practices. It is imperative that higher education institutions devise plans that mitigate the perceived pedagogical beliefs and actual practices among academicians. It is evident that many teachers hold learner centred pedagogical beliefs but do not practise innovative pedagogy.

In the classroom environment that increasingly integrates technology, Ertmer et al. (2011) examined the role of question prompts in facilitating higher-level engagement with course content. While technology integration through web-based instructions is getting more common, the ability of technology to elicit meaningful learning is of great concern (Garrison & Kanuka, 2004; McLoughlin & Mynard, 2009). This study examined: (a) levels of question, (b) types of question; that lead to (c) engagement and interaction in online discussion forums. The three research questions were:

(a) What is the relationship between the level of question prompt and the level of students' responses?

(b) What is relationship between the type of question prompt and the level of students' responses?, and,

(c) Which levels and types of question prompts promote the greatest amount of student-student interactions, especially at the highest levels of critical thinking?

The subjects of the study consists of university graduate and undergraduate students from six disciplines (*n* = 569) selected from 19 discussion forums of ten asynchronous courses. These courses were taught by seven different instructors during five semesters: spring and fall, 2008; and spring, summer and fall, 2009. Three courses were taught primarily online while seven were in blended modes.

A total of 850 online responses were collected during the study. Ninety-two question prompts were collected from 10 courses and classified using Andrew's (1980) typology of nine types of question and Bloom's (1956) taxonomy of six levels of thinking. The responses were firstly filtered through coding to arrive at a final 19 discussion threads. The researchers ensured that all of the discussion threads contained at least two categories of Andrew's (1980) typology. They were: "had generated greater student interactions", and "had demonstrated higher level of Bloom's taxonomy". In order to avoid biasness, two independent researchers further coded the posts from the 19 discussion threads. *NVivo* qualitative analysis software was used to analyse for relationships among specific, selected variables among the coded posts.

Firstly, based on the Bloom's taxonomy, the 19 prompts were further grouped by level of thinking: Knowledge = 1, Comprehension = 3, Application = 5, Analysis =

6, Synthesis = 1, and Evaluation = 3; and levels of questions (low, medium and high). It was observed that as questions moved to higher levels, there was marked downward trend in students' responses at the Knowledge and Comprehension levels (53 % to 38 %). In addition, as questions moved to higher levels, there was an increased response at the Analysis, Synthesis, and Evaluation levels (25 % to 32 %). There was no obvious trend for responses that were at the Application level.

Secondly, in finding out relationship between nine question types (Andrews, 1980) and level of response, equally half of the responses to the prompts were grouped as low level (47 %), and medium level (47 %). Responses of high level thinking order elicited from high level questions were very scarce (6 %). Lower divergent questions were observed to be most effective in generating levels of student thinking at the medium (62 %) and high levels of thinking (12 %).

Thirdly, the interaction patterns among students were explored to identify their engagement in online learning environment. There was an average frequency of posts per student of 4.6 (*SD* 3.9) reported. Questions that generated the highest average of student-student interaction sequences were of brain-storming and playground types (7.1 and 7.5 posts per student). This concurs with Andrews' (1980) findings that there is a significant correlation between the two measures of student responses per prompt and number of student-student interaction sequences.

From this study, it was concluded that none of the three levels of questions could lead to a majority responses at the highest levels of Bloom's taxonomy. Higher level questions only lead to Comprehension level thinking (33 %). Critical thinking does not occur automatically in an online learning environment with technology integration. The majority of responses observed were of lower levels of Bloom's taxonomy. It proved that the use of questions to generate higher level of thinking responses does not solely rely on the level of questions posed in an online learning environment.

Divergent question type of Andrews' typology, often of open-ended questions, is more likely to generate responses at the medium and higher levels of Bloom's taxonomy. In essence, this study warrants further research into how pedagogy strategies and variables such as teachers' beliefs could bring more effective learning in the technologically integrated learning environment. Types and levels of question prompts in an asynchronous learning platform should be appropriately designed and aligned to ensure that higher levels of thinking among students could be elicited (Ertmer, Sadaf, & Ertmer, 2011).

Bullock's (2011) and Shirky (2009) pointed out that technology integration in classroom does not create new motivations and, there are other variables that influence higher order thinking among learners. Many academicians of higher education adopted technologies into their classrooms practices but faced great challenges in eliciting meaningful learning. Bullock (2011) introduced social collaboration by using blogging during his second year of teaching. He considered this approach as a new innovative pedagogical practice that is technologically induced.

The relationship between teacher's pedagogical knowledge and technology integration is a scarcely researched area in education. The use of YouTube in a technologically integrated teaching environment is another innovative pedagogical practice. A recent study by Krauskopf et al. (2012), showed that teacher's pedagogical knowledge can be a predictor of their mental models of YouTube. Their mental models will affect their lesson plan and the use of YouTube as a medium of instruction. The presence of the mental models was analysed based on the TPACK framework of Koehler and Mishra (2006) with details described in preceding section 2.4.

A group of 60 pre-service secondary level teachers undergoing training in a western Germany university were recruited through an online forum. The online questionnaire consists of three parts:

(a) Demographic questions: age, gender, high school grades, and fields of specialisation.

(b) A 22-item section that measures teachers' pedagogical knowledge based on two Germany's national standards: (a) pedagogical psychology in German teacher education (Schulte et al., 2008), and (b) the English and Technology Education (ETS) Praxis Series™. This section of questions has an internal consistency of *Cronbach's Alpha*, $\alpha = .70$.

(c) A 3-open questions that ask teachers of their opinions of YouTube: the three ways of using YouTube in teaching; how it would be used; and, perceived barriers in their effort to integrate YouTube into teaching.

The control variables that were accessed in this study were: gender, teachers' experience with YouTube and their general pedagogical beliefs.

Data from (b) was analysed simultaneously with (c) independently by different groups of researchers. The analysis of general pedagogical knowledge of teachers in this study revealed twelve categories: Vividness, Teacher Presentation, Information Repository, Content Elaboration, Foreign Language Learning, Students' Media Literacy, Students' Productive Use, Exchange, Accessibility, Lesson Start, Entertainment, and Motivation. This set of data was further used as intended and ideal use of YouTube.

Qualitative data from (c) was analysed using procedure applied in cognitive psychological research (Azevedo & Cromley, 2004). Mental models of teachers were extrapolated using coding and quantified through counting of relevant aspects reported.

There were two sets of coding schemes adopted in this study: the emerging categories, and the theoretically derived categories (TPK). There were seven emerging categories that revealed teachers' understanding of benefits of using YouTube identified:

(a) Entertainment

(b) Information Repository

(c) Accessibility and Actuality

(d) Information and Opinion Exchange

(e) Productive use of YouTube

(f) Vividness of Content

(g) School Purpose

The same set of data was then analysed for theoretically derived categories (TPK) that represent complexity of teachers' mental models covers the following learning goals:

(a) Cognitive

(b) Socio-cognitive

(c) Meta-cognitive

(d) Motivational

Data from the emerging categories revealed that most teachers named entertainment as the first function of YouTube (41.7 %), followed by information repository (31.7 %). The third most named function was Accessibility and Actuality (30 %). In spite of the common perception of YouTube as a means of entertainment, teachers also acknowledged YouTube's affordance to active engagement and social interactions in school settings. Nevertheless, teachers rated school purpose that is, school-related use, as the least (6.7 %).

All sections' data were further analysed through computing a score to represent lesson plan quality through counting of number of different codes for intended and ideal use of YouTube, respectively. This is achieved using Zero-order correlation method. These scores represented teachers' individual's TPACK aspects.

Results from the coding based on theoretically derived categories showed that all the three most named functions were socio-cognitive related (≥ 20 %). Very few responses were related to individual cognitive aspects (≤ 15 %). The meta-cognitive and motivational aspects were rarely cited (≤ 1 % and ≤ 5 %, respectively).

This study revealed several important findings. Firstly, YouTube is perceived to be a major entertainment tool. Vividness of the audio-visual materials offered by YouTube is only as good as the existing common film and video experience in the education context. This means YouTube does not increase the motivation level of teachers and students in learning. Simply, YouTube does not guide teachers in devising constructivist learning strategies as required in meta-cognitive learning.

Secondly, although data was collected only from the teachers' perspective of YouTube and its affordance in teaching, they need to overcome the mental model challenge. Many teachers thought that they have good ICT skills but being able to integrate technology into pedagogical knowledge and teach effectively requires more than having tools. Therefore this study has again concurred with Ertmer's (1999) first-order barriers in technological integration.

Thirdly, this study has offered insights into the need for further research to examine innovative pedagogical practices through technology integration. The TPACK framework has teaching (T), pedagogy (P), and content (C) aspects of knowledge that are equally important in assessing a teacher's actual classroom practices. Research on the relationship between teachers' technological mental models and their actual use of the tool should not only be confined to pedagogical knowledge.

Rather the other aspects of TPACK, which are content and teaching knowledge should be considered.

Finally, although the subjects are teacher trainees, they also face barriers in integrating technology into teaching. The findings stressed a very important point to all education leaders- that young teachers although techno-savvy, they still need professional training based on the TPACK framework. Mental models could be barriers to many inexperienced teachers.

Universities need to be resilient and innovative in their multi-faceted roles. Technology integration plays a critical role to address this need. Professional training and development of academicians is vital to the success of technology integration into teaching and learning. The establishment of a complex technology-supported university learning environment requires careful planning that transforms the existing mental models that inhibit technology integration.

The TPACK framework could possibly serve as a guide to many technological novice academicians in higher education institution. However, the TPACK framework needs further research to address some of the theoretical challenges (Chai et al., 2011; Graham, 2011). This framework asserts the importance of the knowledge of technology, pedagogy and content in creating meaningful learning. John Biggs' (2003) constructivist learning environment should also be the guiding principle in realising a "learning community" as proposed by Garrison and Kanuka (2004). The TPACK model proposed by Koehler and Mishra (2005) has also stressed that skilful teaching is very complex and means more than finding and applying the right technological tools, rather being able to bring authentic learning experience in collaborative groups (Koehler & Mishra, 2005).

2.4.2 Previous Research on Pedagogical Innovations

The literature review presented for empirical findings on exemplary pedagogical innovations starts with examining some best practices of teaching from a case study in a Finnish university (Kettunen, 2011). Not all pedagogical innovations are driven by technology integration as clarified by Kozma (2003) and Law et al. (2011). Blended learning on a learning management system (LMS) that enhanced synchronous learning is considered to be a model conforming to the six dimension of pedagogical innovations (Reaburn, 2009, Law et al., 2011). The highlight of pedagogical innovations studies is best described in the international SITES-M2 survey reported Law et al. (2011).

A very important principle to adhere to in this study is that while the study was being conducted, technology advancement presents an unprecedented rate of new applications of the arrays of social networking tools and standards of best pedagogical innovations. Technologies will always offer many exciting teaching and learning experiences transcending classrooms such as innovative and new pedagogy, up-to date curriculum, student centred learning and assessment. Nevertheless, environment and personal factors are of paramount importance in the effort to elicit best pedagogical practices through technology in learning institutions. Empirical study to evaluate the effectiveness of technology integration on pedagogy innovation and organisation outcomes should focus on a new set of specific learning tools and how pedagogical practices has changed over time.

Kettunen (2011) conducted a survey on pedagogical practices that are considered innovative in a Finnish university. He pointed out that the university has three exemplary practices of pedagogy. This university defines innovative pedagogical practices as practices that adopt ICT as the backbone in research and development, entrepreneurship, curricular and assessment development, and community service. The three unique innovative pedagogical practices actually support its endeavours in economic pursuits, enhancement of organisational culture and networking with the broader community.

Firstly, it started a new platform of teaching and learning called *Broadcasting for the twenty first Century*. The new Digital Video Broadcasting-Handled (DVB-H) system in the Finnish University is innovative because it attempts to accommodate consumer needs to receive broadcasts related to the course to a handheld terminal. This new technology has overcome the problems of converting analogue to digital data that exists in the former Digital Video Broadcasting-Terrestrial (DVB-T) television transmission system.

Courses could now be offered to non-traditional students especially working adults through a network of 35 partner universities in Europe. Technology corporations such as Nokia and Digita are key industry partners that add value to the entire new and innovative learning process.

Secondly, the university has introduced a new innovative web-based learning programme that supports the university's endeavour to lead the Central Baltic Programme (2007-2013). This programme aims at promoting environmental management awareness. It consists of two sub-programmes that are transatlantic in nature through national cooperation: the Southern Finland-Estonia sub-programme; and the Archipelago and Islands sub-programme. This transatlantic environmental conservation programme has three priorities: (i) to promote a safe and healthy environment, (ii) to elevate the region to be economically competitive and innovative, and (iii) to promote the region as an attractive and dynamic society (Schwartz, 2007). Both national and international students are exposed to environmental conservation through curriculum embedment. This web-based learning approach has also opened up many new opportunities for the faculty and students to broaden their knowledge and practices through various international exchange programmes.

Thirdly, the university has introduced a radical process innovation that "provides students with the opportunity for group-based and networked learning in a multi-field and cross-border environment." (Kettunen, 2011, p. 6). This innovation in learning style offers students the opportunity to develop an innovative well-being services programme for elderly people. This programme is called the *Virtual Elderly Care Services on the Baltic Islands* (VIRTU). It is a solution to the problem of maintaining the healthcare services for an ageing population in Finland. The VIRTU programme has also overcome the problems related to insufficient health care staff. In addition to that, the university has brought a paradigm change in the cost structure of healthcare using virtual technologies that connect the elderly, their relatives, municipalities, and care givers. The new cost-efficient procedure has developed the healthcare service in Finland into a profitable and transferrable business concept.

Based on the Finnish university successful projects, innovative pedagogical practices offer avenues to enhance learners' experience, promote university and community engagement, and bring economic benefits to the various stakeholders.

In a study on the effects of student engagement of redesigning a work-based learning course based on the principles of constructive alignment and student engagement (Biggs, 2003), Reaburn et. al. (2009) found that:

(a) Blended learning significantly increased student interaction and engagement with assigned learning tasks and incidental learning; student-student, and student-staff interactions.

(b) Blended learning encourages active higher level learning through critical reflection and evaluation of the experience.

Blended learning was introduced using an online platform called learning management system (LMS) that enables asynchronous learning and assessment methods such as viva, individual and group projects, individual learning contracts and portfolios, critical incident analysis, and case study presentations.

The survey was conducted using mixed methods among a group of 39 students who participated in the revamped module. The subjects comprised of 19 males and 20 females with an average age of 20 years. The researchers administered a questionnaire containing both quantitative and qualitative questions via the Term 1, 2008 Blackboard! course site. The analysis of the qualitative survey provided data concerning the students' experience of the redesigned course. The quantitative data from the questionnaire was generated within Blackboard! in tabulated form and analysed for validation and triangulation purposes with other data sources. This survey generated an overall response rate of 49 %, with 19 of the 39 students enrolled in the course, responded to the online survey. A series of unpaired, two-tailed Student *t* tests were carried out to determine statistical differences between the total and mean number of unique 'hits per student' in each of the content areas as well as the total and mean number of hits per student. Statistical significance was accepted at an alpha level of .05.

A comparison of the two semesters' BlackBoard! access statistics results showed that in introduction of blended learning resulted in a significant increase of 136 % in student access and engagement (hits per student) with total Blackboard! course content (p = .002). In addition, the student-student and student-staff interaction increase significantly to 217 % in the Discussion Board forum 'hits per student' (p = .001). These quantitative findings support the qualitative findings of increased connectivity and ability to communicate with other students.

Reaburn et al. (2009) focused on Blackboard! as a means of technology integration to elicit innovation pedagogical practices might not be relevant in this fast paced technological era. In 2012, there are more than a hundred research journals that have actually reported newer and more advanced applications of online technology to teach students, such as the open educational resources (OER) that operates on learning management platforms such as MOODLE (Andrew, 2012).

A new learning environment that is designed to promote authentic learning experience in a global context is vital to meet the challenges of the job market. Technology integration in higher education can fulfil this demand. Technology integration in learning enhances students' interaction and engagement with the course content, learning community, and the situated learning contexts (Reaburn, Muldon, & Bookallil, 2009). Universities could leverage on technology integration to allow students to learn according to their learning styles and preferred pace. The group of students who collaborate, share and create knowledge form a community of active learners. The cross-pollination of ideas and creation of new knowledge allows the community of learners to achieve the higher learning order outcomes.

There has been much published research on pedagogical innovations that focus on descriptions of the innovations. Comparison of innovative pedagogical practices using a standardised instrument is a very recent international research agenda. The main challenge faced by researchers is that the study on pedagogical innovation demands the "kind and levels of expertise over and above knowledge of the countries compared, their cultures, systems and policies" (Alexander, 2004, p.11-12). As pedagogical change is directly related to curriculum innovation that aims at preparing learners for the twenty first century, many researchers have adopted the curriculum framework of the International Association for the Evaluation of Educational Achievement (IEA) (Alexander, 2004; Law et al., 2011b).

One of the exemplary works carried out over the past two decades are the international comparative study of innovative pedagogical practices using technology that involved 28 participatory education systems called SITES-M2 (Second Information Technology in Education Study Module 2). In each of the SITES-M2 case study, pedagogical innovation is measured at classroom level as a pedagogical unit. A pedagogical unit is not defined according to the length of instructional (or organised learning) time rather the totality of all organised learning and teaching activities established to address a specific set of content. This pedagogical unit cannot be further reduced into smaller units during the planning process.

Using the IEA curriculum framework as the SITES-M2 survey, there are six dimensions for comparing the extent of pedagogical innovativeness (Table 2.2). The first dimension of pedagogical innovation concerns the specific intended learning objectives of the pedagogical unit. This dimension measures the extent to which the specific curriculum goals align with the traditional content and skills focus or with the twenty first century skills focus.

Dimension 2 and 3 measures the respective roles of teachers and learners play in relation to decisions on what to learn and how to achieve the learning goals. Typical features of roles are traditional, emergent and innovative (Voogt & Odenthal, 1998). Dimension 4 relates to the level of sophistication of the technology used as ICT has an important role in the learning and teaching process in educational settings. Dimension 5 refers to the extent to which outsiders, such as students and teachers from other schools or people from the community (experts, parents, and alumni) are involved in the teaching and learning process. Dimension 6 measures the multiplicity of learning outcomes revealed through the learning process such as the extent to which different kinds of learning outcomes such as communication skills and collaboration skills are observed during the learning process (Law, Yuen and Fox, 2011).

Table 2.3

Levels of Innovativeness for the Six Dimensions of Innovation

	Innovation Level (Five)				
Dimen-sion	*Traditional*	*Some new elements*	*Emergent*	*Innovative*	*Most Innovative*
Learning Objectives	Conceptual learning, solving well-defined problems, motivate learning	Information skills, ICT-Based productivity skills, self-accessed learning	Critical thinking, catering for individual differences	Inquiry skills, communication skills	Collaborative and organisational skills, provide authentic learning contexts
Teacher's roles	Present and explain, set instructional tasks, monitor and assess	Provide feedback, develop teaching materials, design curriculum and learning activities	Select ICT tools, co-teaching	Support/model inquiry process, liaise with parties outside school	Support team building and collaborative process, mediate communications between students and experts
Students' roles	Listen and follow instructions	Data-gathering and data-processing, search for information	Presentation of own learning, analysing and drawing conclusions from data	Collaborate with local/remote peer learners, engage in inquiry, provide technical support to teachers/others	Peer tutoring, engage in peer evaluation, provide computer-related instructions to adults (incl. teachers), determine own learning goals and strategies, reflect on own learning
ICT used	No ICT used	ICT in course administration, tutorials/drill and practise applications, Web browser and search engines	Email, asynchronous and synchronous communication tools, web/multimedia production tools, ICT as productivity tool (Word, PowerPoint, webpage/media production)	Asynchronous and synchronous tools for collaboration, data-analysis software, network and computer-mediated collaborative tools	Simulation/modelling software, data-logging tools, purpose-designed software as mindtools for specific purposes

Table 2.3 (*Continue*)

Levels of Innovativeness for the Six Dimensions of Innovation

	Innovation Level (Five)				
Dimen-sion	*Traditional*	*Some new elements*	*Emergent*	*Innovative*	*Most Innovative*
Connectedness	*Parties involved*				
	isolated classroom	Teacher collaborating with teachers in the same school, students collaborating with students from different classes of the same grade in the same school	Teacher collaborating locally/nationally, collaboration of multi-grade students from the same school	Involvement of various communities groups (parents, alumni, community groups, private sector) in the curriculum process	Collaborate with teachers and/or students in other countries
	Roles of parties involved				
	As observers	Support course administration, provide technical support	Assess students, provide feedback to students, provide additional information to teachers/students	Develop teaching materials/ curriculum, course of authentic learning tasks	As classroom instructor/ teacher, monitor students' task progression
Multiplicity of learning outcomes exhibited	Written test/exam, close-ended written tasks	Individual open-ended written/presentation tasks	Group products: presentation/discussion log, creative learning product involving variety of media	Inquiry plan/method/instrument for problem solving in authentic contexts, portfolio/learning log	Evaluation of peers inquiry report, authentic products for learning context

Source: Law, Yuen and Fox (2011, p. 33-34)

In this SITES-M2 study of 28 education systems, each of the six dimensions of pedagogical innovation are spread along a continuum of innovativeness, ranging from the most 'traditional' through 'emergent' to 'most innovative' (Law, Yuen, & Fox, 2011a). *Traditional* classroom is described as one where the pedagogical practise is traditional across all six dimensions. This classroom emphasises on pre-determined activities and learning outcomes, teacher-centred and absence of ICT roles, disconnected from the outside world and assessment focuses entirely on cognitive learning outcomes. The classroom that Law et al. (2011a, p. 33-34) consider most innovative across all six dimensions is one that has the following characteristics:

(a) Targets the development of collaborative inquiry abilities through the provision of authentic learning contexts.

(b) Has self-directed students, who take responsibility for defining their own learning goals and pathways in collaborative inquiry, while the teacher guides the exploratory process.

(c) Facilitates team building and reflection.

(d) Mediates communication between and among students and various outside parties, such as experts and co-learners.

(e) Allows both teacher and students to use appropriate technology to support their teaching and learning activities as well as their communications with the outside world.

(f) Bases assessment primarily on authentic evidence generated during the learning process, such that the assessment reflects not only the cognitive outcomes but also the targeted process outcomes.

Emergent classrooms are those with practices mid-way between the most traditional and the most innovative.

2.4.3 The Malaysian Perspective of Technology Integration and Pedagogical Innovations

There are several studies on e-learning status, trends and challenges in Malaysia provided some crucial background information to this study. The study on the development of Web-based Assessment in teaching and learning (e-ATLMS) has revealed that many teachers welcomed the integration of technology into assessment of learning as part of the wider implementation of school-based assessment (Hamsiah Mohd & Raja Maznah, 2010). In a separate study, it was reported that integrating technology such as online learning involves a significant fundamental shift in a teacher's pedagogical practises. The management of HEIs should devise clear strategies and policies to effectively manage the systemic change (Ghavifekr & Hussin, 2011). In order to ensure the success of technology integration, training and technical support should also complement an effective ICT governance of the HEIs. In the Malaysian government's effort to evaluate the status, trends and challenges of e-learning among tertiary education institutions in Malaysia, a preliminary study was undertaken in late 2000 (Mohd Amin, 2011). This study has highlighted the urgency for the ministry to devise a national e-learning policy to guide the coordination of technology training in all HEIs (Raja Maznah & Abdul Halim, 2012). There was only 38.5% of the 27 HEIs sampled actually have e-learning policy and as much as 67.4% of faculty members are not yet confident in developing e-content. This has also highlighted the needs for deliberate effort in pedagogical training that are innovative through the smart applications of technology.

2.4.4 Measurement of Technology Integration and Pedagogical Innovations

The Innovation Configuration Component Map (ICCM) is a diagnostic tool based on the CBAM change concept (Hall & Hord, 2001). ICCM captures adoption variations that range from high to low fidelity hence it complements Rogers' theory of diffusion of innovations.

One of the earliest reported diagnostic functions of ICCM was the Kentucky Educational Reform Act (KERA) in 1990. The Kentucky Institute for Educational Research (KIER) has created six different ICCMs to measure the implementation of educational reforms in Kentucky. This reform covers a wide range of indicators such as professional development of the school staff, extended school services, school-based decision making councils, high school restructuring, family resources and youth service centres, educational technology and the primary education programme (Kacer and Craig, 1999). There were many ICCMs developed to measure each of the scope of reform and particularly in assessing the relationship between level of implementation of educational technology in middle schools and Kentucky's high stakes assessment of academic achievement. The ICCMs were further fine-tuned to assess the relationship between student achievement and the degree of implementation of Extended School Services (ESS) in the middle schools (Craig & Kacer, 2000).

In 1994, the Department of Defense Education Activity (DoDEA) used the ICCM instrument to develop several tools to measure best practices in the teaching of reading, writing and thematic units using a variety of research based resources to achieve successful integration. For this particular study, each ICCM developed has a number of components with variations that describe ways teachers and students interact in the teaching and learning process. The DoDEA further tested the ICCM in the secondary school science programme. The ICCM developed have key components of variations that reflect the adopted standards of the United States' National Science Education (NSE). ICCMs could be developed to match various educational standards to measure different practices of pedagogical innovations. The ICCMs developed for school could be used by teachers for self-analysis and reflection, teacher peer observation and coaching, planning for staff development and enhancing student involvement (Kacer and Craig, 2000).

The Innovation Configuration Component Map has been used in many educational settings to develop and assess the effectiveness of technology integration. This covered the evaluation of technical adequacy of the innovation configuration for problem solving among disadvantaged learning community such as interventions for children and for implementation of ICT among teachers trainees for the United States' schools, colleges and departments of education (Javeri & Persichitte, 2007).

The Innovation Configuration Component Map can also be used to track the implementation fidelity of an innovation. A study done by Mills and Ragan (2000) used ICCM to analyse the effectiveness of the implementation of an integrated Learning system (ILS) called *Successmaker* used in elementary schools. The validated ICCM is called the Integrated Learning System Configuration Matrix (ILSCM) and was used to study if there were differences in the operational patterns of teachers implementing the ILS and to identify which implementation practices of teachers exhibited fidelity (Mills & Ragan, 2000).

Later in 2001, Mills developed and validated an ICCM called Technology Implementation Standards Configuration Matrix (TISCM) to examine the quality of implementation of computer technology in classrooms. This study was conducted in schools that undertook a professional technology development programme (Mills, 2001). The TISCM was reported to be an effective tool for three purposes: (i) to determine technology implementation fidelity; (ii) to reveal the technology implementation attributes of teachers integrating technology in classrooms; and (iii) for identifying appropriate training themes that targeted at specific technology standards.

Javeri and Persichitte (2007) adopted the various ICCMs developed by the researchers to examine innovative pedagogical practices among faculty of higher education in schools, colleges and education departments of education. The purposes of this study were: (i) to capture technology integration standards as set by the International Society for Technology in Education (ISTE) and National Education Technology Standards (NETS); and technology integration best practices found in the current literature in the form of an ICCM; (ii) to follow guidelines and a systematic process of Innovation Component Configuration (ICC) mapping proposed by Hall and Hord (2001), and Heck et al. (1981) to develop, field test, revise and standardise a customised ICCM in preparation for use of the instrument in a full-scale research effort (Javeri & Persichitte, 2007).

The five-step procedure for developing an ICCM as recommended by Heck et al (1981) was adopted to ensure that there was fair consensus-building process and critiques among members of the innovation system (Hall & Hord, 2001). The five-steps are:

(a) Identification of innovation implementation components

(b) Identification of additional components and variations

(c) Refining the innovation components

(d) Testing the innovation map with a few users and finalise the innovation component (field study)

(e) Collection of innovation data

In the first step, the ICCM components were identified based on the standards set by US International Society for Technology in Education (ISTE) and National Educational Technology Standards (NETS).

In the second step, additional components and variations were identified based on an earlier qualitative study (Javeri, 2002). This qualitative study surveyed best practices of seven faculty members from the mid-size western university. The seven participants were teaching pre-service teachers and at the same time were participants in a *Preparing Tomorrow's Teachers to Use Technology (PT3)* research grant project. From the observations, interview feedbacks and triangulated with website and projects analysis, there were 25 technology integration components identified. Each of the 25 components was recorded in variations of low to high scores. These variations were then arranged along a continuum; such that technology integration behaviours reflected in each successive level of variation included behaviours from preceding variations.

The instrument was later refined by Javeri and Persichitte (2007) with some modifications based on the ISTE and NETs online reports. There were six dimensions of technology standards considered to be the most important attributes of technology integration:

(a) Faculty demonstrate a sound or in-depth understanding of technology operations and concepts

(b) Faculty integrate technology in planning and designing learning environments and experiences. (Faculty plan, design, and model effective learning environments and multiple experiences supported by technology).

(c) Faculty integrate technology in the planning of curriculum. (Faculty facilitate, model, design, implement and disseminate curriculum plans that include methods and strategies for applying technology to maximize student learning and also address content standards and student technology standards).

(d) Faculty integrate technology in evaluation and assessment.

(e) Faculty integrate technology to enhance their productivity and professional practice. (Faculty design, develop, evaluate, model and facilitate application of products created using technology resources to improve and enhance their productivity and professional practice.)

(f) Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice.

Each of the technology integration implementation components comprises of five variations of implementation fidelity. The highest fidelity of implementation was assigned a value of 5 and the lowest as 1, along the ICCM continuum. This ICCM has total score ranges from 125 to 25 and numeric coding decisions were made to allow for analysis of integration fidelity in the subsequent full-scale integration study in which this ICCM was implemented. This instrument has a reported internal consistency *Cronbach's Alpha* of .96 for the total scale indicating a very high reliability. This ICCM measures the six distinct aspects of technology integration in higher education and also gives an overall measure of technology integration fidelity.

The various reports on use of ICCMs to measure technology integration practices in school and higher education classrooms in implementation of innovations warrant the "lock and key" match. The ICCM instrument developed based on CBAM of Hall and Hord in complementing the theory of diffusion of innovations (Rogers, 1995) has resulted in a reliable tool with a high degree of content validity for the measurement of technology integration, both as an evaluation tool as well as an implementation guide.

In this study, the ICCM was adapted and used to evaluate technology integration practices of faculty members.

2.4.5 Previous Research on Organisation and Faculty's Beliefs on Technology Integration

The study on innovations and the diffusion theory have stressed the paramount importance to heed the underlying organisation culture and personal beliefs (Ertmer, 1999; Hall et al., 2010; Owston, 2007; Rogers, 1995). Literature review on the dynamics of organisation and personal beliefs in this study started from the perspectives of the United States Department of Education report on the nation-wide effort in helping school teachers to adopt technology (Ertmer, 1999). Then in a separate study on technology implementation and innovation adoption across three distinct industries, the conditions facilitating the success were analysed and presented through Ensminger's (2005) findings. In a study related to SITES-M2, Owston (2007) identified ten challenges faced during technology integration in schools. Challenges faced by teachers and schools in integration technology were further validated through research conducted by Georgina and Hosford (2009), Wachira and Keengwe (2011), and Meyer et al. (2011).

In a meta-analysis study on technology integration among educators, Ertmer (1999) found that there were many sceptical reports on teachers' adoption of technology such as computer in their pedagogical practices. After almost three decades of computer application in schools, Ertmer (1999) drew on the statistical data announced by the United States Department of Education report that was worrisome: millions were spent and yet only 5% of the K-12 teachers are integrating technology effectively into everyday practise (Parks & Pisapia, 1994). In addition to that, it was also reported that technology integration has not changed the pedagogical practices, and education institutions structure (Hativa & Lesgold, 1996).

Ertmer (1999) classified the barriers into first-order and second-order barriers to describe the external and internal barriers to technology integration among teachers. First-order barriers are those that are the obstacles related to organisation issues of adequate access to the technologies, training, and support during technology integration. Overcoming these first-order barriers does not necessarily warrant that technology integration will be successful. Studies have shown that these organisation related barriers could be overcome through a systematic adoption process of technology integration such as training and providing adequate support (Ertmer et al., 2011; Ertmer, 2005).

Second-order barriers refer to personal beliefs that are embedded in a teacher's philosophy of teaching and learning, which are more hidden and deeply rooted in daily practice (Ertmer 1999, 2005). These include a lack of vision or rationale for technology use, lack of technological relevance to the curriculum, and incompatible with pedagogical practices. The interplay of these two barriers is found to exert influence on the process of technology integration and pedagogical practices in education settings (Garrison & Kanuka, 2004; Mehra & Monika, 2007). Research conducted among mathematics teachers in urban schools has also highlighted the presence of first and second-order barriers (Ertmer, 2005).

In a study that examined the conditions that facilitate the implementation of technology and process innovation in the United States, Ensminger (2005) compared three innovation systems: (i) K-12, (ii) higher education, and (iii) business and industry. A total of 756 subjects from the three innovation systems participated in the mixed methods research. An instrument based on Ely's eight conditions (Ely, 1990) that facilitate the implementation of the technological innovations was administered. The Ely's eight conditions are as follows:

(a) Dissatisfaction with the status quo
(b) Adequate resources
(c) Skills and knowledge
(d) Adequate Time
(e) Rewards and incentives
(f) Participation
(g) Leadership
(h) Commitment

The instrument comprised of two components: technology and process form. Based on the ANOVAs for the eight conditions repeatedly measured in the two components, there were significant differences. It was further observed that implementation of technology as an innovation in the three distinct organisational systems faced challenges such as lack of resources, lack of commitment from top management, low level of skills among the adopters, and lack of training (Ensminger, 2005).

In the international study on pedagogical practices brought by technology integration, SITES-M2 has identified ten conditions that will sustain technological innovations in school:

(a) Teacher professional development

(b) Student support

(c) Teacher support

(d) Perceived value of innovation by teacher

(e) Administrative support

(f) Innovation champions

(g) Funding

(h) Supportive plans and policies

(i) Support within school

(j) Support from outside school

The first five conditions are called the essential conditions and the remaining are contributing conditions (Owston, 2007). This collection of conditions were identified through a set of 59 cases from the 174 schools participated in the SITES-M2 study. The researchers applied the grounded theory approach of qualitative study

(Bogdan & Biklen, 1998). This is an iterative step-wise method that focused on emerging and recurrent key issues to arrive at summary of findings. The data of the 59 selected cases were then validated through additional sampling, coding and writing (Owston, 2007).

The findings of Owston (2007) though was not directly linked to Ermter's (1999), have some similarities. The group of five essential conditions that sustain the innovation of technology integration though not entirely similar does resonate with Ertmer's (1999) second order barriers that are more teacher's centric. The five essential conditions of Owston (2007) are comparable to Ertmer's (1999) first order barriers which is organisational and environmental relevant.

Georgina and Hosford (2009) examined the extent to which faculty technology literacy and technology training impact the integration of technology into pedagogical practices. This study was premised on Roger's (1995) innovation adoption as a diffusion process. This is a quantitative study conducted through on-line survey using single-random sampling method. A URL containing the survey was sent to the total population of 1115 faculty within a college of education. A total of 237 subjects responded to the survey.

The research questions of this study were:

(a) How does faculty self-perception of technology literacy predict pedagogical practise (design and delivery)?

(b) To what extent does a relationship exist between faculty self-perception of technology literacy and pedagogical practise (design and delivery) when controlling for faculty training?

(c) How does the integration of technology explain pedagogical practise?

The Likert five-point scale instrument of the survey was tested for validity and reliability through a pilot study. The modified instrument has the following *Cronbach alphas*:

(a) On technology literacy: .951

(b) On technology training: .584, and

(c) On pedagogy practices: .819

Subjects were grouped based on their years of teaching experience; 1-5, 6-10, 11-15, 16-20, and above 20. Pearson correlations for training strategies and pedagogical practise indicted that two training strategies (small group and on my own time) were related to pedagogical practices (design and delivery). When controlling the effect of training, total years of teaching experience has no significant relationship on the integration of technology as shown by the one-way ANOVA $F(4, 230) = .91$, $p = .46$, $\eta^2 = .02$) . The years of teaching experience was reported to have an inverse relationship on both computer hardware and software proficiency.

It was also reported that although the organisations where the faculty work have been spending a lot of resources on expensive on-line teaching platforms, faculty lack confidence in using the less expensive and easy to manage web pages. This shows that many HEIs could be designing overly ambitious training programmes to equip faculty to integrate the best technology available without considering individual faculty's underlying beliefs in technology and pedagogy (Georgina & Hosford, 2009).

With careful planning, digital technologies could offer meaningful learning experiences in a community of learners who innovate, create, and share new knowledge. Wachira and Keengwe (2011) sought to examine barriers in technology integration among school mathematics teachers. The purpose of the study was to study urban school teachers' perspectives on barriers to technology integration in their mathematics teaching. This study aimed to answer three main research questions: what are the technologies available to teachers, main reasons these technologies are not used widely in teaching, and personal reasons teachers do not use technologies in teaching. The subjects were 20 mathematics teachers: 15 female and 5 male, enrolled in a teaching mathematics with technology graduate course. This group of teachers took the course as part of their masters' degree in the Spring semester of 2008.

This is a mixed methods research. Qualitative data was collected from the participants' written responses to a three-question written questionnaire that resembled interview. Quantitative data was collected through a survey on teacher's beliefs and attitudes. This survey consisted of items that evaluate teachers' beliefs and attitudes about mathematics and technologies. Both written questionnaire and the beliefs and attitudes survey were administered at the early stage of the study.

During the third week of the study, three participants who were teacher leaders and mathematics coaches were subsequently selected for an in-depth interview. Participants' use of technology in the course, discussion and observation were collected for more qualitative data.

Qualitative data was then analysed by thematic analysis, coded and sorted for emerging themes. The quantitative data was meant for descriptive purpose. Triangulation was performed using data from interviews, questionnaire survey, observations and discussion notes.

The results of the study showed that barriers exist among this group of mathematics teachers in technology integration. Based on the Snoeyink and Ertmer framework (2001) of barriers, several external and internal barriers were reported from this study. The external barriers are:

(a) Lack of technology. Although there had been an increased provision of technology, it was still not enough. Most technology applications were meant for students' practise and testing purpose. There was also a lack of advanced software to enhance critical learning among students.

(b) Unreliability of technology. Other aspects of facilities in school such as internet connection and high speed server are crucial to ensure that the present technology could function.

(c) Lack of technical support and leadership. When school administrators and leaders do not support technology integration, teachers will not be motivated to use technology in teaching.

The internal barriers identified are:

(a) Lack of time. Hectic classroom management and the need to understand the new technology will always become a hindrance to teachers to pick up new tools.

(b) Lack of knowledge. Skills and expertise in using technology take time to cultivate. Pedagogical knowledge is crucial in integrating the technology meaningfully into teaching.

(c) Anxiety and confidence. When technology was unreliable and support was inadequate, many will be afraid to embrace change in using technology that is considered innovative.

The analysis of quantitative data from the survey revealed that 61 % of the teachers were unsure of their ability to integrate technology into teaching. All of them were willing to learn new technologies to integrate technology. Over 90 % of teachers also agreed strongly that technology could create more learning opportunity for students. In addition to that, over 90 % of teachers think that technology not only motivates students to learn but also makes mathematics learning more fun.

This study has again, stressed the central role played by teachers in integrating technology into meaningful teaching in schools. Teachers should be engaged in the process of technology integration so that barriers could be identified and mitigated. The administrative support in lending leadership to promote technical skills and training would be crucial to assist teachers in using technology. This type of support should come in the form of training to a community of learners which is more important than the availability of technological tools and software. Apart from that, technologically competent teachers could also play a prominent role in leading technology integration in schools.

On the other hand, it has also been highlighted that technology alone cannot bring transformation of classroom teaching, when the context of learning and pedagogy knowledge are not addressed. Wachira and Keengwe (2011) support the TPACK framework of balanced roles of technology, pedagogy and content of teaching in transforming classroom teaching with technology (Koehler and Mishra, 2005).

In a study on using technology integration in the K-12 schools involving 16 elementary classrooms in Canada, it was reported that teachers with "low" technological tool implementation faced more technical obstacles and were more likely to resist change in their pedagogical practices (Meyer, Abrami, Wade, & Scherzer, 2011). Teachers with high technology integration skills were more likely feeling lack of support from their leaders. This group of teachers were also reported to have experienced growth in their pedagogical practices in using the technological tools provided to them.

This study was conducted based on the concept of constructivist pedagogy assessed using a framework of self-regulated learning for students. The main objective of this study was to evaluate the effects of using a typical technology integration tool on teachers' pedagogical practices. The technology integration practice was measured by the efficacy of students using an eportfolio learning tool and also how teachers were using that tool for innovative pedagogical practices. This eportfolio learning tool is called ePEARL and was tested to be effective in helping students to assume greater responsibilities in their learning.

The ePEARL tool was designed by a dedicated centre to enhance learning and performance in Canada. The ePEARL tool offers students the avenues to set their own learning goals and strategies, monitoring of progress, and reflection of work completed. There are three parties involved in promoting meaningful learning: students, teachers, and parents.

The subjects selected in this study were 16 teachers from grades four to six classrooms in urban and rural English school boards in three cities of Canada. The teachers were teaching in the academic year of 2007-2008. Prior to data collection through a mixed method survey, the teachers were given at least a half-day training on the use of the ePEARL tool. This was then followed by administrative support such as lesson plan writing, audio aids, instructional videos, an online discussion forum, classroom observations and availability of model lessons.

The quantitative part of the survey consisted of administration of the Implementation Fidelity Questionnaire (IFQ), the Teaching and Learning Strategies Questionnaire (TLSQ), and, the Technology Integration Questionnaire (TIQ). The qualitative data consisted of student eportfolios and a face-to-face semi-structured interview using the standard Teacher Exit Interview Protocol. The subjects' feedbacks were further evaluated to identify factors that motivated or inhibited their use of the ePEARL tool.

The IFQ was administered in two semesters. It was aimed at identifying the advantages and challenges faced by teachers in using the ePEARL tool. The TLSQ consisted of five sections: Students' Learning Strategies, Approach to Teaching, Portfolio Use, Technology Experience and an open-ended section on the ePEARL tool use and subjects' attitudes towards the ePEARL tool. The TIQ basically evaluated subjects' technological beliefs.

Of the 16 subjects selected, seven did not actually implement the ePEARL tool, hence they were grouped as 'low' implementers. Four of the 16 were found to be 'medium' implementers, whereas the remaining five were 'high' implementers. The most common factors explaining non-use of the ePEARL tool were: too time consuming; conflict with other demands for subjects' time; limited access to computers; and problems associated with an unstable school server. 'High' implementers were found to have exhibited innovative pedagogical practices and they strongly believed that the ePEARL tool gave them good pedagogical support. It was also realised that the level of implementation, low to high, was not significantly related to their general technology use $F(1,14) = .605$, $p > .05$. Hence, this study concluded that teachers who appreciate and understand the importance of pedagogical benefits of using technology were able to enjoy the use of technological integration tool such as the ePEARL tool. The barriers identified in this study were mainly the perceived increased lesson preparation time that actually hindered technological competent teachers to use the ePEARL tool for innovative pedagogical practices (Meyer et al., 2011). This study also asserts the importance of understanding faculty members' perception on technology integration for constructivist pedagogical practices would be more critical than just giving them methodical trainings (Ertmer, 2005).

Similarly, in the context of higher education, the findings on barriers to technology integration were reported in many universities' periodic report on strategic directions. For example, in their quest to become the leading university in Australia as a leader in transnational education, University of Southern Queensland underwent a review process by its senior faculty and administrative leaders (Dashwood, Lawrence, Brown, & Burton, 2008). This committee identified seven issues to be overcome, all are related to professional pedagogy training and communicating the new framework.

The findings on the use of ePEARL case study actually resonate with the effort of the e-ATLMS case in the Malaysian schools (Hamsiah Mohd & Raja Maznah, 2010). In a study that initiated web-based assessment in teaching and learning management system (e-ATLMS), educational technology enhances student-centred learning. In the Malaysian study, teachers reported that technology such as e-ATLMS has enabled them to facilitate teaching and learning, as well as assessment beyond classroom. Hence, the subject of technology integration for pedagogical innovations at all education settings is a timely research agenda. Connectedness with external learning environment is one of six the innovation dimensions of Law and colleagues' framework (Law et al., 2011b).

Higher education systems and institutions are facing many challenges of globalisation. Technology integration is crucial for education institutions to deliver higher efficiency and effectiveness in achieving their institutional goals. Barriers to technology integration could be removed through adequate planning, technical and leadership support, and proper alignment of types of technology and objectives of pedagogical practices (Mishra and Koehler, 2006).

After three decades of pervasive technology integration in classrooms, Ertmer et al. (2012) investigated the relationship between teacher beliefs and technology integration practises. The main objectives of this study were to evaluate how the extensive technology funding, online ICT tools access, availability of training and support to teachers, have addressed the barriers to technology integration. The two main research questions posted in this study were: (a) how do the pedagogical beliefs and classroom technology practices of teachers, recognised for their technology uses, align? and, (b) to what extent do external, or first order, barriers constrain teachers' integration efforts, leading to potential misalignment between beliefs and practices?

This is a multiple case study research that examined the similarities and differences among the pedagogical beliefs and technology practices of 12 K-12 classroom teachers. Data were collected through in-depth document analyses of teachers' websites, followed by one-on-one interviews. The teachers' websites provided evidence of teachers' classroom technology practices while interviews provided insights into the extent to which beliefs support their practices. Teachers self-rating of barriers based on a 5-point Likert scale provided supplementary quantitative data that was analysed using simple descriptive statistics. The third source of data was obtained from interviews where constant comparison method was used to identify patterns among teacher's espoused beliefs. The website data was used to identify differences between teacher's personal descriptions of their pedagogical beliefs and espoused beliefs.

The team of researchers comprised of two faculty members and three graduate students. The participants of this study were selected based on Paton's (2002) purposeful sampling survey methodology. A secured online spread sheet was first created to capture data on all potential participants for the selection process. Potential participants were selected from online search for recipients of technology awards in preceding years. This had yielded the first round of 78 potential participants. Subsequently, a three-step selection process was followed: review of website information on pedagogical practices evidence (reduced to 41), student-centred pedagogical practises evidence (reduced to 20), and invitation for interview (reduced to 12). The final 12 participants were interviewed over a period of one month, each lasted between 35 to 60 minutes. All interviews were audio-taped and transcribed following a semi-structured protocol comprising nine questions. Eight participants were interviewed through Skype while the remaining through telephone.

The website information of the 12 teachers showed that they were all award-winning technology-using teachers. The extent to which barriers influenced their enacted beliefs was reflected in the self-rating of barriers to technology integration. The most impactful barriers were all external: availability of support (M =3.0), state standards (M = 2.83), money (M = 2.83), access (M = 2.67), time (M = 2.58), and assessments (M = 3.17). Among the three least impactful barriers, two were internal: teachers' own attitudes and beliefs, and teachers' knowledge and skills.

The major finding of this study was that eleven of the 12 teachers showed that their pedagogical beliefs were aligned to their practices. Two of the teachers use technology to deliver content and reinforce skills among their students. Six teachers showed great ability to enrich their teaching of curriculum. The remaining three teachers showed that they mastered the highest level of desired technology integration skills that transform teaching and learning. Teachers with student-centred beliefs tend to enact a student-centred curricula despite technological, administrative, or assessment barriers. Teacher's own beliefs and attitudes about the relevance of technology to their students' learning were perceived as having the biggest impact on their practises. The teachers revealed that the strongest barriers were their existing attitudes and beliefs towards technology, and their current levels of knowledge and skills. This research has further highlighted the strong relationship between teachers' underlying pedagogical beliefs and technology integration practises.

Most qualitative research findings are not generalisable. Hence, the findings of this research are interpretative of the actual context in the study and unique to the 12 teachers only. Quantitative methods should be used to supplement findings on students' feedbacks on how they perceived their teacher's teaching. The current generation of students are digital natives highly participative in their own learning that influences how teachers teach in the classroom. The barriers identified and verified by many other researchers (Nancy Law, Angela Chow, & Allan H. K. Yuen, 2005b; Owston, 2003). The methodologies were clearly stated that quantitative research could be applied to study a wider scope of technology integration and pedagogical beliefs among a selected homogenous group of participants. Quantitative analysis will identify further what are the prevalent barriers affecting teacher's espoused pedagogical beliefs. Using multiple regression analysis, the various barriers identified will also be ranked according to their significance in influencing teachers' use of technology in the classroom.

The research design of this project could have been improved by incorporating more extensive review of each selected participants. The 12 participant's selected were varied in their demographic background and their core subject of teaching. This will inevitably led to bias in how an individual participant had been compared with other participants of the study. Teachers always have pedagogical beliefs that are shaped by their experience in teaching a particular core subject. In this study, there was no indication of how biases had been minimised as only the participants with highest performance have been selected.

The use of teacher's websites information such as blog and wikis had allowed the evaluation of how the community of learners were exchanging ideas while transformative learning takes place. However, exemplary teaching practices using technology could be better evaluated using classroom observations, peer review, students learning portfolio (Law et al., 2011b). Law et al. (2011) proposed the framework of most innovative pedagogical practises should be evaluated in six dimensions: learning objectives, teacher's roles, student's roles, ICT used, connectedness of the classroom, and multiplicity of learning outcomes exhibited. This framework was based on the international SITES-M2 (Second Information Technology in Education study Module 2) longitudinal studies. There are 28 countries been tracked and studied for their exemplary pedagogical innovations practices. An important point to highlight is that pedagogical beliefs has been reported to influence how a teacher uses technology (Kozma, 2003). Malaysia did not participate in this study.

The team of five researchers involved in evaluating the website information and performed interviews showed that there were serious considerations on validity and reliability of the findings. There is however, lack of evidence pertaining to how the data collected was coded and triangulated among the team of five. There was no mention of frequencies of different results coded by the researchers conducted the interviews. As outlined by Bogdan and Biklen (1998) triangulation of data in qualitative research is most critical in ensuring all findings are not biased. Triangulation of data from three sources in this study: teachers' own website information, interviews and classroom observation was nevertheless not reported.

As this research also looked at how student-centred teachers taught differently, classroom observations should have been conducted. One of the most important elements of qualitative research is the observation of classroom activities based on the descriptions of the participant (Bogdan & Biklen, 1998). Classroom observation will allow the researchers to further evaluate if the alignment of pedagogical beliefs and espoused beliefs are indeed aligned as described by teachers.

In summary, this multiple case study research has strengthened further a proven critical relationship. In the fast paced education communities, researchers have identified many underlying factors and relationships between teacher's technology use and their underlying pedagogical beliefs. It is high time that in depth study on group of teachers of similar core subject is examined for their pedagogical beliefs and espoused beliefs through quantitative research. This will then enable school administrators and leaders to design relevant training according to teacher's core subject of teaching. Training could also be customised further that will align teacher's pedagogical beliefs and their technology use. A successful teacher that practices transformative teaching leveraging on technology should become the catalyst for innovative pedagogical practises.

2.5 Relationship between Technology Integration and Pedagogical Innovations

In this study, the main scope of analysis would be to examine the relationship between faculty's fidelity level of technology integration and levels of pedagogical innovations. The presence of organisation and faculty's beliefs from the perspective of faculty will also be examined for their relationship with the technology integration and pedagogical practices. The organisation and faculty's beliefs will be collectively labelled as the mediating variables. The demographic background of faculty will also be examined as the moderating variables in this study.

2.6 Conceptual framework

This research aims to examine the relationship of technological integration (independent variable) and pedagogical innovations (dependant variable) in HEIs. The presence of organisation and faculty beliefs (mediating variable), and demographic background (moderating variable) will also be evaluated on their effects. Technology integration in higher education will be assessed using the framework of ICCM adapted from the innovation adoption model of CBAM developed by Hall and Hord (2001, as cited in (Javeri & Persichitte, 2007). The independent variable of the study, pedagogical practices in higher education will be measured using level of innovativeness of pedagogy practices using the framework used in the SITES-M2 (Law et al., 2005a) as reported in Hong Kong as there are no other similar studies in the higher education context. Organisation and faculty's beliefs would be examined based on Ertmer's (1999) and Owston's (2003) findings. The extent to which faculty's demographic variable moderate the relationship between the independent variables and the dependent variable will be further examined (Figure 2.4).

2.7 Summary

This chapter has presented detailed literature review of empirical findings and reports related to the current state of technology integration and pedagogical innovations. The review could be examined from the perspective of technology integration that leads to innovative pedagogical practices and the reverse. The walk-through of the past research and reports have helped to identify potential external factors that interplay with the direct relationship between technology integration and pedagogical innovations. The demographic variables and organisation and faculty's beliefs variables were also identified based on the various research findings. The overall literature review has helped to formulate and conceptualise the research framework of the study.

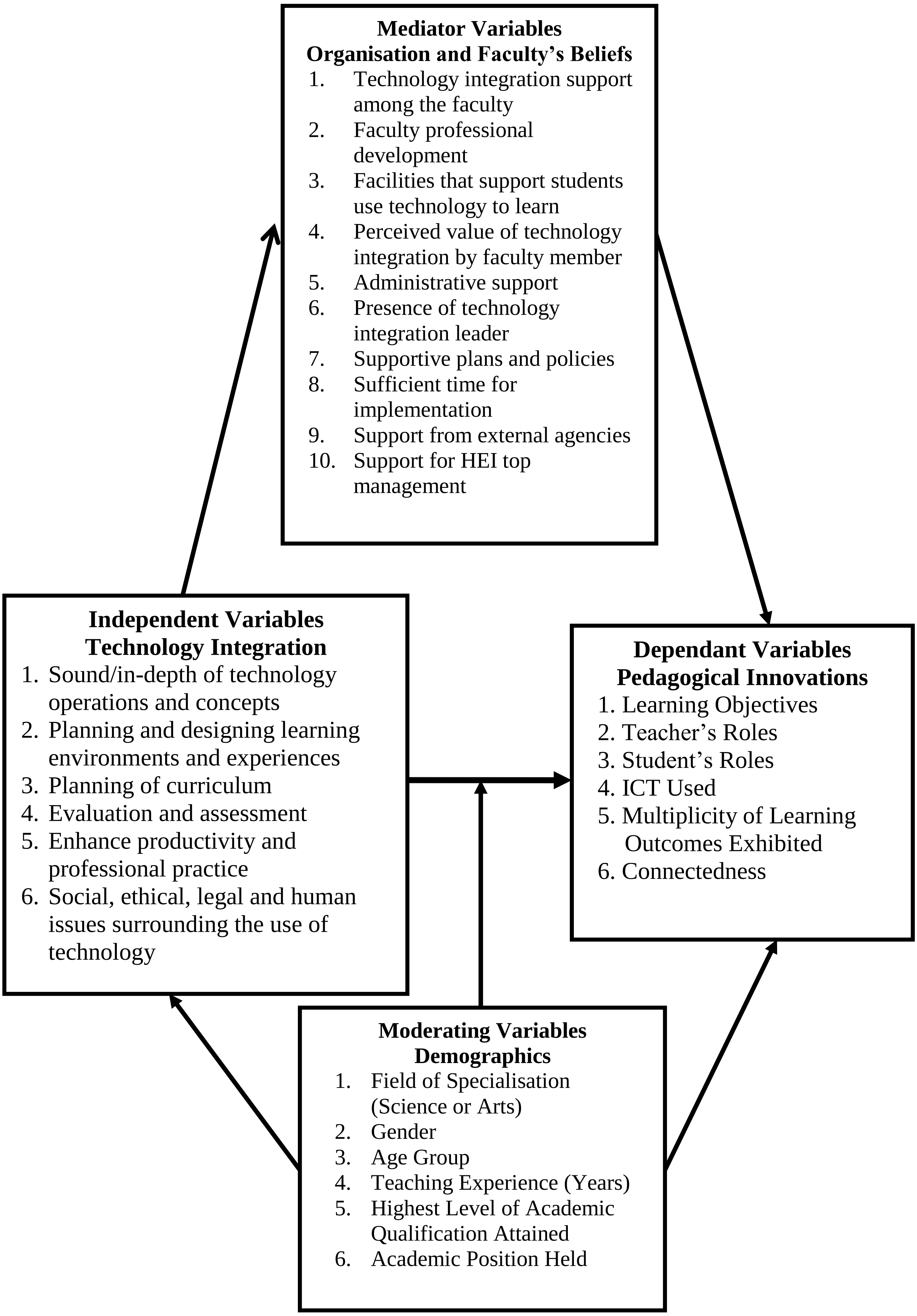


Figure 2.4 The Conceptual framework of the study

CHAPTER 3

METHODOLOGY

3.1 Overview

The purpose of this chapter is to discuss the methodology of the study. It describes the research design of the study, sampling method, and the selection of the subjects of the study. It also discusses the data collection procedures, the development of the research instruments and the pilot study.

3.2 Research Design

The study on technology integration and pedagogical innovations in higher education is a very complex process. This is a non-experimental research using survey technique through the administration of questionnaire that has been developed for data collection. According to Gliner and Morgan (2000), non-experimental approach is applied when the researcher studies patters of individual differences in attributes of the participants and does not have control over the independent variables. This design is useful in identifying the type of associate, explaining complex relationships of multiple factors that explain an outcome, and predicting an outcome from one or more predictor variables. This non-experimental approach does not lead to a causal relationship rather it helps to explain the relationships between variables (Creswell, 2002).

In view of the highly varied sizes of faculty staffing and the mixed ownership of Tier 5 HEIs, a simple random sampling procedure was conducted to determine the subjects to be chosen in this study. In order to achieve meaningful statistical data analysis in a quantitative research project, the minimum sample size of 30 subjects was adhered to. There were three public HEIs and three private HEIs with total target sampling size of 611 identified. The subjects of this study were identified first through the respective HEIs website. There were two science and two arts faculty groupings selected from each HEI. Upon obtaining the consent from the university management and the deans' office, the name lists of each of the faculty groupings were prepared. Subject selection was determined using the Krejie and Morgan's (1970) Sample Size Determining Table (*in* Chua, 2012, p. 227).

Figure 3.1 shows the series of steps involved in conducting this study starting from literature review to data analysis.

Stage 1 involved a comprehensive review of the relevant literature especially from the *ERIC* and ProQuest databases. The review of literature helped the researcher to define the scope of the study, analysed the theories and concepts, as well as formulate the research questions.

A pilot study was conducted at Stage 2. This aims to validate and refine the instrument further. During Stage 3, the researcher selected five HEIs to be the subjects of the study. The survey instrument was administered to the subjects through e-mail. The subjects could also respond to the instrument via hardcopy. The data were entered into the Statistical Package for Social Sciences (SPSS) software for further analysis in Stage 4.

In Stage 5, a comprehensive discussion of the findings was conducted. This was followed by a reporting on the major findings, implications of the study, suggestions for future research, and conclusion.

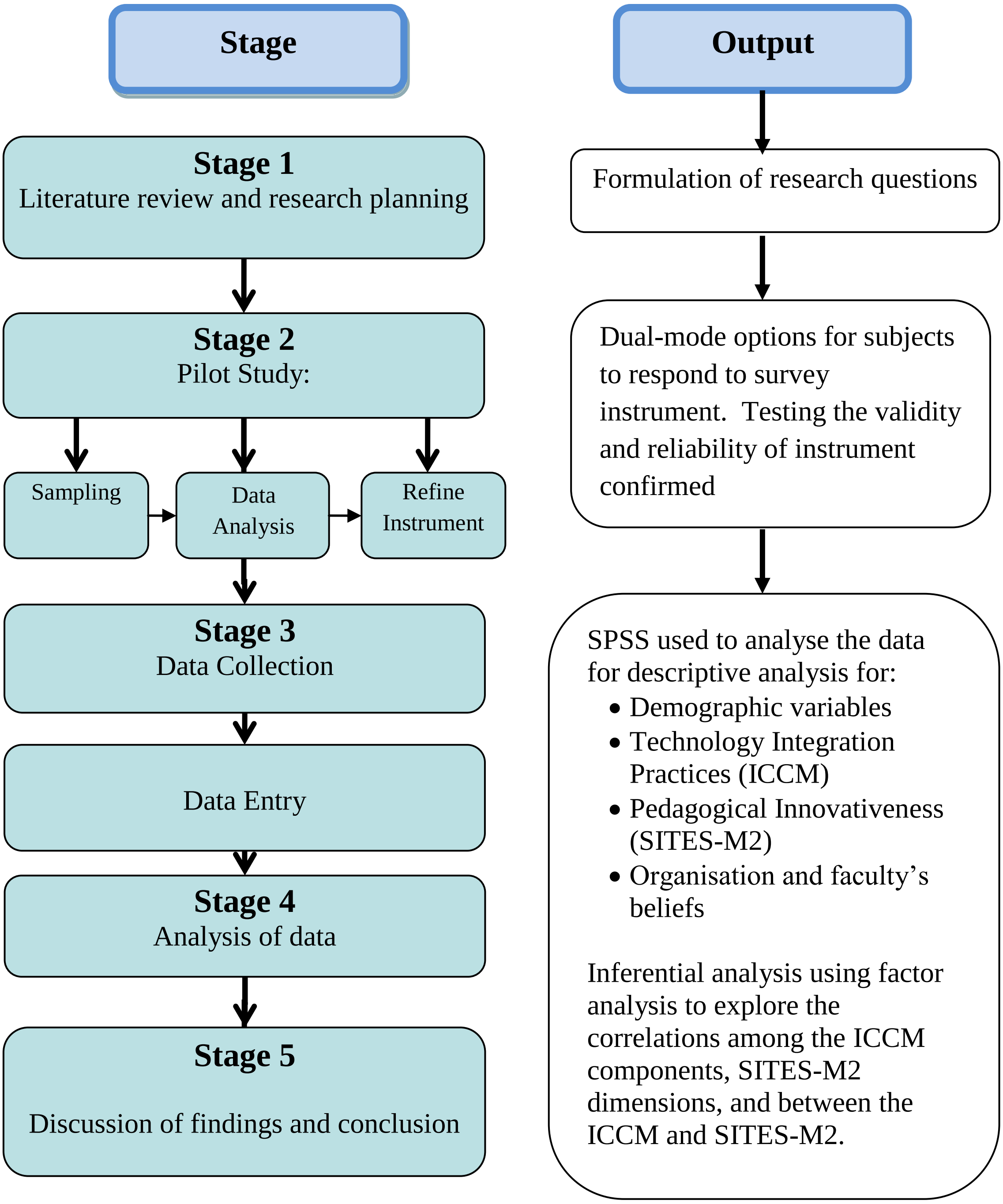


Figure 3.1 Research Design: Stages and outputs for the study

3.3 Subjects for the Study

The subjects of this study were selected based on simple random sampling method. The researcher selected six HEIs. The HEIs were ranked Tier 5 and above in the Rating System for Malaysian Higher Education (SETARA) ranking 2011 (Appendix A). The SETARA rating was based on 25 criteria, captured through 82 indicators covering three generic dimensions of input, process and output to assess the quality of teaching and learning of HEIs in Malaysian higher education. A Tier 5 ranking means the HEI scored a minimum performance rating of: 70 % to 79.9 % based on the twelve areas of academic performance audit conducted in 2009 by the Malaysian Qualification Agency (MQA) and an independent panel. The panel consists of five professors and senior administrators from HEIs. They were appointed by the Ministry of Higher Education Malaysia (MoHE).

The following steps were followed to select the HEIs in this study: (a) the first criteria of HEIs selection was that the HEIs selected are ranked as Tier 5 and above. (b) The second criteria of HEIs selection was based on category of ownership, either public or private HEIs. There were three public HEIs and three private HEIs selected.

Each of the HEIs selected in this study is assigned to a strata based on public versus private ownership. Subsequently, the researcher selected the faculties according to science and arts disciplines.

Finally, the deans of the various faculties and their members were invited to participate in the research. The subjects of the study consist of the deans and faculties of the six HEIs. Subjects must be fulltime teaching faculty members. This is to ensure that all subjects are familiar with the HEIs policies and practices related to technology integration and pedagogical practices.

3.4 Instrumentation

In this quantitative study, the researcher developed an instrument that consists of four sections (Appendix B). These are: (a) demographic background; (b) technology integration; (c) pedagogical innovations; (d) organisation and faculty's beliefs on technology integration; and pilot study conducted. Each of the section is discussed as follows.

3.4.1 Demographic Variables

The primary subjects of this study were faculty members of higher education institutions in Malaysia. These HEIs faculty members were involved in designing curriculum, teaching and supervising of HEIs students. In addition to that, Rogers (1995) diffusion theory has also highlighted that a social system such as a HEI that implements technology integration for pedagogical innovation will have different profiles of adopters among its members.

Based on the findings of Ertmer (1999) and Owston (1997) on organisational and environmental as first and second barriers to technology integration, the following demographic variables data were collected in this study:

1. Field of specialisation (Science/Arts)
2. Gender
3. Age group
4. Years of teaching experience
5. Highest level of academic qualification attained
6. Academic position held

These variables are listed in Section A of the instrument of study (Appendix B). Information on subjects' demographic background was collected in the form of nominal data. Nominal scale is used for three or more unordered categories (Morgan, Leech, Gloeckner & Barret, 2004). The use of nominal data will allow researcher to examine the various categories of demographic variables using frequency distribution.

3.4.2 Technology Integration Practices using the ICCM

The instrument to measure technology integration was adapted with modifications from the ICCM developed by Javeri & Persichitte (2007). This ICCM instrument was grounded on best practices and technology standards set forth by the International Society for Technology in Education (ISTE). ICCM was developed using the five standardised steps proposed by Hall and Hord (2001) and Heck et al. (1981). This ICCM has been tested and confirmed to be reliable in evaluating and mapping fidelity levels (high, moderate and low) of technology integration practices of faculty. Another purpose of this ICCM was to match the fidelity levels with recommendations for support and interventions. In this study, the fidelity levels of technology integration will be matched with levels of pedagogical innovations of faculty.

The ICCM measures levels of technology integration among the faculty of HEIs. It uses the following six main components (Javeri and Persichitte, 2007) as outlined in Section 2.4.3.

Subjects responded to each of the six main components. The six main components consist of a further 25 sub-components of ICCM (Section B of questionnaire). Each of the technology integration sub components comprised of five ascending levels of implementation fidelity. The highest level of fidelity implementation carries a score of 5 and subsequently, 4, 3, 2 and 1. A score of 1 represents the lowest level of fidelity along the ICCM continuum. Overall, the total score of the ICCM ranges from a minimum of 25 to a maximum of 125.

The total score from all subjects will be further ranked into three fidelity levels: low (25 to 49), medium (50 to 74), and high (75 to 125). In this study, the cut-off point of high fidelity in technology integration is 75. The mean score of the subjects will be extrapolated to understand the current fidelity profile of technology integration among the population of study. The 25 sub-components of ICCM are listed in the Section B of the questionnaire (Appendix B).

Information from ICCM scores were also compiled into ordinal data as the variables were measured on Likert scale that gave ordered levels. This allowed researcher to evaluate the fidelity levels of technology integration practices.

3.4.3 Pedagogical Innovations

Pedagogical innovation was measured using the SITES-M2 six dimensions of pedagogical innovations that had been developed by Law et al. (2005). The original instrument was grounded on the SITES-M2 findings from the international comparative study of innovative pedagogical practices involving 28 countries. In this study, a slight modification was made to this instrument with aims to characterise and compare different innovations in terms of their levels or extent of innovation of HEIs. This revised instrument can be administered to faculty of HEIs to examine the levels of pedagogical innovations.

Law (2003) and Law et al., (2005) reported that there are six dimensions that must be considered when research on pedagogical innovations is carried out. These consist of the following:

1. Learning Objectives
2. Teacher's Roles
3. Student's Roles
4. ICT used

5. Multiplicity of learning outcomes exhibited
6. Connectedness

Law et al. (2007) used a 7-point Likert scale to measure levels of pedagogical innovations in the six dimensions. When the subject indicated that he/she did not use ICT in pedagogical practices, a score of one point on the Likert scale was assigned. The score of one point was considered to be the most traditional practise.

At the mid-point of the scale, a score of 4 is awarded when the subject indicated that ICT such as power point is used in pedagogical practices. At the other extreme, a score of 7 point indicates that the subjects employed the most innovative pedagogical practices such as simulation/modelling software.

Each of the subjects in the study obtained a score for each of the six dimensions related to pedagogical innovations. The six dimensions were: the curriculum goal score (CG), the teacher's role score (TR), students' role score (SR), ICT sophistication score (ICT), multidimensional learning outcome score (MLO) and connectedness score (ConT). The individual scores of a subject represent an innovation profile of the subject's pedagogical practices.

Ultimately, the mean score of all the subjects could be analysed by their HEI ownership and demographic variables that represent the innovation profiles in radar diagrams.

In this study, the researcher developed an innovation profile using a 5-point Likert scale to measure pedagogical innovativeness of a faculty, the discipline of study, and the selected HEIs. The Likert 5-point scale gave ordinal data that denotes ordered levels of pedagogical innovations. In addition, the researcher compared the innovation profile of the HEIs in this study based on Law's (2007) six dimensions of pedagogical innovation. This is Section C of the questionnaire (Appendix B).

The scores of each of the dimensions could be interpreted by five levels of pedagogical innovations as outlined in Table 3.1.

Table 3.1

Score Matrix for Six Dimensions of Pedagogical Innovations by Levels

	Innovation Level (Score)				
Dimension	Traditional	Some new elements	Emergent	Innovative	Most Innovative
Learning Objectives	3	6	9	12	15
Teacher's Roles	3	6	9	12	15
Student's Roles	3	6	9	12	15
ICT used	3	6	9	12	15
Multiplicity of Learning Outcomes Exhibited	3	6	9	12	15
Connectedness	3	6	9	12	15
Total for six dimensions	18	36	54	72	90

A correlation matrix of the different innovation scores revealed whether there is a significant relationship between one dimension with that of another dimension.

3.4.4 Organisation and Faculty's Beliefs on Technology Integration

Based on Ertmer (1999) and Owston (2007), the organisation and faculty's beliefs relevant to the context of this study are as follows:

1. Technology integration support among the faculty
2. Faculty professional development
3. Facilities that support students use technology to learn
4. Perceived value of technology integration by faculty
5. Administrative support
6. Presence of technology integration leader
7. Supportive plans and policies
8. Sufficient time for implementation

9. Support from external agencies

10. Support from HEI top management

The subjects responded to each of the ten items based on a five-point Likert scale (Section D of the instrument) (Appendix B). Table 3.2 shows the items and measurement scales of the instrument as ordinal data.

Table 3.2

Items and Measurement Scale by Sections of Instrument

Variable	Section (Label)	Number of item	Measurement Scale
Moderating	A (Demographic Characteristics)	6	Nominal
Independent	B (Technology Integration Practices*)	25	Ratio
	1. Sound/in-depth of technology operations and concepts	5	
	2. Planning and designing learning environments and experiences	5	
	3. Planning of curriculum	4	
	4. Evaluation and assessment	3	
	5. Enhance productivity and professional practice	4	
	6. Social, ethical, legal and human issues surrounding the use of technology	4	
Dependant	C (Pedagogical Innovativeness**)	18	Ratio
	1. Learning Objectives	3	
	2. Teacher's Roles	3	
	3. Student's Roles	3	
	4. ICT Used	3	
	5. Multiplicity of Learning Outcomes Exhibited	3	
	6. Connectedness	3	
Mediating	D (Organisation and Faculty's Beliefs)	10	Ratio

Note. *consisted of six components, **consisted of six dimensions

3.4.5 Pilot Study

One of the critical steps in this study is to ensure that the instrument developed will measure the intended variables as proposed by the conceptual framework. The development of the instrument incorporates testing the instruments' validity and reliability, using a selected group of respondents with similar demographic characteristics as the actual participants. Validity is defined as the 'correlation value between measurement and the true value of a variable' (Chua, 2012). A pilot study is recognised as an appropriate way to identify unanticipated problems. In addition it also helps to pre-test the understandability of the survey instrument. The survey instrument designed in this study was pilot-tested using a convenience sample of faculty at a different HEI in Malaysia.

The methodology for this pilot study and completed outputs are outlined in Figure 3.2. The pilot study using the initial instrument was conducted in the months of July and August 2012 using a simple random sampling procedure. Firstly, a letter seeking permission to conduct the study was sent to the Director General of Ministry of Higher Education in June 2012 (Appendix C). The official permission was granted by the Director General through the Deputy Director General in two weeks' time (Appendix D).

Thereafter, a letter seeking approval to the Vice Chancellor of the university selected for the pilot study was sent in mid June 2012 (Appendix E). The letter of approval from the Vice Chancellor was then received promptly before the deans of two science faculties and two arts faculties were contacted. All the four deans were contacted through personalised emails (Appendix F). The emails stated the purpose of the study and the intention to seek the participation and cooperation from a minimum sample of 35 subjects from one science and one arts faculty. The first science and arts faculty respective deans that responded were selected as the sampling site for the pilot study.

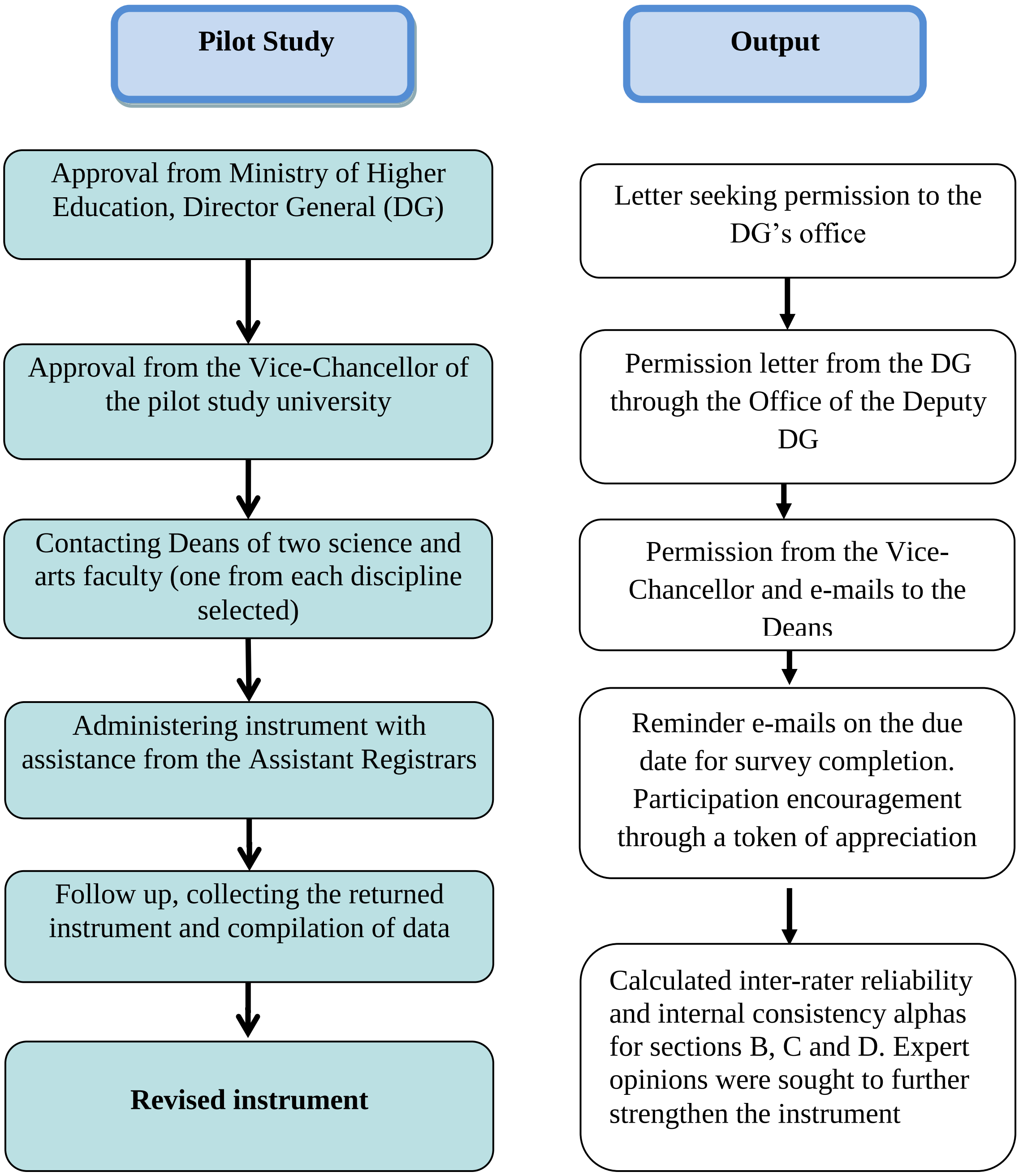


Figure 3.2 Data Collection Procedure for Pilot Study

The assistant registrars of both faculties provided the researcher a list of the subjects' names. Forty printed copy of the pilot study instrument forms were then passed to the assistant registrars who were appointed by the deans to assist in distributing the instrument forms randomly and collected the returned copies. All selected subjects of the faculties were first contacted via e-mail for a face to face session to meet voluntary subjects in a meeting room in the arts faculty (Appendix G). However, at this stage, the subjects did not turn up for the pilot study session. Subsequently, the researcher handed the 40 sets of instrument forms to the respective assistant registrars who helped to distribute during the faculty meetings. The subjects were informed via e-mail. The forms were slotted into the faculty staff individual letter box by the assistant registrars. The researcher used emails to remind the subjects at intervals of one week and two weeks.

The science faculty had a total teaching staff of 80 with their names and positions listed in the faculty website. The assistant registrar helped to verify the list of names displayed and helped distributed 40 sets of the printed instrument.

The arts faculty had a total teaching staff of 51 with their names and positions listed in the faculty website. The assistant registrar helped to verify the list of names displayed and distributed the 40 sets of printed instrument.

The shortlisted subjects of each faculty were then contacted through e-mail and informed of the due date for the submission of the questionnaire, which was two weeks from the date of announcement. A follow up personalised e-mail was sent to each faculty member based on the name list provided by the assistant registrars. The follow up e-mail also contained the PDF version of the questionnaire to allow subjects to respond to the questionnaire by downloading the forms. The researcher provided a token of appreciation to subjects who completed and returned the instrument. The reward was in the form of a well-known cake that is famous among the local community where the university was located. The subjects were reminded to either submit the completed instrument to the respective assistant registrar or simply return the scanned copy of the filled instrument through email.

The researcher received 61 sets of the questionnaire from the total of 80 sets provided to the subjects. The return rate for the pilot study was 76% after two rounds of collection with the help from the assistant registrars. Out of the 33 sets returned from the arts faculty, four sets were excluded from the data analysis due to omission of a section (2 subjects) or a page of the questionnaire (2 subjects). Out of the 28 sets returned questionnaire from the science faculty, one set was excluded from the data analysis due to section D that was left blank by the subject.

Out of the 80 faculty who were identified and distributed the instrument forms, 61 faculty members returned the instruments. Fifty-six instruments were completed without missing information. Of the 56 subjects, two submitted completed instrument through e-mail attachment. Among the subjects, 39 % were male and 61% were female. There were almost an equal number of subjects from science (48%) and arts (52 %). The subjects' teaching experience ranged from less than 2 to more than 20 years (M = 3.5, SD = 1.68). Slightly over half of the subjects have a doctorate degree. The majority of the subjects held academic ranking of lecturer and senior lecturer (62%), followed by associate professor (14 %), professor (13 %) and tutor (11 %). In the data analysis, the position of assistant professor was combined with senior lecturer as the terms were interchangeably used by HEIs in Malaysia. Table 3.3 provides a description of the demographic characteristics of the subjects by faculty discipline.

All data from the 56 subjects were entred into the SPSS version 18 to perform the various statistical analyses. One of the primary purpose of the pilot study is to establish the validity and reliability as well as further improve the items in the instrument. Section B of the instrument, the ICCM that was adopted and modified from Javeri and Persichitte (2007) had an internal consistency, *Cronbach Alpha* of .912 for the total scale (*M* = 82.71, *SD* = 13.49). The finding was almost consistent with Javeri and Persichitte (2007) who reported an internal consistency, *Cronbach Alpha* of .96.

Table 3.3

Descriptive Statistics of the Subjects in the Pilot Study

Variable	Descriptive	Science, *n* (%)	Arts, *n* (%)
Gender	Male	12(41)	10 (37)
	Female	17 (59)	17 (63)
Age Group	20-30 years old	7 (24)	5 (19)
	31-40 years old	9 (31)	12 (44)
	41-50 years old	8 (28)	3 (11)
	51-60 years old	5 (17)	7 (26)
	Above 60 years old	0 (0)	0 (0)
Teaching Experience	Less than 2 years	4 (14)	2 (7)
	2 to 5 years	6 (20)	9 (33)
	6 to 10 years	4 (14)	5 (19)
	11 to 15 years	3 (10)	3 (11)
	16 to 20 years	8 (28)	3 (11)
	More than 20 years	4 (14)	5 (19)
Highest Level of Qualification Attained	Bachelor (Science)	0 (0)	1 (3)
	Bachelors (Arts)	4 (14)	0 (0)
	Masters (Science)	2 (7)	8 (30)
	Masters (Arts)	11 (38)	0 (0)
	Masters (Philosophy)	1 (3)	0 (0)
	Doctor of Philosophy	11 (38)	18 (67)
Academic Position Held	Professor	2 (7)	4 (19)
	Associate Professor	4 (14)	4 (15)
	Senior Lecturer*	8 (28)	9 (33)
	Lecturer	10 (34)	8 (30)
	Tutor	5 (17)	1 (3)

Note. *includes Assistant Professor, *N*= 56

Section C of the instrument, the pedagogical innovations profile, had an internal consistency, *Cronbach Alpha* of .524. This was below the minimum accepted value of .70. To further improve this construct, five subjects among the 56 participants in the pilot study were contacted for an interview to obtain their feedback related to Section C. After discussions with the supervisors, the researcher sought the external referees' opinions. The referees were experts in pedagogy expert. A face to face discussion was held with a respondent from the pilot study. The respondent is a male associate professor from the arts faculty. He had 17 years of experience in the university where he taught first year to final year students. It was suggested that the items in Section C to be further elaborated in more detailed using additional sub-items. Hence, in a subsequent discussion with the supervisor, the researcher decided to increase the items of each of the six sub-sections to three items. The purpose was to enhance the reliability of the measurements. The section was further tested with subjects from the university where the actual study was carried out. From a group of 30 subjects, the reliability test revealed a greater internal consistency, *Cronbach Alpha* of .91 (M = 62.68, SD = 10.39). The value was above the minimum accepted value of .70.

Section D of the instrument consists of three subsections: subjects' general use of ICT, subjects' pedagogy use of ICT, and subjects' perception on the organisation and faculty's beliefs on technology integration and pedagogical innovations. The subjects' perception on the organisation and faculty's beliefs had an internal consistency, *Cronbach Alpha* of .921 for the ten items (M = 35.96, SD = 7.42). Table 3.4 below shows the summary of the *Cronbach Alphas* for each section of the instrument.

Table 3.4

Cronbach's Alphas for the Instrument of the Study

Variable	Section (Label)	Number of item	Measurement Scale	*Cronbach alpha*
Moderating	A (Demographic)	6	Nominal	-
Independent	B (Technology Integration Practices*)	25	Ordinal	.91
	1. Sound/in-depth of technology operations and concepts	5		.54
	2. Planning and designing learning environments and experiences	5		.81
	3. Planning of curriculum	4		.81
	4. Evaluation and assessment	3		.82
	5. Enhance productivity and professional practice	4		.85
	6. Social, ethical, legal and human issues surrounding the use of technology	4		.73
Dependant	C (Pedagogical Innovativeness**)	18	Ordinal	.91
	1. Learning Objectives	3		.85
	2. Teacher's Roles	3		.80
	3. Student's Roles	3		.84
	4. ICT Used	3		.62
	5. Multiplicity of Learning Outcomes Exhibited	3		.79
	6. Connectedness	3		.75
Mediating	D (Organisation and Faculty's Beliefs)	10	Ordinal	.92

Note. *consisted of six components, **consisted of six dimensions

Further attempts to validate the entire instrument were achieved through professional consultation with two higher education research experts in the United States and Malaysia. The research expert from the United State was Professor Kay Persichitte, an expert in education curriculum and programme development and technology integration among pre-service teacher. Professor Persichitte is also the current Dean of the College of Education at the University of Wyoming, US. Professor Persichitte was instrumental in developing the technology integration fidelity evaluation using an ICCM tool which is adopted and modified to suit the contexts this study. The ICCM tool was developed by one of her doctoral students in a study on best practices of technology integration among higher education faculty (Javeri and Persichitte, 2007). Professor Persichitte was contacted through email correspondence. She provided the researcher with some important input on using the instrument among HEIs in Malaysia such as the terminology of and phrases used in describing each of the statement of technology integration practices. She also granted kind permission to use the modified ICCM to measure technology integration practices of subjects in this study.

The second education research expert consulted on the validity of this questionnaire was a professor in web-based learning at a pioneer online learning university, the Open University of Malaysia. The online learning professor's comments on the clarity of the statements were taken into consideration.

The instrument was further discussed with the supervisors of this research project before an invitation to participate was made to the subjects through email and also via printed copies.

3.5 Research Procedure

As soon as the pilot study was completed and the reliability and validity of the instrument was established, the actual data collection was implemented. There were six HEIs of Tier 5 research universities selected in this study. The profiles of each of the HEIs are presented in Table 3.5.

Based on the calculation of Krejcie and Morgan (1970 *in* Chua, 2012) the minimum sample size for study population of 650 and 600 is 242 and 234, respectively. Hence the 248 subjects responded to the questionnaire is sufficient and type I error was minimised. The significance level for all the statistical tests was set at $p < .05$.

Table 3.5

Selected HEIs and Subjects Distribution

HEI	Ranking (SETARA 2011)	HEI funding source	Faculty Randomly Selected	Subject *n*	Response rate (%)
A	Tier 5	Public	125	42	33.6
B	Tier 5	Public	128	43	33.6
C	Tier 5	Public	120	60	50.0
D	Tier 5	Private	88	60	68.2
E	Tier 5	Private	76	32	42.0
F	Tier 5	Private	74	11	14.9
	Total		611	248	40.6

Note. Total respondents in this study, $N = 248$

The average response rate of the subjects in this study was 40.6%.

3.5.1 Selection of Subjects

The researcher applied for permission from the MoHE and HEIs to conduct the research. The faculty selected in this study comprised of lecturers that are directly involved in the teaching and learning at their respective schools/faculties. The names of the subjects were first identified from the respective HEIs and faculty websites using the simple random sampling procedure.

At the first stage, the researcher contacted the vice chancellor's office through e-mail or by telephone. There were two science and two arts faculty groupings identified from each HEI. Once consent was granted by the vice chancellors and the deans, an e-mail containing an invitation to the faculty was sent to the selected subjects.

Within the same email, the link to the online questionnaire site was embedded for the subjects who had volunteered to participate.

Follow-up emails were sent to the deans and subjects who did not respond. In the event of where the subjects faced difficulties to access the online questionnaire, a template of the questionnaire in portable document format (PDF) was sent to these subjects. Engaging deans to select their faculty as subjects of this study has helped to ensure a higher response rate. All data collected and compiled from the on-line survey were further analysed using the SPSS. The total subject sampled from the six HEIs selected in this study is 611 (Table 3.3).

Three HEIs in this study had subjects respond to both printed and online questionnaire. The remaining three HEIs faculty members were invited to participate in this study through the online mode of data collection. The leadership of these particular HEIs preferred the paperless and online mode of research at their respective HEIs. Hence, there was no printed questionnaire distributed to the three HEIs.

3.5.2 Administering Data Collection through Printed and Online Questionnaire

This study aims to examine the relationship between technology integration and pedagogical practices of faculty in selected HEIs in Malaysia. The avenue for faculty to have access to more than one mode of response to the survey is of crucial importance. Leveraging on the pervasive use of Google applications suite, it was presumed that many faculty would prefer to respond to the survey via online questionnaire. The online version of the questionnaire, list of faculty contacts and response data were hosted on the Google cloud server.

There were three main Google application tools used in this study. The Google Doc function was used to construct the online version of the questionnaire which was identical to the printed version. Email addresses and contact details of faculty selected in this study were first compiled using the Google Contact function. The URL address that links to the online questionnaire was embedded into the invitation email that was sent out to each of the selected HEIs separately. In essence, there were six distinct contact groups that represent each of the HEI selected in this study. There were also six identical online questionnaires with an invitation to the faculty members of the HEI selected in this study. Each of the six separate online questionnaire generated HEI specific database capturing responses from each of the subjects.

All the online responses were auto-compiled in the Google Drive and were subsequently downloaded and saved into Microsoft Excel. The data from the respective HEIs was then coded and compiled before entering into the SPSS software. There were a total of six different grouping of data compiled in each SPSS files, labelled as HEI A, HEI B, HEI C, HEI D, HEI E and HEI F.

3.5.3 Follow Up and Improving the Response Rate

There were six HEIs selected in this study. Faculty members of three HEIs were given a choice to participate in this survey through either a printed copy of questionnaire distributed through their respective assistant registrar offices, or they could participate through the online version of questionnaire that was embedded as a link in an email that was "blast" to the mailing list of all the selected faculty members.

The option of the dual mode survey was made known to each faculty member through email reminders that were sent out on weekly basis. The intended size of respondents from each HEI in this study was 60. The invitation to all faculty members randomly selected from identified HEI was sent out in the month of August 2012. Reminders were sent out on a weekly basis until the third month of data collection. The response rate by the third month was less than encouraging and an incentive was offered to each respondent who would voluntarily identify their names and office address through an optional response box at the end of the online questionnaire. A special confectionary known as layered cake, which is a famous delicacies in a Malaysian state on Borneo was offered as an incentive to the faculty who participated in the survey. The special incentive as a token of appreciation was announced to all subjects selected in this study for another three months. Data collection was carried out over a period of six months (August 2011 until January 2013).

3.6 Analysis of Data

The data was analysed using the SPSS version 18 software. Both descriptive and inferential statistics were used to analyse the data. The study also sought to examine the correlation among technology integration (independent variable), organisation and faculty's beliefs (mediating variable), pedagogical innovations (dependent variable), and demographic background as moderating variable. Table 3.6 shows the types of statistical analysis for this study based on the eight research questions in this study.

Table 3.6

Statistical Analysis based on Research Questions

Research Question	Variables	Measurement Scale	Type of Analysis
1. Fidelity profiles of technology integration practices among the subjects of this study	IV: Technology integration (scores of 25-125)	Ordinal	Mean score
2. Relationship between technology integration practices and demographic background	IV: Technology integration MoV: Demographic characteristics	Ordinal Nominal	One way ANOVA or *t*-Test
3. Relationship between technology integration practices and organisation and faculty's beliefs	IV: Technology integration MeV: organisation and faculty's beliefs	Ordinal Ordinal	Pearson *r*, partial correlation
4. Profiles of pedagogical innovativeness among the HEIs subjects	DV: six dimensions	Ordinal	Mean score
5. Relationship between pedagogical innovativeness profile and demographic characteristics	DV: Pedagogical Innovations MoV: demographic characteristics	Ordinal Nominal	One way ANOVA or *t*-Test
6. Relationship between pedagogical innovativeness and organisation and faculty's beliefs	DV: Pedagogical Innovations MeV: Organisation and faculty's beliefs	Ordinal Ordinal	Multiple Linear Regression (MLR)
7. Relationship between pedagogical innovativeness profile and demographic variables?	DV: Pedagogical Innovations IV: Technology integration		
8. Is the proposed model of technology integration practices based on ICCM score as a significant predictor to pedagogical innovativeness valid?	DV: Pedagogical Innovations IV: Technology integration MoV: Demographic background MeV: organisation and faculty's beliefs	Ordinal Ordinal Nominal Ordinal	Hierarchical Multiple Regression

Note: DV: Dependant Variable; IV: Independent variable; MoV: Moderating Variable; MeV: Mediating Variable

3.7 Summary

This chapter discusses the pilot study and the procedure for data collection. It also discusses the procedures for the development of an instrument to examine the fidelity levels of technology integration, organisation and faculty's beliefs in technology integration, and levels of pedagogical innovations. It is envisaged that this study will lead to establish the relationship among technology integration, organisation and faculty's beliefs, and pedagogical innovations in HEIs. Feedback from the pilot study and experts were obtained to further improve the instrument to measure levels of technology integration that could predict level of pedagogical innovativeness for the HEIs. The subject in this study consists of faculty members from six HEIs. They were selected through a simple random sampling procedure. The permission from each HEIs' leadership was sought for the two science and two arts faculty groupings. Data collection for three HEIs commenced with the help from the faculty registrars who distributed the printed questionnaire. In addition, all the targeted private HEIs faculty members and public HEIs faculty members who did not submit printed copy of questionnaire were invited through emails to complete the online version of the questionnaire. This procedure was used to enhance the response rate in this study. Hence, these three HEIs respondents participated in this survey through dual modes, namely the paper-based and online.

CHAPTER 4

RESULTS

4.1 Overview

This chapter presents the results and findings of the study. The results are presented in the form of descriptive statistics followed by statistical analyses for each of the main research questions in this study. The first section of this chapter gives an overview of the subjects' demographic profile by faculty's discipline, gender, age group, teaching experience, highest level of academic qualification and academic position held. This is then followed by the subjects' technology integration practices using descriptive statistics (research question 1). Technology integration practices were analysed by the fidelity levels (low, medium and high) and also by mean score. The six HEIs' respective mean scores of technology integration practices are also presented. Inferential statistics for parametric data such as *t*-test, one-way ANOVA and UNIVARIATE tests were used to analyse the relationship between technology integration practices and demographic variables (research question 2). Pearson correlation tests were performed to analyse the relationship between technology integration practices and organisation and faculty's beliefs (mediating variables) (research question 3).

For the independent variable of this study (pedagogical innovativeness), descriptive statistics were used to demonstrate the overall pedagogical innovativeness level as well as trend analysis by the six dimensions (research question 4). Inferential statistics were used to analyse the relationship between pedagogical innovativeness and demographic variables (research question 5). Pearson correlation tests were used to analyse the relationship between pedagogical innovativeness and organisation and faculty's beliefs (mediating variables) (research question 6).

The final section of the chapter presents the inferential statistics analysis using multiple regression to predict the amount of variance contributed by each of the independent variables (six dimensions and the mean score) in influencing pedagogical innovativeness (research question 7). The section ends with the hierarchical multiple regression analysis to determine the predictors for pedagogical innovativeness (research question 8). The significance level for all the statistical tests was set at $p < .05$.

4.2 Preliminary Data Analysis

A total of 248 subjects responded to the study. The demographic variables in this study comprised of faculty's discipline, gender, age group, teaching experience, highest level of academic qualification and academic position held. All these variables were measured as nominal data and descriptive statistics such as mean, standard deviation, frequency and percentage are reported.

4.2.1 Demographic Characteristics of Subjects

A total of 248 subjects responded to the survey through either printed or online questionnaires. The demographic variables of the subjects in this study are presented in Table 4.1. There was a 40.6% of response rate in this study.

Table 4.1

Selected HEIs and Subjects Distribution

HEI	HEI funding source	Establishment History* (Year)	Faculty Randomly Selected	Subject *n*	Response rate (%) Online	Paper
A	Public	1949 (64)	125	42	26.6	7.0
B	Public	1969 (44)	128	43	18.6	15.0
C	Public	1973 (40)	120	60	20.8	29.0
D	Private	2010 (3)	88	60	68.2	-
E	Private	2000 (13)	76	32	42.0	-
F	Private	1998 (15)	74	11	14.9	-
Total			611	248	40.6	

Note: Total respondents in this study, *N*= 248; *Based on the year fully accorded as university (*Mean* = 29.8)

The six selected HEIs in this study were ranked as Tier 5 based on the report of the rating system of the Malaysian Higher Education Institutions 2011 (MQA, 2011). The Tier 5 status was given to 35 HEIs in Malaysia that were excellent in terms of quality of teaching and learning at the undergraduate level. HEI A, HEI B and HEI C are fully government funded and are commonly known as public universities. HEI D, HEI E and HEI F are not funded by the government and are commonly known as private universities. Specifically, HEI D is a private university which first started as a private college about 50 years ago. HEI E and HEI F are foreign universities operating in Malaysia as offshore university campuses. Since they do not receive any form of funding on operating expenses nor development grants, hence in this study, they are grouped with HEI D as private HEIs.

All the HEIs were informed of the available options of printed and online questionnaires. Subjects from HEI A, HEI B and HEI C participated in the survey through both printed and online questionnaire. The response rate of the two modes of data collection from public HEIs revealed that HEI A had higher response rate from the online questionnaire. HEI B had almost the same response rate of both mode of questionnaire whereas HEI C subjects preferred paper mode of questionnaire. However, HEI D, HEI E and HEI F only allowed their faculty members to be contacted through emails. Hence, all the responses from the three private HEIs were compiled through only one mode of survey which is online questionnaire. There was no significant difference between the response rate of online (*M* =22, *SD* = 4.13) and paper (*M* =17, *SD* = 11), *t* (2) = .621 (*p* > .050).

HEI A is a university established 64 years ago and had a response rate of 33.6 % from the total of 125 faculty members contacted. Of the 42 subjects, about one-fifth completed the printed questionnaire forms which were distributed through the faculty assistant registrars. The balance of the subjects, 33 chose the online questionnaire that was embedded in the email link.

HEI B is a university established 44 years ago and had a response rate of 33.6 % from the total of 128 faculty members contacted. Forty-four percent of the subjects returned the printed questionnaire forms while the remaining 24 subjects chose the online version of the questionnaire.

HEI C is a 40 years old university and had a response rate of 50 % of the total of 120 faculty members contacted. Of the 60 subjects, 58 % participated through printed questionnaire and the balance of 42 % chose the online version of the questionnaire.

HEI D is a private university established three years ago and had a response rate of 68.2 % from the total of 88 faculty members contacted through emails. Of the 60 subjects, 59 participated through the online questionnaire except for one subject who requested for the PDF version of questionnaire to be sent through email.

HEI E is a private university established 13 years ago and had a response rate of 42 % (*n* = 32) from the total of 76 faculty members contacted. HEI F is a private university established 15 years ago and had a response rate of 14.9 % (*n* = 11) from the total of 74 contacted. In view of the low number of subjects, HEI F was left out in the data analysis involving comparison among HEIs. Nevertheless, the 11 subjects were included in the analysis of overall subjects (*N* = 248) and the analysis of subjects by demographic characteristics, and in comparison of subjects based on private and public HEIs groupings. Both HEI E and HEI F are foreign university's offshore campus hence grouped in the private university category in this study.

Table 4.2 presents the descriptive statistics information for the total subjects (*N* = 248) in this study.

Table 4.2

Descriptive Statistics for Demographic Profile of Overall Subjects

Variable	Category	Frequency	Percentage (%)
Faculty Discipline	Science	122	49
	Arts	126	51
Gender	Male	110	44
	Female	138	56
Age Group	20-30 years old	26	10
	31-40 years old	94	38
	41-50 years old	60	24
	51-60 years old	59	24
	Above 60 years old	9	4
Teaching Experience	Less than 2 years	13	5
	2 to 5 years	58	23
	6 to 10 years	62	25
	11 to 15 years	31	13
	16 to 20 years	24	10
	More than 20 years	60	24
Highest Level of Academic Qualification	Bachelor (Arts)	3	1
	Bachelors (Science)	7	3
	Masters (Arts)	25	10
	Masters (Science)	32	13
	Masters in Philosophy	0	0
	MBA	5	2
	Doctor of Philosophy	176	72
Academic Position*	Professor	32	13
	Associate Professor	43	17
	Senior Lecturer	144	58
	Lecturer	19	8
	Tutor	10	4

Note: *N* = 248, *Assistant professor was recorded as Senior Lecturer

On the academic position held, the assistant professor was regrouped as the senior lecturer as two of the private HEIs had senior lecturer classified as assistant professor. There was almost an equal number of subjects by the science (49 %) or arts (51 %) faculty discipline. Forty-four percent (*n* = 110) of the subjects were male and 56 % were females (*n* = 138). The majority of the subjects were aged between 31 and 40 years old (38 %), followed by the 41-50 years old age group (24 %) and 51-60 years old age group (24 %). Ten percent of the subjects were aged between 20 to 30 years old and the remaining 4 % of the subjects belonged to the age group of above 60 years old. A quarter of the subjects had six to ten years of teaching experience, followed by more than 20 years (24 %), two to five years (23 %), 11 to 15 years (13 %), 16 to 20 years (10 %), and the lowest number of subjects with less than two years of teaching experience (5 %).

Over two-thirds of the subjects had a Doctor of Philosophy qualification (72 %) as their highest academic qualification. Master's degree holders made up of a quarter of the subjects, namely, Masters in Science (13 %), Masters in Arts (10 %), and Masters in Business Administration (2 %). Bachelor's degree holders made up 4 % of the total subjects, namely, Science (*n* = 7) and Arts (*n* = 3) respectively.

Thirty percent of the subjects held the highest rank of academic position as professor (*n* = 32), and this was followed by associate professor (*n* = 43). More than half of the subjects (58 %) held the position of senior lecturer or assistant professor. The remaining 29 subjects actually held either lecturer (8 %) or tutor (4 %) positions.

4.2.2 Demographic Characteristics of Six HEIs Subjects

There are six HEIs selected in this study. Specific information on the subjects demographic characteristics are presented in this section.

Among the 42 subjects in HEI A, more than half of the subjects were from the science discipline faculty (67 %) compared to subjects from the arts discipline faculty (33 %). About two-thirds (67 %) of the subjects were female. In terms of age group distribution, 45% of the subjects were aged between 31 and 40 years old. This is followed by 51 to 60 years old group (29 %), 41 to 50 years old group (21 %) and the above 60 years old group (5 %). In this group of subjects, there was no subject aged 30 years old or younger. In terms of teaching experience, 24 % of the subjects had more than 20 years. An equal number of subjects (*n* = 9) had six to ten and 16 to 20 years of teaching experience. Similarly, an equal number of subjects had 11 to 15 years and less than two years of teaching experience. There were four subjects who indicated that they had two to five years of teaching experience. The demographic data of the 42 subjects from HEI A is presented in Table 4.3.

Table 4.3

Descriptive Statistics for Demographic Profile of HEI A Subjects

Variable	Category	Frequency	Percentage (%)
Faculty Discipline	Science	28	67
	Arts	14	33
Gender	Male	14	33
	Female	28	67
Age Group	20-30 years old	0	0
	31-40 years old	19	45
	41-50 years old	9	21
	51-60 years old	12	29
	Above 60 years old	2	5
Teaching Experience	Less than 2 years	5	12
	2 to 5 years	4	10
	6 to 10 years	9	21
	11 to 15 years	5	12
	16 to 20 years	9	21
	More than 20 years	10	24

Table 4.3 (*continue*)
Descriptive Statistics for Demographic Profile of HEI A Subjects

Variable	Category	Frequency	Percentage (%)
Highest Level of Academic Qualification	Bachelor (Arts)	0	0
	Bachelors (Science)	0	0
	Masters (Arts)	1	2
	Masters (Science)	1	2
	Masters in Philosophy	0	0
	MBA	0	0
	Doctor of Philosophy	40	96
Academic Position*	Professor	8	19
	Associate Professor	12	29
	Senior Lecturer	20	47
	Lecturer	2	5
	Tutor	0	0

Note: n = 42, *Assistant professor is recorded as Senior Lecturer

Almost all of the subjects in HEI A had a Doctor of Philosophy (PhD) as their highest academic qualification (95 %), except for one each with a masters in arts and masters in science qualification. Almost half of the subjects held the academic position of professor (19 %) and associate professor (29 %). Forty-seven percent of the subjects were senior lecturers and the remaining two subjects were lecturers.

Among the 43 subjects of HEI B, 60 % were from the arts discipline while the remaining were from the science discipline. The female subjects (58 %) outnumbered their male colleagues (42 %). Forty-two percent of the subjects were aged between 51 and 60 years old. This is followed by 41 to 50 years old group (35 %), 31 to 40 years old group (16 %) while the remaining three belonged to the extremes, 20-30 years old (*n* = 1) and above 60 years old (*n* = 2). In terms of teaching experience, most had more than 20 years of teaching experience (44 %). Eight subjects had six to ten years of teaching experience. An equal number of subjects (*n* = 5) had two to five, 11 to 15 and 16 to 20 years of teaching experience. There was only one subject who had less than two years of teaching experience at HEI B. Almost all the subjects of HEI A hold PhD as their highest academic qualification (91%), except for four with masters in arts (*n* = 2), masters in science (*n* = 1) and MBA (*n* = 1) respectively. Faculty members holding academic position of professor (26 %) and associate professor (28 %) made up more than half of the HEI B subjects. Forty-four percent of the subjects were senior lecturers and the remaining one subject was a lecturer. The demographic data of the 43 subjects from HEI B is presented in Table 4.4.

Table 4.4

Descriptive Statistics for Demographic Profile of HEI B Subjects

Variable	Category	Frequency	Percentage (%)
Faculty Discipline	Science	17	40
	Arts	26	60
Gender	Male	18	42
	Female	25	58
Age Group	20-30 years old	1	2
	31-40 years old	7	16
	41-50 years old	15	35
	51-60 years old	18	42
	Above 60 years old	2	5
Teaching Experience	Less than 2 years	1	2
	2 to 5 years	5	12
	6 to 10 years	8	18
	11 to 15 years	5	12
	16 to 20 years	5	12
	More than 20 years	19	44
Highest Level of Academic Qualification	Bachelor (Arts)	0	0
	Bachelors (Science)	0	0
	Masters (Arts)	2	5
	Masters (Science)	1	2
	Masters in Philosophy	0	0
	MBA	1	2
	Doctor of Philosophy	39	91
Academic Position*	Professor	11	26
	Associate Professor	12	28
	Senior Lecturer	19	44
	Lecturer	1	2
	Tutor	0	0

Note: n = 43, *Assistant professor is recorded as Senior Lecturer

Among the 60 subjects of HEI C, 58 % were from science discipline faculty while the remaining 42 % were from arts discipline. The number of female subjects (53 %) was slightly higher than their counterpart male colleagues (47 %). There were 22 subjects (37 %) aged between 31 and 40 years old. This is followed by 51 to 60 years old group (25 %), 41 to 50 years old group (20 %) and the remaining 20-30 years old (n = 8) or aged above 60 years old (n = 3). In terms of teaching experience, slightly more than a third of the subjects have had two to five years (33 %). Thirty percent had more than 20 years of teaching experience. Seventeen percent of the subjects had six to ten years of teaching experience and 12 % had 11 to 15 years. There were however, two subjects who had 16 to 20 years of teaching experience while three had less than two years. The majority of the subjects had PhD as their highest academic qualification (80 %), except for nine with masters in science, MBA (n = 1) and two with bachelor in science. Faculty members holding academic position of professor (17 %) and associate professor (12 %) made up close to one third of the HEI C subjects. More than half of the subjects (n = 32) were senior lecturers and the remaining 11 subjects were either lecturers (n = 3) or tutors (n = 8). The demographic data of the 43 subjects from HEI C is presented in Table 4.5.

Table 4.5

Descriptive Statistics for Demographic Profile of HEI C Subjects

Variable	Category	Frequency	Percentage (%)
Faculty Discipline	Science	35	58
	Arts	25	42
Gender	Male	28	47
	Female	32	53
Age Group	20-30 years old	8	13
	31-40 years old	22	37
	41-50 years old	12	20
	51-60 years old	15	25
	Above 60 years old	3	5
Teaching Experience	Less than 2 years	3	5
	2 to 5 years	20	33
	6 to 10 years	10	17
	11 to 15 years	7	12
	16 to 20 years	2	3
	More than 20 years	18	30
Highest Level of Academic Qualification	Bachelor (Arts)	0	0
	Bachelors (Science)	2	3
	Masters (Arts)	0	0
	Masters (Science)	9	15
	Masters in Philosophy	0	0
	MBA	1	1
	Doctor of Philosophy	48	80
Academic Position*	Professor	10	17
	Associate Professor	7	12
	Senior Lecturer	32	53
	Lecturer	3	5
	Tutor	8	13

Note: *n* = 60, *Assistant professor is recorded as Senior Lecturer

Higher Education Institution D has 60 subjects responded to the online survey. Sixty percent of subjects were from arts discipline faculty while the remaining 40% were from science discipline. Number of female subjects (58 %) was higher than their counterpart male colleagues (42 %). There were 22 subjects (37 %) aged between 31 and 40 years old. Almost half of the subjects were in the age group of 31 to 40 years old (47 %).

Twenty-two percent of the subjects were 30 years old or younger. There was only 17 % of the subjects between 41 and 50 years old. Fewer were between 51 and 60 years old (13 %) and only one subject was above 60 years old. In terms of teaching experience, most subjects had less than ten years. Subjects with two to five and six to ten years of teaching experience made up 32 % and 33 % of the total respectively. Seventeen percent of the subjects had 11 to 15 years of teaching experience, followed by 7 % of 16 to 20 years and 10 % had more than 20 years. More than half of the subjects had master's degree or equivalent as their highest academic qualification in arts (30 %), science (29 %), MBA (3 %) and master's in philosophy (2 %). PhD holders made of 27 % of the subjects from HEI D. While the remaining held bachelor's degree in science (8 %) and arts (5 %). Faculty members holding academic position of senior lecturer (80 %) were the majority. This is followed by lecturers (13 %) and the remaining four subjects as tutor (n = 1), associate professor (n = 2) and professor (n = 1), respectively. The demographic data of the 43 subjects from HEI D is presented in Table 4.6.

Table 4.6

Descriptive Statistics for Demographic Profile of HEI D Subjects

Variable	Category	Frequency	Percentage (%)
Faculty Discipline	Science	24	40
	Arts	36	60
Gender	Male	25	42
	Female	35	58
Age Group	20-30 years old	13	22
	31-40 years old	28	47
	41-50 years old	10	17
	51-60 years old	8	13
	Above 60 years old	1	1
Teaching Experience	Less than 2 years	2	3
	2 to 5 years	19	32
	6 to 10 years	20	33
	11 to 15 years	9	15
	16 to 20 years	4	7
	More than 20 years	6	10
Highest Level of Academic Qualification	Bachelor (Arts)	3	5
	Bachelors (Science)	5	8
	Masters (Arts)	18	30
	Masters (Science)	17	29
	Masters in Philosophy	1	2
	MBA	2	3
	Doctor of Philosophy	14	23
Academic Position*	Professor	1	2
	Associate Professor	2	3
	Senior Lecturer	48	80
	Lecturer	8	13
	Tutor	1	2

Note: n = 60, *Assistant professor is recorded as Senior Lecturer

Higher Education Institution E is an offshore campus of a foreign university. Among the 32 subjects who responded to the online survey, there was more science discipline faculty (66 %) compared to the arts (34 %). More than half of the subjects were male (56 %). As much as 47 % of the subjects were aged between 31 to 40 years old, followed by 31 % aged between 41 to 50 years old. Thirteen percent were between 20 to 30 years old and the remaining nine subjects were between 51 to 60 years old. There was no subject aged above 60 years old. Most subjects had two to five years of teaching experience (31 %), followed by six to ten years (28 %). Sixteen percent of the subjects had 11 to 15 years of teaching experience while 13 % had between 16 to 20 years. On the extremes, only one subject had less than two years of teaching experience and three had over 20 years. HEI E subjects had two main types of highest academic qualification, PhD holders constituted 81 % while the balance had masters in arts (13 %) and science (6 %). The professorial rank faculty made up six percent of the subjects, followed by associate professor (19 %). Most subjects held senior lecturer position (69 %) and the remaining two were each lecturer and tutor. The demographic data of the 32 subjects from HEI E is presented in Table 4.7.

Table 4.7

Descriptive Statistics for Demographic Profile of HEI E Subjects

Variable	Category	Frequency	Percentage (%)
Faculty Discipline	Science	11	34
	Arts	21	66
Gender	Male	18	56
	Female	14	44
Age Group	20-30 years old	4	13
	31-40 years old	15	47
	41-50 years old	10	31
	51-60 years old	3	9
	Above 60 years old	0	0
Teaching Experience	Less than 2 years	1	3
	2 to 5 years	10	31
	6 to 10 years	9	28
	11 to 15 years	5	16
	16 to 20 years	4	13
	More than 20 years	3	9
Highest Level of Academic Qualification	Bachelor (Arts)	0	0
	Bachelors (Science)	0	0
	Masters (Arts)	4	13
	Masters (Science)	2	6
	Masters in Philosophy	0	0
	MBA	0	0
	Doctor of Philosophy	26	81
Academic Position*	Professor	2	6
	Associate Professor	6	19
	Senior Lecturer	22	69
	Lecturer	1	3
	Tutor	1	3

Note: n = 32, *Assistant professor is recorded as Senior Lecturer

Higher Education Institution F is another offshore campus of a foreign university. Despite many rounds of email reminder sent through selected faculty members, only 11 subjects responded to the online survey. Seven subjects were from the science discipline while the remaining four from arts. Similarly, seven subjects were males and four were females. Four subjects belonged to the age group of 41 to 50 years old. An equal number of subjects (n = 3) were aged 31 to 40 and aged 51 to 60 years old. There was one subject above 60 years old. In terms of teaching experience, six had between six to ten years, four had more than 20 years, and just one had less than two years. Almost all the subjects hold a PhD except for two with masters in science as their highest academic qualification. As for academic position, one subject was a professor and four were associate professors. Two were senior lecturers and the remaining four were lecturers. The demographic data of the 11 subjects from HEI F is presented in Table 4.8.

Table 4.8

Descriptive Statistics for Demographic Profile of HEI F Subjects

Variable	Category	Frequency	Percentage (%)
Faculty Discipline	Science	7	64
	Arts	4	36
Gender	Male	7	64
	Female	4	36
Age Group	20-30 years old	0	0
	31-40 years old	3	27
	41-50 years old	4	37
	51-60 years old	3	27
	Above 60 years old	1	9
Teaching Experience	Less than 2 years	1	9
	2 to 5 years	0	0
	6 to 10 years	6	56
	11 to 15 years	0	0
	16 to 20 years	0	0
	More than 20 years	4	37
Highest Level of Academic Qualification	Bachelor (Arts)	0	0
	Bachelors (Science)	0	0
	Masters (Arts)	0	0
	Masters (Science)	2	18
	Masters in Philosophy	0	0
	MBA	0	0
	Doctor of Philosophy	9	82
Academic Position*	Professor	1	9
	Associate Professor	4	37
	Senior Lecturer	2	17
	Lecturer	4	37
	Tutor	0	0

Note: n = 11, *Assistant professor is recorded as Senior Lecturer

4.3 Results of the Study

This section presents the results and data analysis of the research questions of this study.

4.3.1 Technology Integration Practices based on the ICCM Instrument

The analysis of technology integration practices is divided into three sections: overall subjects (*N* = 248), subjects' demographic profiles and its relationship with technology integration practices, and subjects according to HEIs in this study.

Research question 1: What are the fidelity profiles of technology integration practices among the subjects of this study?

4.3.1.1 Technology Integration Practices of the Subjects

The ICCM instrument (Section B of the questionnaire) measures technology integration practices of the subjects of this study. The first step of data analysis of technology integration practices looked into the individual subject's total score of the 25-item section of the instrument. Each of the subjects' total score was computed, coded and the score profiles were further ranked according to three fidelity levels: low (25 to 49), medium (50 to 74), and high (75 to 125). The minimum total score of 75 is deemed to have achieved best practices in this study (Javeri & Persichitte, 2007).

The total scores of technology integration practices of all subjects were first checked to see if they had met the minimum cut-off value of 75 for high fidelity using the One Sample *t*-test. The One Sample T-test yielded a mean total score of 82.97 (*SD* = 18.70) which was statistically significant from 75, t (247) = 69.87, $p < .001$ (Figure 4.1). This means that subjects in this study had an average technology integration practices score that is significantly higher than the cut-off value of 75. The distribution of subjects' total ICCM scores is also found to be normally distributed as shown in Figure 4.1.

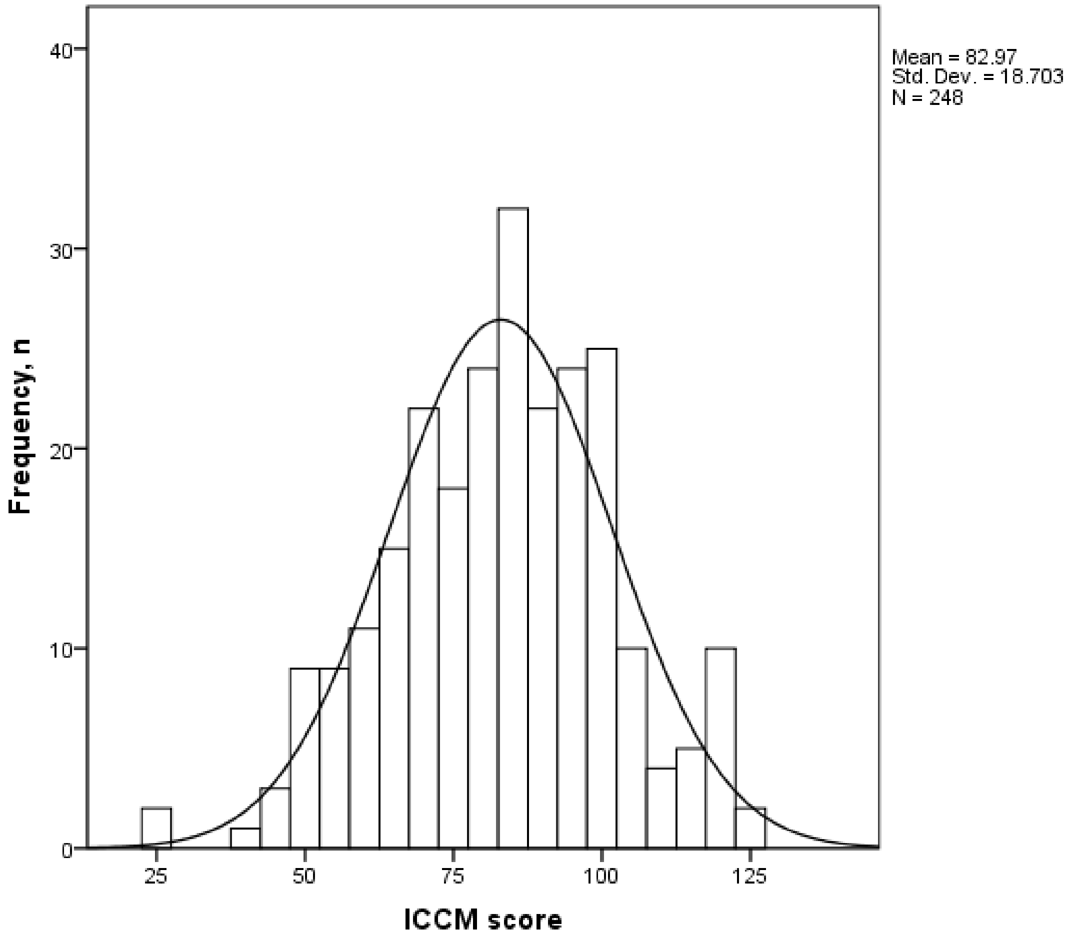


Figure 4.1 Distributions of Total ICCM Score of Subjects

In order to examine the fidelity level profiles of the subjects in this study, subjects' technology integration practices score as measured by the ICCM were further coded by the three levels. The frequency profiles of the 248 subjects in terms of technology integration practices fidelity levels are shown in Table 4.9.

From Table 4.9, it is clearly demonstrated that as much as 65.7 % of the subjects had high fidelity (75 to 125) in technology integration practices. Nearly one-third of the subjects had medium fidelity in their technology integration practices (30.6%). Surprisingly though a minority group of subjects were found to be of low fidelity (3.6%).

However, when the subjects' fidelity levels were analysed by their HEIs ownership, there was no significant difference between subjects from both the public and private HEIs [$F(1,246) = .001$, $p > .05$].

Table 4.9

Subjects' Technology Integration Practices (ICCM) by Fidelity Levels

Fidelity Level (total score range)	Frequency (*n*)	Percent (%)	Cumulative (%)
High (75 to 125)	163	65.7	100.0
Medium (50 to 74)	76	30.6	34.3
Low (25 to 49)	9	3.6	3.6

Note: $N = 248$; $M = 82.97$

4.3.1.2 Technology Integration Practices of Subjects from the Six HEIs

The technology integration practices fidelity profile of the six HEIs is presented in Table 4.10 below.

Table 4.10

Fidelity Profiles of HEIs

			Fidelity Level		
HEI Subject	Mean	SD	High (75 to 125)	Medium (50 to 74)	Low (25 to 49)
Overall	82.97	18.70	65.7	30.6	3.6
HEI A	85.67	21.24	71.4	23.8	4.8
HEI B	79.19	20.47	55.8	37.2	7.0
HEI C	83.72	19.14	68.3	25.0	6.7
HEI D	82.67	18.04	63.3	36.7	0
HEI E	80.34	13.78	59.4	40.6	0
HEI F*	92.73	11.83	100.0	0	0

Note: *HEI F has 11 subjects only

The technology integration practices of each HEI in this study were compared against the overall subjects on fidelity levels, mean and standard deviation of total

ICCM scores. In this analysis, the frequencies of the three fidelity levels from the overall 248 subjects were used as benchmark values for comparison. It is interesting to note that on the low fidelity level, all the public universities, namely HEI A, HEI B and HEI C, were showing a higher percentage of subjects with low fidelity. The results showed that none of the subjects from the private universities, namely HEI D, HEI E and HEI F, have low fidelity of technology integration practices. In actual fact, from the pool of subjects of this study, all the low fidelity subjects were found to be public university faculty members.

In terms of percentage of subjects with medium fidelity level, the three public universities were consistently found to have lower than the overall subject benchmark of 30. 6 %. HEI D and HEI E again have a higher score than the benchmark percentage.

The highest level of fidelity in technology integration practices in this study had a benchmark frequency of 65.7 %. HEI A, HEI C and HEI F have higher than the benchmark percentage. Although HEI F has 100 % of subjects with high level of fidelity, due to the limited number of subjects (n = 11) it cannot be deduced that faculty members of this HEI are extremely competent in technology integration.

When the 248 subjects were analysed for fidelity levels by their HEI ownership, it was found that there was no significant difference between subjects from the public and private HEIs subjects [$F(1,246) = .001$, $p > .05$].

4.3.2 Technology Integration Practices and Subjects' Demographic Profile

Research question 2: Is there a significant relationship between technology integration practices and demographic characteristics?

In order to evaluate the relationship between the demographic profile of the subjects and technology integration practices, the researcher used two types of statistical analysis. Firstly, the means and standard deviations of technology integration practices were obtained according to the subjects' demographic profile (Table 4.11) and secondly, univariate analyses was used (Table 4.12).

Table 4.11

Means and Standard Deviations of Technology Integration Practices by Demographic Variables

		Technology Integration Practices		
Variable	Category	Frequency	*M*	*SD*
Faculty Discipline	Science	122	86.84	16.31
	Arts	126	85.64	17.99
Gender	Male	110	87.13	18.11
	Female	138	85.53	16.41
Age Group	20-30 years old	26	86.85	17.85
	31-40 years old	94	88.19	15.83
	41-50 years old	60	84.83	15.86
	51-60 years old	59	83.84	20.36
	Above 60 years old	9	87.27	15.53
Teaching Experience	Less than 2 years	13	88.62	16.84
	2 to 5 years	58	84.45	15.64
	6 to 10 years	62	88.79	16.31
	11 to 15 years	31	85.98	17.64
	16 to 20 years	24	86.20	18.17
	More than 20 years	60	84.72	18.84
Highest Level of Academic Qualification	Bachelor (Arts)	3	62.67	6.71
	Bachelors (Science)	7	86.50	13.89
	Masters (Arts)	25	84.47	18.84
	Masters (Science)	32	85.06	11.95
	Masters in Philosophy	0	-	-
	MBA	5	79.80	20.77
	Doctor of Philosophy	176	87.19	17.74
Academic Position*	Professor	32	86.93	17.05
	Associate Professor	43	82.81	17.55
	Senior Lecturer	144	86.47	14.28
	Lecturer	19	87.27	17.65
	Tutor	10	90.18	10.63

Note: *N* = 248, *Assistant professor was recorded as Senior Lecturer

Table 4.11 shows that subjects from the science discipline (*M* = 86.84, *SD* = 16.31) had a slightly higher technology integration score compared to those from the arts discipline (*M* = 85.64, *SD* = 17.99). It was also found that the males (*M* = 87.13, *SD* = 18.11) had a slightly higher technology integration practices score compared to the females (*M* = 85.53, *SD* = 16.41).

When all the subjects were grouped according to age categories, the 31 to 40 years old had the highest technology integration practices mean (*M* = 88.19, *SD* = 15.83). This is followed by the other extreme groups, those above 60 years old (*M* = 87.27, *SD* = 15.53) and those of 20 to 30 years old (*M* = 86.85, *SD* = 17.85). The age groups with a mean value below 85 were the 41 to 50 years old (*M* = 84.83, *SD* = 15.86) and 51 to 60 years old (*M* = 83.84, *SD* = 20.36) groups.

Further analysis of the subjects' teaching experience showed that, those with six to ten years were found to have the highest mean score for technology integration practices (*M* = 88.79, *SD* = 16.31). This is followed by subjects with less than two years of teaching experience (*M* = 88.62, *SD* = 16.84). Those with 16 to 20 years of teaching experience had a higher mean (*M* = 86.20, *SD* = 18.17) compared to the remaining three groups: 11 to 15 years of teaching experience (*M* = 85.98, *SD* = 17.64), more than 20 years teaching experience (*M* = 84.72, *SD* = 18.84), and two to five years of teaching experience (*M* = 84.45, *SD* = 15.64).

In comparing the subjects' highest level of academic qualification attained, the PhD group had the highest mean value of technology integration (*M* = 87.19, *SD* = 17.74). Subjects with bachelor's degree in science were found to have a higher mean value (*M* = 86.50, *SD* = 13.89) than the arts (*M* = 62.67, *SD* = 6.71). For subjects with master's degree qualification, again those specialised in science (*M* = 85.06, *SD* = 11.95) had a higher technology integration practices score compared to the arts (*M* = 84.47, *SD* = 18.84). The subjects with MBA as their highest academic qualification were found to have the lowest mean value for their technology integration practices (*M* = 79.80, *SD* = 20.77) among those with master's degree.

Based on subjects' academic position held, it was found that tutors had the highest mean value of technology integration practices (*M* = 90.18, *SD* = 10.63) compared to lecturers (*M* = 87.27, *SD* = 17.65), professors (*M* = 86.93, *SD* = 17.05), senior lecturers (*M* = 86.47, *SD* = 14.28), and associate professors (*M* = 82.81, *SD* = 17.55).

Univariate analyses were performed to examine the relationship between technology integration practices and demographic variables. The six demographic variables in this study were checked for their statistical significance as moderating variables. The results of the univariate analyses are shown in Table 4.12.

Table 4.12

Univariate Analyses for Demographic Variables and Technology Integration Practices

Variable	*F*	*df1*	*df2*	*Sig.*	*Effect Size,* η^2
Academic Discipline	.614	1	246	.434	.002
Gender	.037	1	246	.848	.000
Age Group	1.589	4	243	.178	.025
Teaching Experience	.930	5	242	.462	.019
Highest Level of Academic Qualification	.724	7	240	.724	.018
Academic Position	.575	6	241	.750	.014

Note: Correlation is significant at $p < .05$

From the results of univariate analyses in Table 4.12, it is obvious that among the 248 subjects in the study, all the demographic variables do not have any significant effect on subjects' technology integration practices fidelity ($p > .05$).

4.3.3 Relationship between Technology Integration Practices and Organisation and Faculty's Beliefs

Research question 3: Is there a significant relationship between technology integration practices and organisation and faculty's beliefs?

The relationships between technology integration practices (independent variable) and organisation and faculty's beliefs (mediating variables) were examined using the Pearson Correlation test. Table 4.13 shows the correlation between the subjects' technology integration practices and perceptions on their organisations and their personal beliefs on technology integration. In this partial correlation analysis, demographic variables were the controlled factors.

Table 4.13

Organisation and Faculty's Beliefs and Partial Correlation with Technology Integration Practices

		Technology Integration Practices	
Organisation and Faculty's Beliefs	*Barriers Order****	*Partial correlation r*	*Sig.*
Support is always available among faculty members to integrate technology into pedagogical practices	1°	.265**	.000
Sufficient professional development for faculty members	2°	.208**	.001
Excellent infrastructure that supports students to use technology to learn	1°	.217**	.001
Technology Integration is a valuable means for faculty members	2°	.144*	.026
Excellent Administrative support for faculty to facilitate technology integration	1°	.229**	.000
Prominent technology leader that drives the initiative of technology integration	1°	.190*	.003
Supportive plans and policies that form the strategy of technology integration within the faculty	1°	.260**	.000
Sufficient time to implement technology integration projects	2°	.232**	.000
Support from external agencies	1°	.222**	.001
Strong support from the university top management	1°	.159*	.014

Note: *significant at $p < .05$ level, **significant at $p < .001$ level, ***1°: first order, 2°: second order

Table 4.13 shows that when the subjects' demographic variables were controlled, the analysis revealed a moderate correlation between the subjects' technology integration practices and their perceptions on HEIs and personal beliefs on technology integration.

All the ten mediating variables of organisation and faculty beliefs were statistically significant in their positive mediating effects on technology integration practices with *r* values greater than 0. The variable "*support from among faculty members to integrate technology into pedagogical innovations*" was found to be most significantly correlated, $r = .265$ ($p < .001$). However, in comparing the mean scores of the ten mediating variables, the perceived organisational belief of "*technology integration is a valuable means for faculty members*" has the highest mean value and closest scores among the subjects ($M = 3.92$, $SD = .891$). However, this mediating variable had the lowest partial correlation $r = .144$ ($p < .05$) to subjects' technology integration practices. This means, though subjects' had ranked "*technology integration is a valuable means for faculty members*" (a second order barrier) as most important to their technology integration practices, the correlation analysis results contradicted with this finding. The subjects' technology integration was most influenced by their environment, such as availability of support which belongs to "first order barriers" (Ertmer, 1999).

4.3.4 Pedagogical Innovations based on SITES-M2 Six Dimensions

The pedagogical innovativeness of the subjects in the study was analysed in the following sequence: overall subjects ($N = 248$), subjects' demographic profiles, and subjects by HEIs. The six dimensions of pedagogical innovations were analysed by their total scores. It was further examined to determine whether it is possible to use the six specific dimensions as an indicator of pedagogical innovations.

Research question 4: What are the profiles of pedagogical innovativeness among the HEIs subjects?

4.3.4.1 Pedagogical Innovativeness of Overall Subjects and HEIs

The mean scores of pedagogical innovativeness of the overall subjects in this study and HEIs are presented in Table 4.14.

Table 4.14

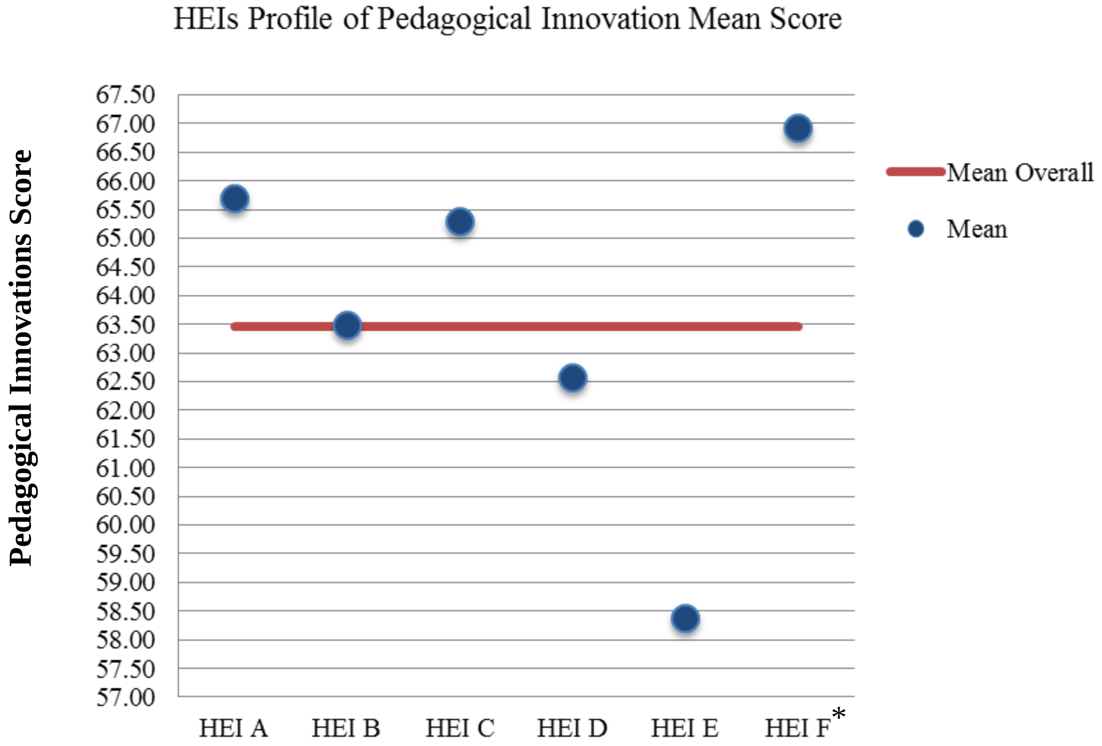
Means and Standard Deviations of Pedagogical Innovations Scores

	Pedagogical Innovations Score	
HEI Subjects	*Mean*	*Standard Deviation*
Overall	63.47	12.19
HEI A	65.70	14.16
HEI B	63.48	11.09
HEI C	65.28	10.45
HEI D	62.57	12.57
HEI E	58.38	12.06
HEI F*	66.91	12.78

Note: *HEI F has 11 subjects only

There are a total of 18 items in section C of the questionnaire. The total score for this 18-item section is 90. The findings showed a mean score of 63.47 (N = 248). The results showed that the subjects' pedagogical innovation was higher than "emergent" (minimum score of 54) but have yet to become "innovative" (minimum score of 72). In this context, higher than "emergent" means the subjects were demonstrating some elements of pedagogical innovation.

Interestingly, the public universities, namely HEI A, HEI B and HEI C have a higher mean score than the private universities (Figure 4.2). The mean score of the private universities, namely HEI D and HEI E are lower than their counterparts. Although HEI F subjects had the highest mean value of pedagogical innovativeness, due to the limited number of subjects (n = 11), it cannot be deduced that subjects of HEI F were pedagogically more innovative than the rest of the HEIs.



Note: *HEI F, $n < 30$

Figure 4.2 Mean score of HEIs on pedagogical innovations

4.3.4.2 Trend Analysis of the Six Dimensions of Pedagogical Innovations

According to Law et al. (2012), the pedagogical innovations profile of a teacher, a school or a cluster of schools could be presented using the six dimensions of the SITES-M2 pedagogical innovations. In this study, each of the dimensions carries a total score of minimum three to maximum 15. It is of great interest to evaluate which of the dimensions were contributing significantly to the overall innovativeness of the subjects, among the HEIs as well as between the public and private HEIs. Table 4.15 shows the respective HEI's profile of pedagogical innovativeness based on the total mean scores of the subjects.

Table 4.15

Pedagogical Innovativeness of HEI on Six Dimensions of Innovations

	Mean Score (*SD*)						
Dimension	Overall	HEI A	HEI B*	HEI C	HEI D	HEI E	HEI F
Learning Objectives	12.38	12.26	12.33	13.10	11.92	12.09	12.55
	(2.17)	(2.34)	(2.20)	(1.88)	(2.23)	(2.18)	(2.02)
Teacher's Roles	10.65	10.98	11.42	10.48	10.45	9.88	10.64
	(2.81)	(3.25)	(2.52)	(2.58)	(2.68)	(2.89)	(3.48)
Students' Roles	10.63	10.81	10.81	11.37	10.50	8.94	10.91
	(2.66)	(3.00)	(2.35)	(2.54)	(2.45)	(2.78)	(2.26)
ICT Used	11.52	12.52	11.49	11.58	11.03	10.72	12.45
	(2.51)	(2.19)	(1.81)	(2.78)	(2.51)	(2.95)	(1.92)
Connectedness	8.26	8.02	8.02	8.08	8.43	8.31	9.91
	(3.18)	(3.56)	(3.20)	(3.11)	(3.29)	(2.75)	(2.43)
Multiplicity of learning Outcomes Exhibited	10.06	10.57	9.56	10.67	10.23	8.44	10.45
	(2.92)	(3.26)	(2.70)	(2.49)	(2.84)	(3.13)	(3.08)

Note: *one subject from HEI B did not fill up this section

Table 4.15 shows that all the six HEIs had the highest mean score in the dimension 'learning objectives'. The dimension 'connectedness' had the lowest mean score. The pedagogical innovations profile of the population of study could be further presented in a radar diagram as depicted in Figure 4.3. From Figure 4.3, it is clearly demonstrated that for the population of this study (N = 248), the mean values of six dimensions of pedagogical innovations are presented by respective markers. The subjects in this study had the highest mean value for the "learning objectives" dimension (M = 12.38, SD = 2.17). This is followed by the "ICT used" dimension (M = 11.52, SD = 2.51). The dimension "teachers' roles" (M = 10.65, SD = 2.81) had slightly higher mean value than "students' roles" (M = 10.63, SD = 2.66). "Multiplicity of learning outcomes" had mean value of 10.06 (SD = 2.92) while the "connectedness" dimension had the lowest mean value (M = 8.26, SD = 3.18). The six HEIs' individual pedagogical innovations profiles are presented in Appendix H.

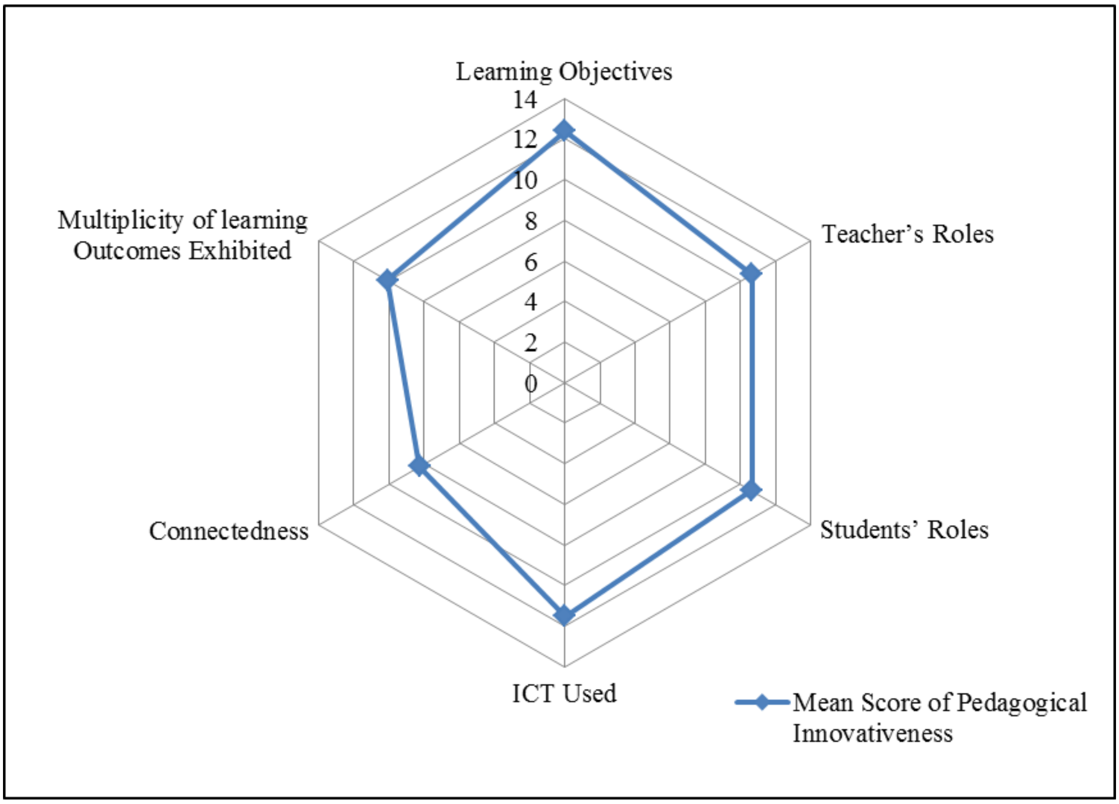


Figure 4.3 Pedagogical Innovations Profile of the Population of Study

The pedagogical innovations profiles of subjects from public and private HEIs were compared using the radar diagram representation (Figure 4.4). Although none of the markers for each mean value of the dimensions overlapped, the pedagogical innovations profiles of public and private HEIs were almost identical.

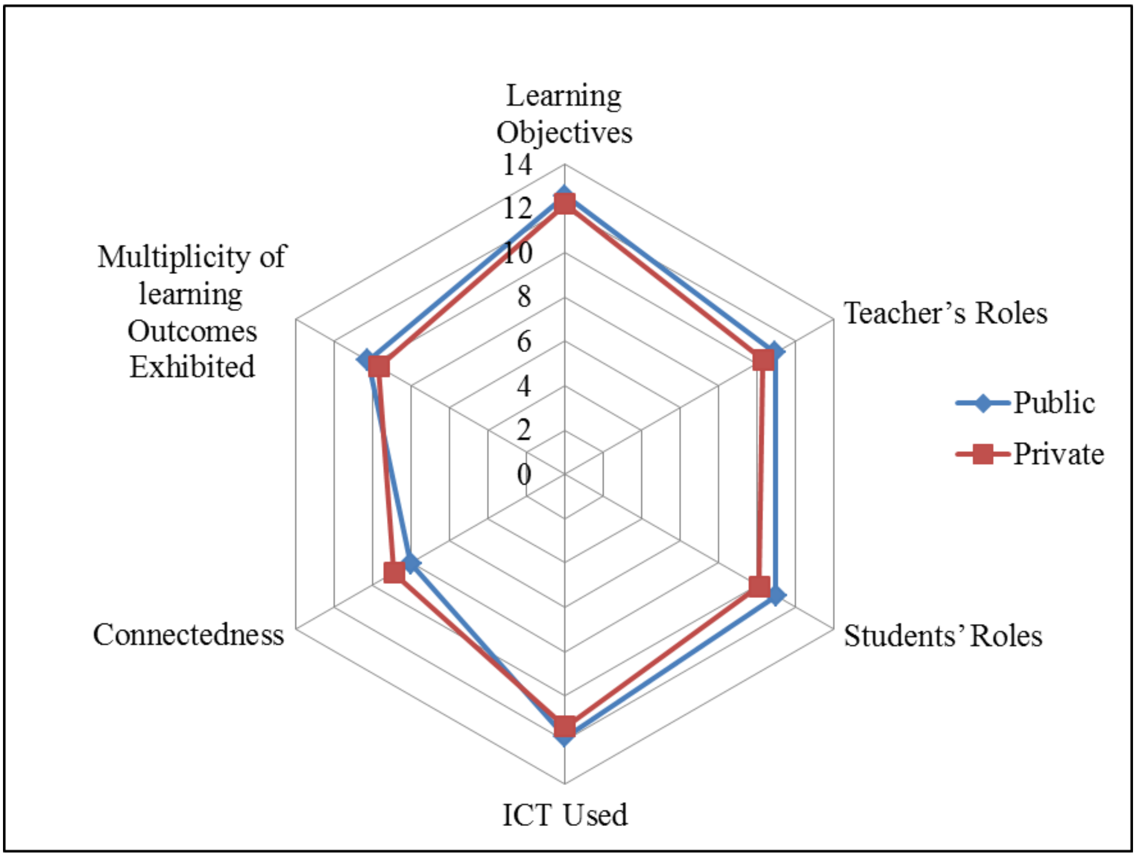


Figure 4.4 Pedagogical Innovations Profiles of Public and Private HEIs

To further investigate if there was significant difference between the two groups of HEIs (public and private), comparisons of mean using ANOVA tests were performed for the six dimensions of pedagogical innovations profile. Table 4.16 shows the results of One-way ANOVA test.

When the 248 subjects were divided into their HEIs' ownership, there are three dimensions of the pedagogical innovation profiles significantly different between the two groups. The public HEIs subjects consistently had significantly higher means for "teacher's roles" [$F(1,246) = 4.49$, $p < .05$], "student's roles" [$F(1,246) = 8.42$, $p < .05$], whereas private HEIs had higher mean for "connectedness" [$F(1,246) = 5.34$, $p < .05$].

Table 4.16

ANOVA Results for Six Dimensions of Pedagogical Innovations by Ownership of HEIs

Pedagogical Innovations Dimension	*Ownership*	*n*	*M*	*SD*	*df1*	*df2*	*F*	*Sig.*
Learning Objectives	Public	145	12.63	2.14	1	246	2.88	.091
	Private	103	12.04	2.18				
Teacher's Roles	Public	145	10.90	2.78	1	246	4.49*	.035
	Private	103	10.29	2.82				
Student's Roles	Public	145	11.04	2.63	1	246	8.42*	.004
	Private	103	10.06	2.63				
ICT Used	Public	145	11.83	2.38	1	246	1.52	.219
	Private	103	11.09	2.63				
Connectedness	Public	145	8.05	3.26	1	246	5.34*	.022
	Private	103	8.55	3.06				
Multiplicity of Outcomes Exhibited	Public	145	10.31	2.81	1	246	2.65	.105
	Private	103	9.70	3.05				

Note: **F* value is significant at $p < .05$ level

4.3.5 Pedagogical Innovativeness and Subjects' Demographic Profile

Research question 5: Is there a significant relationship between pedagogical innovativeness profile and demographic variables?

The moderating effects of the demographic variables on the subjects' pedagogical innovativeness were examined through univariate analyses (Table 4.17).

From Table 4.17, for demographic variable of faculty discipline, it was found that the science group of subjects (*M* = 65.54, *SD* = 11.61) had higher pedagogical innovation practices compared to the arts group (*M* = 64.42, *SD* = 11.71).

When comparing the two groups of gender, male (*M* = 65.00, *SD* = 13.03) had higher pedagogical innovation practices than female (*M* = 64.95, *SD* = 10.51).

Subjects aged above 60 years old were found to have the highest pedagogical innovation practices (*M* = 67.18, *SD* = 13.68). Subjects of 31 to 40 years old (*M* = 65.61, *SD* = 11.05) had higher pedagogical innovation practices compared to those of 51 to 60 years old (*M* = 65.56, *SD* = 13.04). Subjects from the age group of 20 to 30 years old (M = 63.03, SD = 11.21) had lower pedagogical innovation practices compared to the 41 to 50 years old (M = 66.78, SD = 13.13).

Table 4.17

Means and Standard Deviations of Pedagogical Innovation Practices by Demographic Variables

Variable	Category	Pedagogical Innovation Practices		
		Frequency	*M*	*SD*
Faculty	Science	122	65.54	11.61
Discipline	Arts	126	64.42	11.71
Gender	Male	110	65.00	13.03
	Female	138	64.95	10.51
Age Group	20-30 years old	26	63.03	11.21
	31-40 years old	94	65.61	11.05
	41-50 years old	60	63.95	11.19
	51-60 years old	59	65.56	13.04
	Above 60 years old	9	67.18	13.68
Teaching Experience	Less than 2 years	13	67.71	13.17
	2 to 5 years	58	63.52	9.88
	6 to 10 years	62	65.26	12.25
	11 to 15 years	31	62.69	10.99
	16 to 20 years	24	65.11	9.61
	More than 20 years	60	66.78	13.13
Highest Level of Academic Qualification	Bachelor (Arts)	3	52.67	2.07
	Bachelors (Science)	7	61.17	10.94
	Masters (Arts)	25	63.06	11.45
	Masters (Science)	32	64.13	9.89
	Masters in Philosophy	0	-	-
	MBA	5	61.70	8.49
	Doctor of Philosophy	176	65.86	12.03
Academic Position*	Professor	32	68.76	11.48
	Associate Professor	43	64.11	11.61
	Senior Lecturer	144	66.29	10.81
	Lecturer	19	64.51	14.46
	Tutor	10	67.11	6.44

Note: N = 248; *Assistant professor was recorded as Senior Lecturer

Comparing subjects' teaching experience, the two extreme groups had higher pedagogical innovation practices, namely the less than two years (M = 67.71, SD = 13.1) and the above 20 years (M = 64.42, SD = 11.71). This is followed by those with six to 10 years (*M* = 65.26, *SD* = 12.25), 16 to 20 years (*M* = 65.11, *SD* = 9.61), two to five years (*M* = 63.52, *SD* = 9.88), and 11 to 15 years (*M* = 62.69, *SD* = 10.99).

On the demographic variable highest academic qualification attained, subjects with PhD had the highest mean value of pedagogical innovation practices (*M* = 65.86, *SD* = 12.03). This is followed by those with master's degree in science (*M* = 64.13, *SD* = 9.89), master's degree in arts (*M* = 63.06, *SD* = 11.45), MBA (*M* = 61.70, *SD* = 8.49), bachelor's degree in science (*M* = 61.17, *SD* = 10.94), and bachelor's degree in arts (*M* = 52.67, *SD* = 2.07).

Comparing the subjects' academic position held, the professors had the highest mean value for pedagogical innovation practices (*M* = 68.76, *SD* = 11.48). The tutors (*M* = 67.11, *SD* = 6.44) had higher mean than the rest of the academic positions, namely, senior lecturers (*M* = 66.29, *SD* = 10.81), lecturers (*M* = 64.51, *SD* = 14.46), and associate professors (*M* = 64.11, *SD* = 11.61).

Table 4.18-4.23 show the relationship between each of the six pedagogical innovation dimensions and demographic variables.

Table 4.18

Univariate Analyses and Effect Size Estimation for Demographic Variables and Pedagogical Innovativeness (Dimension 1: Learning Objectives)

Variable	*F*	*df1*	*df2*	*Sig.*	*Effect Size* η^2
Faculty Discipline	.260	1	246	.610	.001
Gender	.028	1	246	.867	.000
Age Group	2.645*	4	243	.034	.042
Teaching Experience	1.951	5	242	.087	.039
Highest Level of Academic Qualification	1.702	7	240	.109	.047
Academic Position	2.157*	6	241	.048	.051

Note: Correlation is significant at $p < .05$

From Table 4.18 it is found that 'age group' [$F(4,243) = 2.645$, $p < .05$] and 'academic position' [$F(6,241) = 2.157$, $p < .05$] were statistically significant in influencing the dimension of 'learning objectives' of pedagogical innovativeness. However, the effect size of the two demographic variables is very small, 4.2 % and 5.1 % respectively.

Table 4.19

Univariate Analyses and Effect Size Estimation for Demographic Variables and Pedagogical Innovativeness (Dimension 2: Teacher's Roles)

Variable	*F*	*df1*	*df2*	*Sig*	*Effect Size* η^2
Faculty Discipline	3.43	1	246	.065	.014
Gender	.639	1	246	.425	.003
Age Group	1.056	4	243	.379	.017
Teaching Experience	.510	5	242	.769	.010
Highest Level of Academic Qualification	.904	7	240	.504	.026
Academic Position	1.599	6	241	.148	.038

Note: Correlation is significant at $p < .05$

From Table 4.19, none of the six demographic variables had significant effect on subjects' 'teacher's roles' dimension of the pedagogical innovativeness.

From Table 4.20, none of the six demographic variables had significant effect on subjects' 'student's roles' dimension of the pedagogical innovativeness.

Table 4.20

Univariate Analyses and Effect Size Estimation for Demographic Variables and Pedagogical Innovativeness (Dimension 3: Student's Roles)

Variable	*F*	*df1*	*df2*	*Sig.*	*Effect size* η^2
Faculty Discipline	.473	1	246	.492	.002
Gender	2.994	1	246	.085	.012
Age Group	.220	4	243	.927	.004
Teaching Experience	1.198	5	242	.311	.024
Highest Level of Academic Qualification	.396	7	240	.904	.011
Academic Position	1.758	6	241	.109	.042

Note: Correlation is significant at $p < .05$

From Table 4.21, it is shown that for the dimension of 'ICT used', only the 'academic position' of subjects is significant, [$F(6,241) = 2.294$, $p < .05$]. However, the effect size of 'academic position' was very small, at 5.4 %.

Table 4.21

Univariate Analyses and Effect Size Estimation for Demographic Variables and Pedagogical Innovativeness (Dimension 4: ICT Used)

Variable	*F*	*df1*	*df2*	*Sig.*	*Effect size* η^2
Faculty Discipline	.541	1	246	.463	.002
Gender	2.077	1	246	.151	.008
Age Group	1.086	4	243	.364	.018
Teaching Experience	1.249	5	242	.287	.025
Highest Level of Academic Qualification	1.872	7	240	.075	.052
Academic Position	2.294*	6	241	.036	.054

Note: Correlation is significant at $p < .05$

From Table 4.22, it is shown that none of the six demographic variables had significant effect on subjects' pedagogical innovativeness dimension connectedness'.

Table 4.22

Univariate Analyses and Effect Size Estimation for Demographic Variables and Pedagogical Innovativeness (Dimension 5: Connectedness)

Variable	*F*	*df1*	*df2*	*Sig.*	*Effect size* η^2
Faculty Discipline	1.689	1	246	.195	.007
Gender	1.616	1	246	.205	.007
Age Group	1.187	4	243	.317	.019
Teaching Experience	.868	5	242	.503	.018
Highest Level of Academic Qualification	.578	7	240	.774	.017
Academic Position	.575	6	241	.750	.014

Note: Correlation is significant at $p < .05$

Table 4.23 shows that none of the six demographic variables had significant effect on subjects' pedagogical innovativeness dimension 'multiplicity of learning outcomes'.

Table 4.23

Univariate Analyses and Effect Size Estimation for Demographic Variables and Pedagogical Innovativeness (Dimension 6: Multiplicity of Learning Outcomes Exhibited)

Variable	*F*	*df1*	*df2*	*Sig.*	*Effect size* η^2
Faculty Discipline	.001	1	246	.969	.000
Gender	.780	1	246	.378	.003
Age Group	.455	4	243	.769	.007
Teaching Experience	1.056	5	242	.385	.021
Highest Level of Academic Qualification	.356	7	240	.927	.010
Academic Position	1.254	6	241	.279	.030

Note: Correlation is significant at $p < .05$

The effect on demographic variables on the overall pedagogical innovativeness is also examined using the mean score of the six dimensions. Table 4.24 shows that none of the demographic variables had a statistically significant effect on subjects' pedagogical innovativeness.

Table 4.24

Univariate Analyses and Effect Size Estimation for Demographic Variables and Pedagogical Innovativeness (Total)

Variable	*F*	*df1*	*df2*	*Sig.*	*Effect size* η^2
Faculty Discipline	.401	1	245	.527	.002
Gender	.140	1	245	.709	.001
Age Group	.434	4	242	.784	.007
Teaching Experience	.592	5	241	.706	.012
Highest Level of Academic Qualification	.765	7	239	.618	.022
Academic Position	1.786	6	240	.103	.043

Note: Correlation is significant at $p < .05$

Consistent with the findings on technology integration practices, the demographic characteristics' of subjects in this study did not exert statistically significant effect on their pedagogical innovativeness. Hence, for subsequent statistical analysis on the validity of the overall conceptual framework, analysis of demographic characteristics as moderating variables was less critical.

4.3.6 Relationship between Pedagogical Innovativeness and Organisation and Faculty's Beliefs

Research question 6: Is there a significant relationship between pedagogical innovativeness profile and organisation and faculty's beliefs?

The Pearson Product-moment partial correlation test was performed to examine the relationship between subjects' pedagogical innovativeness and their organisation and personal beliefs on technology integration. In this analysis, demographic variables were the controlled variables. The SPSS output of results were presented in an appendix (Appendix I). As Type I error could arise from the interaction effects among the variables of this analysis, the *Bonferroni* method was used to control the interaction effects among the variables.

The first step of this analysis was performed to examine the correlation between the ten mediating variables and each of the six pedagogical dimensions. Tables 4.25 to 4.30 present the results of the partial correlation tests.

Table 4.25

Organisation and Faculty's Beliefs and Partial Correlation with Pedagogical Innovativeness (Dimension 1: Learning Objectives)

	Learning Outcomes	
Organisation and Faculty's Beliefs	*Partial correlation r*	*Sig.*
Support is always available among faculty members to integrate technology into pedagogical practices	.243**	.000
Sufficient professional development for faculty members	.136*	.036
Excellent infrastructure that supports students to use technology to learn	.151*	.019
Technology Integration is a valuable means for faculty members	.279**	.000
Excellent Administrative support for faculty to facilitate technology integration	.178*	.006
Prominent technology leader that drives the initiative of technology integration	.186*	.004
Supportive plans and policies that form the strategy of technology integration within the faculty	.187*	.004
Sufficient time to implement technology integration projects	.152*	.018
Support from external agencies	.132*	.041
Strong support from the university top management	.154*	.017

Note: *significant at $p < .05$ level, **significant at $p < .001$ level

All the ten mediating variables were significantly correlated to subjects' pedagogical innovativeness for dimension 1 'learning objectives'. The variable "technology is a valuable means for faculty members' has the highest *r* value, .279 ($p < .001$).

Table 4.26

Organisation and Faculty's Beliefs and Partial Correlation with Pedagogical Innovativeness (Dimension 2: Teacher's Roles)

	Teacher's Roles	
Organisation and Faculty's Beliefs	*Partial correlation r*	*Sig.*
Support is always available among faculty members to integrate technology into pedagogical practices	.168*	.009
Sufficient professional development for faculty members	.152*	.018
Excellent infrastructure that supports students to use technology to learn	.051	.434
Technology Integration is a valuable means for faculty members	.111	.086
Excellent Administrative support for faculty to facilitate technology integration	.152*	.019
Prominent technology leader that drives the initiative of technology integration	.229**	.000
Supportive plans and policies that form the strategy of technology integration within the faculty	.236**	.000
Sufficient time to implement technology integration projects	.194*	.003
Support from external agencies	.197*	.002
Strong support from the university top management	.156*	.015

Note: *significant at $p < .05$ level, **significant at $p < .001$ level

All the ten mediating variables were significantly correlated to subjects' pedagogical innovativeness dimension 2 'teacher's roles'. The variable "supportive plans and policies that form the strategy of technology integration within the faculty' has the highest r value, .236 ($p < .001$).

Table 4.27

Organisation and Faculty's Beliefs and Partial Correlation with Pedagogical Innovativeness (Dimension 3: Student's Roles)

	Student's Roles	
Organisation and Faculty's Beliefs	*Partial correlation r*	*Sig.*
Support is always available among faculty members to integrate technology into pedagogical practices	.164*	.011
Sufficient professional development for faculty members	.140*	.031
Excellent infrastructure that supports students to use technology to learn	.110	.088
Technology Integration is a valuable means for faculty members	.148*	.023
Excellent Administrative support for faculty to facilitate technology integration	.180*	.005
Prominent technology leader that drives the initiative of technology integration	.182*	.005
Supportive plans and policies that form the strategy of technology integration within the faculty	.264**	.000
Sufficient time to implement technology integration projects	.267**	.000
Support from external agencies	.226**	.000
Strong support from the university top management	.140*	.031

Note: *significant at $p < .05$ level, **significant at $p < .001$ level

Nine of the mediating variables were significantly correlated to subjects' pedagogical innovativeness dimension 3 'student's roles'. The variable 'excellent infrastructure that supports students to use technology to learn' has no significant correlation to 'student's role'. The variable "Sufficient time to implement technology integration projects' has the highest *r* value, .267 (p<.001).

Table 4.28

Organisation and Faculty's Beliefs and Partial Correlation with Pedagogical Innovativeness (Dimension 4: ICT Used)

	ICT Used	
Organisation and Faculty's Beliefs	*Partial correlation r*	*Sig.*
Support is always available among faculty members to integrate technology into pedagogical practices	.152*	.019
Sufficient professional development for faculty members	.165*	.010
Excellent infrastructure that supports students to use technology to learn	.153*	.017
Technology Integration is a valuable means for faculty members	.177*	.006
Excellent Administrative support for faculty to facilitate technology integration	.114	.078
Prominent technology leader that drives the initiative of technology integration	.079	.223
Supportive plans and policies that form the strategy of technology integration within the faculty	.160*	.013
Sufficient time to implement technology integration projects	.125	.054
Support from external agencies	.112	.085
Strong support from the university top management	.073	.258

Note: *significant at $p < .05$ level, **significant at $p < .001$ level

Five of the mediating variables were significantly correlated to subjects' pedagogical innovativeness dimension 4 'ICT used'. The variable "technology integration is a valuable means for faculty members' has the highest r value, .177 ($p < .05$).

Table 4.29

Organisation and Faculty's Beliefs and Partial Correlation with Pedagogical Innovativeness (Dimension 5: Connectedness)

	Connectedness	
Organisation and Faculty's Beliefs	*Partial correlation r*	*Sig.*
Support is always available among faculty members to integrate technology into pedagogical practices	.229**	.000
Sufficient professional development for faculty members	.183*	.004
Excellent infrastructure that supports students to use technology to learn	.141*	.029
Technology Integration is a valuable means for faculty members	.086	.183
Excellent Administrative support for faculty to facilitate technology integration	.162*	.012
Prominent technology leader that drives the initiative of technology integration	.260*	.012
Supportive plans and policies that form the strategy of technology integration within the faculty	.317**	.000
Sufficient time to implement technology integration projects	.257**	.000
Support from external agencies	.281**	.000
Strong support from the university top management	.156*	.015

Note: *significant at $p < .05$ level, **significant at $p < .001$ level

Nine of the mediating variables were significantly correlated to the subjects' pedagogical innovativeness dimension 5 'connectedness'. The variable "supportive plans and policies that form the strategy of technology integration within the faculty' has the highest r value, .317 ($p < .001$).

Table 4.30

Organisation and Faculty's Beliefs and Partial Correlation with Pedagogical Innovativeness (Dimension 6: Multiplicity of Learning Outcomes Exhibited)

	Multiplicity of Learning Outcomes Exhibited	
Organisation and Faculty's Beliefs	*Partial correlation r*	*Sig.*
Support is always available among faculty members to integrate technology into pedagogical practices	.152*	.018
Sufficient professional development for faculty members	.149*	.021
Excellent infrastructure that supports students to use technology to learn	.113	.082
Technology Integration is a valuable means for faculty members	.086	.184
Excellent Administrative support for faculty to facilitate technology integration	.152*	.018
Prominent technology leader that drives the initiative of technology integration	.193*	.003
Supportive plans and policies that form the strategy of technology integration within the faculty	.268**	.000
Sufficient time to implement technology integration projects	.245**	.000
Support from external agencies	.254**	.000
Strong support from the university top management	.097	.135

Note: *significant at $p < .05$ level, **significant at $p < .001$ level

Seven of the mediating variables were significantly correlated to the subjects' pedagogical innovativeness dimension 6 'multiplicity of learning outcomes exhibited'. The variable "supportive plans and policies that form the strategy of technology integration within the faculty' has the highest *r* value, .268 ($p < .001$).

In order to further examine the correlation between the ten mediating variables and the entire pedagogical innovativeness mean score, a partial correlation test was performed for the two clusters of mediating variables and dependant variables. Table 4.31 shows the summary of the correlation analysis between pedagogical innovativeness by controlling the demographic variables.

Table 4.31

Organisation and Faculty's Beliefs and Partial Correlation with Pedagogical Innovativeness

	Pedagogical Innovativeness	
Organisation and Faculty's Beliefs	*Partial correlation R*	*Sig.*
Support is always available among faculty members to integrate technology into pedagogical practices	.246**	.000
Sufficient professional development for faculty members	.206*	.001
Excellent infrastructure that supports students to use technology to learn	.163*	.012
Technology Integration is a valuable means for faculty members	.189*	.003
Excellent Administrative support for faculty to facilitate technology integration	.215*	.001
Prominent technology leader that drives the initiative of technology integration	.259**	.000
Supportive plans and policies that form the strategy of technology integration within the faculty	.331**	.000
Sufficient time to implement technology integration projects	.288**	.000
Support from external agencies	.274*	.000
Strong support from the university top management	.179*	.005

Note: *significant at $p < .05$ level, **significant at $p < .001$ level

By controlling the demographic variables, there was a significantly weak positive correlation between pedagogical innovativeness and the ten mediating variables identified in this study (r values were ranging from .163 to .331, $p < .05$). In other words, by removing the control variables (demographic variables) as shown in the correlation table (Appendix I), the subjects in this study did not have a significantly higher pedagogical innovativeness profiles as compared to the zero order partials results.

The relationship between the independent and dependent variables was further analysed using various statistical methods. In order to better understand the predictive power of the technology integration practices based on the ICCM instrument, the 25 items were further grouped into their respective dimensions. There are six dimensions in this ICCM as outlined in Chapter Two (section 2.2, page 43). Firstly, multiple linear regression analysis was conducted to examine the predictive power of the independent variable, namely technology integration practices (ICCM total score and each of the six dimension score) on the subjects' pedagogical innovativeness. Secondly, the hierarchical regression model was further employed to further determine the relationship among the main variables of this study by controlling the mediating variables.

4.3.7 Multiple Linear Regression Analysis

Research question 7: Is technology integration practices based on ICCM score a significant predictor to pedagogical innovativeness?

In order to examine the relationship between technology integration practices and pedagogical innovativeness, multiple linear regression analysis was performed. In this analysis, the predictor variables were the six components of technology integration practices. In addition to this, the total score of the ICCM was also used as a single predictor variable to examine its reliability compared to the six dimensions. The criterion variable here was the pedagogical innovativeness sum score.

Using the *Enter* Method, the dependent variable "pedagogical innovativeness" was selected, followed by the seven independent variables: "Technology Integration Practices (ICCM Total Score)", "Faculty demonstrate a sound or in-depth understanding of technology operations and concepts", "Faculty integrate technology in planning and designing learning environments and experiences", "Faculty integrate technology in the planning of curriculum", "Faculty integrate technology in evaluation and assessment", "Faculty integrate technology to enhance their productivity and professional practice", and "Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice". All the seven predictor variables were entered into the regression model at $p < .05$. This means all seven are examined for their prediction significance for pedagogical innovativeness of subjects of the study. Tables 4.32 to 4.35 show the outputs of the multilinear regression analysis.

Table 4.32

Variables Entered or Removed[a] for Multiple Linear Regression Analysis

Model	Variables Entered	Variables Removed	Method
1	Technology Integration Practices (ICCM Total Score)		Stepwise(Criteria: Probability-of-F-to-enter <=.50, Probability-of-F-to-remove >= .100)
2	Faculty integrate technology in evaluation and assessment		Stepwise(Criteria: Probability-of-F-to-enter <=.50, Probability-of-F-to-remove >= .100)
3	Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice		Stepwise(Criteria: Probability-of-F-to-enter <=.50, Probability-of-F-to-remove >= .100)
4	Faculty integrate technology to enhance their productivity and professional practice		Stepwise(Criteria: Probability-of-F-to-enter <=.50, Probability-of-F-to-remove >= .100)
5	Faculty integrate technology in planning and designing learning environments and experiences		Stepwise(Criteria: Probability-of-F-to-enter <=.50, Probability-of-F-to-remove >= .100)

Note: [a]Dependent Variable: Pedagogical innovativeness

Table 4.33 shows the correlation between the criterion variable “pedagogical innovativeness” and the five predictor variables based on the multiple linear regression analysis.

Model 1 shows the correlation between pedagogical innovativeness and technology integration practices (ICCM total score) at r = .648. R^2 value of .420 shows that 42 % of the variance in subjects’ pedagogical innovativeness were caused by changes in the technology integration practices as represented by the subjects’ ICCM total score.

Table 4.33

Model Summary[f] of Regression Analysis

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.648[a]	.420	.419	8.888
2	.657[b]	.432	.430	8.805
3	.671[c]	.450	.448	8.666
4	.677[d]	.458	.455	8.608
5	.680[e]	.462	.458	8.583

Note:

a. Predictors: (Constant), Technology Integration Practices (ICCM Total Score)
b. Predictors: (Constant), Technology Integration Practices (ICCM Total Score), Faculty integrate technology in evaluation and assessment
c. Predictors: (Constant), Technology Integration Practices (ICCM Total Score), Faculty integrate technology in evaluation and assessment, Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice
d. Predictors: (Constant), Technology Integration Practices (ICCM Total Score), Faculty integrate technology in evaluation and assessment, Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice, Faculty integrate technology to enhance their productivity and professional practice
e. Predictors: (Constant), Technology Integration Practices (ICCM Total Score), Faculty integrate technology in evaluation and assessment, Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice, Faculty integrate technology to enhance their productivity and professional practice, Faculty integrate technology in planning and designing learning environments and experiences
f. Dependant variable: Pedagogical Innovativeness

Model 2 shows the correlation between pedagogical innovativeness and the combination of the subjects' technology integration practices (ICCM Total Score) and faculty integrate technology in evaluation and assessment (dimension 4 of the ICCM), $r = .657$. R^2 of .432 shows that (43.2 % - 42.0 %) 1.2 % of the additional changes in subjects' pedagogical innovativeness are caused by the combination of changes in "the faculty integrate technology in evaluation and assessment" (dimension 4 of the ICCM).

Model 3 shows the correlation between pedagogical innovativeness and the combination of the subjects' technology integration practices (ICCM Total Score), "faculty integrate technology in evaluation and assessment" (dimension 4 of the ICCM), and "faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice" (dimension 6 of the ICCM) at r = .671. R^2 of .450 shows that (45.0 % - 42.0 %) 3 % of the additional changes in subjects' pedagogical innovativeness are caused by the combination of changes in "the faculty integrate technology in evaluation and assessment" (dimension 4 of the ICCM), and "faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice" (dimension 6 of the ICCM).

Model 4 explains that correlation between pedagogical innovativeness and the combination of the subjects' technology integration practices (ICCM Total Score), "faculty integrate technology in evaluation and assessment" (dimension 4 of the ICCM), "faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice" (dimension 6 of the ICCM), and "faculty integrate technology to enhance their productivity and professional practice" (dimension 5 of ICCM) at r = .677. R^2 of .458 shows that (45.8 % - 42.0 %) 3.8 % of the additional changes in subjects' pedagogical innovativeness are caused by the combination of changes in "the faculty integrate technology in evaluation and assessment" (dimension 4 of the ICCM), "faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice" (dimension 6 of the ICCM), and "faculty integrate technology to enhance their productivity and professional practice" (dimension 5 of ICCM).

Model 5 explains further that the correlation between pedagogical innovativeness and the combination of the subjects' technology integration practices (ICCM Total Score), "faculty integrate technology in evaluation and assessment" (dimension 4 of the ICCM), "faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice" (dimension 6 of the ICCM), "faculty integrate technology to enhance their productivity and professional practice" (dimension 5 of ICCM), and "faculty integrate technology in planning and designing learning environments and experiences" (dimension 2 of ICCM) at $r = .680$. R^2 of .462 shows that (46.2 % - 42.0 %) 4.0 % of the additional changes in subjects' pedagogical innovativeness are caused by the combination of changes in "the faculty integrate technology in evaluation and assessment" (dimension 4 of the ICCM), "faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice" (dimension 6 of the ICCM), "faculty integrate technology to enhance their productivity and professional practice" (dimension 5 of ICCM), and "faculty integrate technology in planning and designing learning environments and experiences" (dimension 2 of ICCM).

Table 4.34 presents the ANOVA results that there are significant effects between the five predictor variables and the criterion variable "pedagogical innovativeness" at $p < .05$ level. For technology integration practices (ICCM Total Score), the result is significant [$F(1, 246) = 467.1$, $p < .05$]. The ANOVA result for combination of technology integration practices (ICCM Total Score) and "faculty integrate technology in evaluation and assessment" is also significant [$F(2, 246) = 244.6$, $p < .05$].

The ANOVA result for combination of technology integration practices (ICCM Total Score), "faculty integrate technology in evaluation and assessment", and "faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice" is significant [$F(3, 245) = 175.6$, $p < .05$].

Table 4.34

ANOVA[f] Results of the Five Models for Regression Analysis

Model		Sum of Squares	df	Mean square	*F*	Sig.
1	Regression	36894.4	1	36894.4	467.1	.000[a]
	Residual	50947.1	247	79.0		
	Total	87841.5	248			
2	Regression	37917.9	2	18959.0	244.6	.000[b]
	Residual	49923.6	246	77.5		
	Total	87841.5	248			
3	Regression	39553.0	3	13184.3	175.6	.000[c]
	Residual	48288.5	245	75.1		
	Total	87841.5	248			
4	Regression	40272.6	4	10068.1	135.9	.000[d]
	Residual	47569.0	244	74.1		
	Total	87841.6	248			
5	Regression	40624.0	5	8124.8	110.3	.000[e]
	Residual	47217.5	243	73.7		
	Total	87841.5	248			

Note:

a. Predictors: (Constant), Technology Integration Practices (ICCM Total Score)
b. Predictors: (Constant), Technology Integration Practices (ICCM Total Score), Faculty integrate technology in evaluation and assessment
c. Predictors: (Constant), Technology Integration Practices (ICCM Total Score), Faculty integrate technology in evaluation and assessment, Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice
d. Predictors: (Constant), Technology Integration Practices (ICCM Total Score), Faculty integrate technology in evaluation and assessment, Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice, Faculty integrate technology to enhance their productivity and professional practice
e. Predictors: (Constant), Technology Integration Practices (ICCM Total Score), Faculty integrate technology in evaluation and assessment, Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice, Faculty integrate technology to enhance their productivity and professional practice, Faculty integrate technology in planning and designing learning environments and experiences
f. Dependant variable: Pedagogical Innovativeness

The ANOVA result for combination of technology integration practices (ICCM Total Score), “faculty integrate technology in evaluation and assessment”, “faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice” and “faculty integrate technology to enhance their productivity and professional practice" is significant [$F(4, 244) = 135.9, p < .05$].

The ANOVA result for combination of technology integration practices (ICCM Total Score), "faculty integrate technology in evaluation and assessment", "faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice", "faculty integrate technology to enhance their productivity and professional practice", and "faculty integrate technology in planning and designing learning environments and experiences" is significant [$F(5, 243) = 110.3, p < .05$].

The results of the multiple linear regression analysis showed that in the population of study ($N = 248$), technology integration practices based on the ICCM score of the 25-items instrument is a significant predictor for pedagogical innovativeness among the subjects. When further analysis according to the dimensions is conducted, four of the six technology integration practices dimensions are significant predictors to pedagogical innovativeness.

Table 4.35

Coefficient[a] Values for the Regression Analysis

Model		Unstandardised Coefficients		Standardised coefficients		
		B	Std. Error	Beta	*t*	Sig.
1	(Constant)	27.12	1.79		15.19	.000
	Technology Integration Practices (ICCM Total Score)	.44	.02	.65**	21.61	.000
2	(Constant)	29.52	1.89		15.63	.000
	Technology Integration Practices (ICCM Total Score)	.33	.04	.479**	8.70	.000
	Faculty integrate technology in evaluation and assessment	.78	.21	.20**	3.63	.000

Note. [a] Dependent variable: Pedagogical innovativeness, *significant at $p < .50$, **significant at $p < .001$

Table 4.35 (*continue*)

Coefficient[a] Values for the Regression Analysis

Model		Unstandardised Coefficients B	Std. Error	Standardised coefficients Beta	*t*	Sig.
3	(Constant)	29.64	1.86		15.95	.000
	Technology Integration Practices (ICCM Total Score)	.14	.05	.20*	2.53	.012
	Faculty integrate technology in evaluation and assessment	1.08	.22	.28**	4.91	.000
	Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice	.93	.20	.25**	4.67	.000
4	(Constant)	31.56	1.95		16.21	.000
	Technology Integration Practices (ICCM Total Score)	.22	.06	.32**	3.62	.000
	Faculty integrate technology in evaluation and assessment	1.02	.22	.26**	4.65	.000
	Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice	.99	.20	.27**	5.01	.000
	Faculty integrate technology to enhance their productivity and professional practice	-.59	.19	-.15*	-3.12	.002
5	(Constant)	30.39	2.01		15.10	.000
	Technology Integration Practices (ICCM Total Score)	.40	.10	.59**	3.90	.000
	Faculty integrate technology in evaluation and assessment	.88	.23	.23**	3.83	.000
	Faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice	.82	.21	.23**	3.84	.000
	Faculty integrate technology to enhance their productivity and professional practice	-.82	.22	-.21**	-3.80	.000
	Faculty integrate technology in planning and designing learning environments and experiences	-.45	.21	-.17*	-2.18	.029

Note. [a] Dependent variable: Pedagogical innovativeness, *significant at $p < .50$, **significant at $p < .001$

Technology integration practices based on the ICCM score of the 25-item instrument [$F(1, 246) = 467.1$, $p < .05$] significantly explained 42 % of variance (R^2= .42) in the pedagogical innovativeness of the subjects. This means technology integration practices based on the ICCM score of the 25-items instrument ($\beta = .65$, $p < .05$) is the main predictor for the subjects' pedagogical innovativeness. The combination of the four dimensions of the technology integration practices, "faculty integrate technology in evaluation and assessment" ($\beta = .23$, $p < .05$), "faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice" ($\beta = .23$, $p < .05$), "faculty integrate technology to enhance their productivity and professional practice" ($\beta = -.21$, $p < .05$), and "faculty integrate technology in planning and designing learning environments and experiences" ($\beta = -.17$, $p < .05$) only adds (46.2 %-42.0 %) 4.0 % to the variance (R^2 of .462) of pedagogical innovativeness [$F(5,243) = 110.3$, $p < .05$].

In this study, the regression analysis showed that the technology integration practices based on the ICCM score of the 25-item instrument is a better predictor variable to pedagogical innovativeness compared to using the six components of the technology integration practices.

The Regression Model for Pedagogical Innovativeness derived from the results is:

Pedagogical Innovativeness = .650 (ICCM Score)

4.3.7.1 ICCM Score as a Predictor of Pedagogical Innovativeness for Dimension 1

Table 4.36 and Table 4.37 show the results of stepwise linear regression of ICCM as a predictor on pedagogical innovativeness dimension 1 ‘learning objectives’. The correlation between the predictor variable ICCM and the criterion variable ‘learning objectives’ was .404. The R^2 value of .164 in Model 1 shows that 16.4 % (r = .404) changes in the criterion variable were caused by changes in the predictor variable, the ICCM score.

Table 4.36

Variables Entered or Removed[a] for Linear Regression Analysis

Model	Variables Entered	Variables Removed	Method
1	Technology Integration Practices (ICCM Total Score)		Enter

[a]Dependent Variable: Pedagogical innovativeness Dimension 1 (Learning Objectives)

Table 4.37

Model Summary of Regression Analysis

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.404[a]	.164	.160	1.990

a. Predictor: (Constant), ICCM Score

The result of the ANOVA test is presented in Table 4.38. The ICCM score is a significant predictor of pedagogical innovativeness dimension 1 ‘learning objectives’. The ICCM score is a significant predictor of the subjects’ pedagogical innovativeness for dimension 1 ‘learning outcomes’, [$F(1,246) = 48.101$, $p < .001$].

Table 4.38

Result of One-Way ANOVA[b] for ICCM as Predictor on 'Learning Objectives'

Model		Sum of Squares	df	Mean Square	*F*	Sig.
1	Regression	190.473	1	190.473	48.101	.000[a]
	Residual	974.136	246	3.960		
	Total	1164.609	247			

Note. *Significant at $p < .001$

a. Predictor: (Constant), ICCM Score
b. Dependent Variable: Learning Objectives

The Regression Model for 'Learning Objectives' derived from the result is:

Learning Objectives = .404 (ICCM Score)

Table 4.39 shows the standardised coefficient for ICCM score as a predictor on pedagogical innovativeness dimension 1 'learning objectives'. ICCM score (β = .404, p < .001) is a significant predictor for 'learning outcome' dimension of pedagogical innovativeness. This predictor contributed 16.4% (r = .404) of the changes of variance in the 'learning outcomes' dimension of the pedagogical innovativeness of subjects in this study [F(1,246) = 48.101, p < .001].

Table 4.39

Standardised Coefficients for ICCM as Predictor for Learning Outcomes

Model		Unstandardised Coefficients		Standardised coefficients		
		B	Std. Error	Beta	*T*	Sig.
1	(Constant)	8.487	.576		14.741	.000
	ICCM Score	.047	.007	.404**	6.935	.000

Note: **Significant at $p < .001$

4.3.7.2 ICCM Score as a Predictor of Pedagogical Innovativeness for Dimension 2

Table 4.40 and Table 4.41 shows the results of stepwise linear regression of ICCM as a predictor on pedagogical innovativeness for the dimension 2 'teacher's roles'. The correlation between the predictor variable ICCM and criterion variable 'teacher's roles' was .455. The R^2 value of .207 in Model 1 shows that 20.7 % (r = .455) changes in the criterion variable were caused by changes in the predictor variable, the ICCM score.

Table 4.40

Variables Entered or Removed[a] for Linear Regression Analysis

Model	Variables Entered	Variables Removed	Method
1	ICCM Score		Enter

[a]Dependent Variable: Pedagogical innovativeness Dimension 2 (teacher's roles)

Table 4.41

Model Summary of Regression Analysis

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.455[a]	.207	.204	2.507

a. Predictor: (Constant), ICCM Score

The result of the ANOVA test is presented in Table 4.42. The ICCM score was a significant predictor of pedagogical innovativeness for dimension 2 'teacher's roles'. The ICCM score is a significant predictor to subjects' pedagogical innovativeness for dimension 2 'teacher's roles', [$F(1,246) = 64.251$, $p < .001$].

Table 4.42

Result of One-Way ANOVA[b] for ICCM as Predictor on 'teacher's roles

Model		Sum of Squares	df	Mean Square	*F*	Sig.
1	Regression	403.930	1	403.930	64.251	.000[a]
	Residual	1546.550	246	6.287		
	Total	1950.480	247			

Note: *Significant at $p < .001$

a. Predictor: (Constant), ICCM Score
b. Dependent Variable: Teacher's Roles

The Regression Model for 'teacher's roles' derived from the result is:

Teacher's Roles = .455 (ICCM Score)

Table 4.43 shows the standardised coefficient for ICCM score as a predictor on pedagogical innovativeness for dimension 2 'teacher's roles'. The ICCM score (β = .455, $p < .001$) is a significant predictor for 'teacher's roles' dimension of pedagogical innovativeness. This predictor contributed 20.7% (r = .455) of the changes of variance in the 'teacher's roles' dimension of the pedagogical innovativeness of subjects in this study [$F(1,246) = 64.251$, $p < .001$].

Table 4.43

Standardised Coefficients for ICCM as Predictor for Teacher's Roles

Model		Unstandardised Coefficients B	Unstandardised Coefficients Std. Error	Standardised coefficients Beta	*T*	Sig.
1	(Constant)	4.976	.725		6.859	.000
	ICCM Score	.068	.009	.455**	8.016	.000

Note: **Significant at $p < .001$

4.3.7.3 ICCM Score as a Predictor of Pedagogical Innovativeness for Dimension 3

Table 4.44 and Table 4.45 shows the results of stepwise linear regression of ICCM as a predictor on pedagogical innovativeness dimension 3 'student's roles'. The correlation between the predictor variable ICCM and criterion variable 'student's roles' was .491. The R^2 value of .241 in Model 1 shows that 24.1 % (r = .491) changes in the criterion variable were caused by changes in the predictor variable, the ICCM score.

Table 4.44

Variables Entered or Removed[a] for Linear Regression Analysis

Model	Variables Entered	Variables Removed	Method
1	ICCM Score		Enter

[a]Dependent Variable: Pedagogical innovativeness Dimension 3 (student's roles)

Table 4.45

Model Summary of Regression Analysis

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.491[a]	.241	.238	2.327

a. Predictor: (Constant), ICCM Score

The result of the ANOVA test is presented in Table 4.46. The ICCM score is a significant predictor of pedagogical innovativeness for dimension 3 'student's roles'. The ICCM score is a significant predictor to subjects' pedagogical innovativeness for dimension 3 'student's roles', [$F(1,245) = 77.687$, $p < .001$].

Table 4.46

Result of One-Way ANOVA[b] for ICCM as Predictor on 'Student's Roles'

Model		Sum of Squares	df	Mean Square	*F*	Sig.
1	Regression	420.705	1	420.705	77.687	.000[a]
	Residual	1326.769	245	5.415		
	Total	1747.474	246			

Note: *Significant at $p < .001$

a. Predictor: (Constant), ICCM Score
b. Dependent Variable: Student's Roles

The Regression Model for 'Student's Roles derived from the result is:

Student's Roles = .491 (ICCM Score)

Table 4.47 shows the standardised coefficient for ICCM score as a predictor on pedagogical innovativeness for dimension 3 'student's roles'. The ICCM score (β = .491, $p < .001$) is a significant predictor for 'student's roles' dimension of pedagogical innovativeness. This predictor contributed 24.1 % (r = .491) of the changes of variance in the 'student's roles' dimension of the pedagogical innovativeness of subjects in this study [$F(1,245) = 77.687$, $p < .001$].

Table 4.47

Standardised Coefficients for ICCM as Predictor for Student's Roles

Model		Unstandardised Coefficients		Standardised coefficients	*T*	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.842	.673		7.190	.000
	ICCM Score	.070	.008	.491**	8.814	.000

Note: **Significant at $p < .001$

4.3.7.4 ICCM Score as a Predictor of Pedagogical Innovativeness for Dimension 4

Table 4.48 and Table 4.49 shows the results of stepwise linear regression of ICCM as a predictor on pedagogical innovativeness for dimension 4 ‘ICT Used’. The correlation between the predictor variable ICCM and criterion variable ‘ICT Used’ was .520. The R^2 value of .270 in Model 1 shows that 27% (r = .520) changes in the criterion variable were caused by changes in the predictor variable, the ICCM score.

Table 4.48

Variables Entered or Removed[a] for Linear Regression Analysis

Model	Variables Entered	Variables Removed	Method
1	ICCM Score		Enter

[a]Dependent Variable: Pedagogical innovativeness Dimension 4 (ICT Used)

Table 4.49

Model Summary of Regression Analysis

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.520[a]	.270	.267	2.147

a. Predictor: (Constant), ICCM Score

The result of the ANOVA test is presented in Table 4.50. The ICCM score is a significant predictor of pedagogical innovativeness for dimension 4 ‘ICT Used’. The ICCM score is a significant predictor to subjects’ pedagogical innovativeness for dimension 4 ‘ICT Used’, [F(1,246) = 91.025, p < .001].

Table 4.50

Result of One-Way ANOVA[b] for ICCM as Predictor on 'ICT Used'

Model		Sum of Squares	df	Mean Square	*F*	Sig.
1	Regression	419.684	1	419.684	91.025	.000[a]
	Residual	1134.216	246	4.611		
	Total	1553.899	247			

Note: *Significant at $p < .001$

a. Predictor: (Constant), ICCM Score
b. Dependent Variable: ICT Used

The Regression Model for 'ICT Used' derived from the result is:

ICT Used = .520 (ICCM Score)

Table 4.51 shows the standardised coefficient for ICCM score as a predictor on pedagogical innovativeness for dimension 4 'ICT Used'. The ICCM score (β=.520, p<.001) is a significant predictor for 'ICT Used' dimension of pedagogical innovativeness. This predictor contributed 27% (r=.520) of the changes of variance in the 'ICT Used' dimension of the pedagogical innovativeness of the subjects in this study [F(1,246)= 91.025, p<.001].

Table 4.51

Standardised Coefficients for ICCM as Predictor for ICT Used

Model		Unstandardised Coefficients		Standardised coefficients	*t*	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.737	.621		9.235	.000
	ICCM Score	.070	.007	.520**	9.541	.000

Note: **Significant at $p < .001$

4.3.7.5 ICCM Score as a Predictor of Pedagogical Innovativeness for Dimension 5

Table 4.52 and Table 4.53 show the results of stepwise linear regression of ICCM as a predictor on pedagogical innovativeness for dimension 5 ‘connectedness’. The correlation between the predictor variable ICCM and criterion variable ‘connectedness’ was .608. The R^2 value of .370 in Model 1 shows that 37 % (r = .608) changes in the criterion variable were caused by changes in the predictor variable, the ICCM score.

Table 4.52

Variables Entered or Removed[a] for Linear Regression Analysis

Model	Variables Entered	Variables Removed	Method
1	ICCM Score		Enter

[a]Dependent Variable: Pedagogical innovativeness Dimension 5 (connectedness)

Table 4.53

Model Summary of Regression Analysis

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.608[a]	.370	.367	2.532

a. Predictor: (Constant), ICCM Score

The result of the ANOVA test is presented in Table 4.54. The ICCM score is a significant predictor of pedagogical innovativeness for dimension 5 ‘connectedness. The ICCM score is a significant predictor to subjects’ pedagogical innovativeness for dimension 5 ‘connectedness’, [$F(1,246) = 144.241$, $p < .001$].

Table 4.54

Result of One-Way ANOVA[b] *for ICCM as a Predictor on 'Connectedness'*

Model		Sum of Squares	df	Mean Square	*F*	Sig.
1	Regression	924.601	1	924.601	144.241	.000[a]
	Residual	1576.883	246	6.410		
	Total	2501.484	247			

Note: *Significant at p<.001

a. Predictor: (Constant), ICCM Score
b. Dependent Variable: Connectedness

The Regression Model for 'Connectedness' derived from the result is:

Connectedness = .608 (ICCM Score)

Table 4.55 shows the standardised coefficient for ICCM score as a predictor on pedagogical innovativeness for dimension 5 'connectedness'. The ICCM score (β = .608, p < .001) is a significant predictor for 'connectedness' dimension of pedagogical innovativeness. This predictor contributed 37 % (r = .608) of the changes of variance in the 'connectedness' dimension of the pedagogical innovativeness of subjects in this study [F(1,246) = 144.241, p < .001].

Table 4.55

Standardised Coefficients for ICCM as a Predictor for Connectedness

Model		Unstandardised Coefficients		Standardised coefficients		
		B	Std. Error	Beta	*t*	Sig.
1	(Constant)	-.325	.733		-.444	.657
	ICCM Score	.103	.009	.608**	12.010	.000

Note: **Significant at p < .001

4.3.7.6 ICCM Score as a Predictor of Pedagogical Innovativeness for Dimension 6

Table 4.56 and Table 4.57 shows the results of stepwise linear regression of ICCM as a predictor on pedagogical innovativeness for dimension 6 ‘multiplicity of learning outcomes exhibited’. The correlation between the predictor variable ICCM and criterion variable ‘multiplicity of learning outcomes exhibited’’ was .521. The R^2 value of .271 in Model 1 shows that 27.1 % (r = .521) changes in the criterion variable were caused by changes in the predictor variable, the ICCM score.

Table 4.56

Variables Entered or Removed[a] for Linear Regression Analysis

Model	Variables Entered	Variables Removed	Method
1	ICCM Score		Enter

[a]Dependent Variable: Pedagogical innovativeness Dimension 3 (student’s roles)

Table 4.57

Model Summary of Regression Analysis

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.521[a]	.271	.268	2.501

a. Predictor: (Constant), ICCM Score

The result of the ANOVA test is presented in Table 4.58. The ICCM score is a significant predictor of pedagogical innovativeness for dimension 6 ‘multiplicity of learning outcomes exhibited’ [F(1,246) = 91.649, p < .001].

Table 4.58

Result of One-Way ANOVA[b] for ICCM as a Predictor on 'multiplicity of learning outcomes exhibited'

Model		Sum of Squares	df	Mean Square	*F*	Sig.
1	Regression	573.050	1	573.050	91.649	.000[a]
	Residual	1538.159	246	6.253		
	Total	2111.210	247			

Note: *Significant at $p < .001$

a. Predictor: (Constant), ICCM Score
b. Dependent Variable: multiplicity of learning outcomes exhibited

The Regression Model for 'multiplicity of learning outcomes exhibited' derived from the result is:

Multiplicity of learning outcomes exhibited= .521 (ICCM Score)

Table 4.59 shows the standardised coefficient for ICCM score as a predictor on pedagogical innovativeness for dimension 6 'multiplicity of learning outcomes exhibited'. The ICCM score (β = .520, $p < .001$) is a significant predictor for 'multiplicity of learning outcomes exhibited' dimension of pedagogical innovativeness. This predictor contributed 27.1 % (r = .521) of the changes of variance in the 'learning outcomes' dimension of the pedagogical innovativeness of subjects in this study [F(1,246) = 91.649, $p < .001$].

Table 4.59

Standardised Coefficients for ICCM as a Predictor for multiplicity of learning outcomes exhibited

Model		Unstandardised Coefficients		Standardised coefficients	*t*	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.299	.723		4.560	.000
	ICCM Score	.081	.009	.521**	9.573	.000

Note: **Significant at $p < .001$

4.3.7.7 Summary of ICCM Score as a Predictor for the Six Dimensions

Table 4.60 below shows the summary of the ICCM as predictors to pedagogical innovations by dimensions and total score of the six dimensions.

Table 4.60

Predictors' Regression Values for Pedagogical Innovations

Pedagogical Innovations	ICCM Regression value, R^2	Standardised Coefficient, β
Dimension 1 'learning objectives'	.164	.404
Dimension 2 'teacher's roles'	.207	.455
Dimension 3 'student's roles'	.241	.491
Dimension 4 'ICT used'	.270	.520
Dimension 5 'connectedness'	.370	.608
Dimension 6 'multiplicity of learning outcomes exhibited'	.271	.521
Total Score of Six Dimensions	.420	.650

In terms of dimensions, the ICCM is the best predictor for subjects' 'connectedness' for pedagogical innovations that explained 37 % (r = .608) of the variance in the findings. However, the total score of ICCM is a stronger predictor [$F(1, 246) = 467.1$, $p < .05$] that significantly explained 42 % of variance ($R^2 = .42$) for pedagogical innovations.

4.3.7.8 Correlational Analysis on Mediating Effects of Organisation and Faculty's Beliefs

In order to further examine the relationship between fidelity level of subject and the highest score of pedagogical innovation dimension, the effect of barriers was evaluated using regression analysis.

The first step in this analysis involved linear regression test for dependant variable "pedagogical innovativeness" and followed by the mean scores of the mediating variables "organisation and faculty's beliefs". Regression results of the test showed that the correlation between pedagogical innovativeness and the mediating variables at $r = .358$. R^2 value of .128 shows that up to 12.8% of the variance in subjects' pedagogical innovativeness was caused by changes in the mediating variables. When each of the ten barriers were examined further, it was revealed that only "Supportive plans and policies that form the strategy of technology integration within the faculty" was the only significant predictor, $\beta 1 = .295$ ($p < .050$) (Table 4.61). This means other nine barriers were not significant mediators for technology integration and pedagogical innovations.

Table 4.61

Regression Results of the Relationship between Pedagogical Innovativeness and Organisation and Faculty's Beliefs

Organisation and Faculty's Beliefs	*β*	*Sig.*
Support is always available among faculty members to integrate technology into pedagogical practices	.142	.151
Sufficient professional development for faculty members	.009	.923
Excellent infrastructure that supports students to use technology to learn	-.054	.562
Technology Integration is a valuable means for faculty members	.032	.716
Excellent Administrative support for faculty to facilitate technology integration	-.050	.624
Prominent technology leader that drives the initiative of technology integration	-.073	.507
Supportive plans and policies that form the strategy of technology integration within the faculty	.295*	.015
Sufficient time to implement technology integration projects	.075	.541
Support from external agencies	.121	.212
Strong support from the university top management	-.144	.147

Note: *significant at $p < .050$ level

Second step in this analysis involved linear regression test between "Supportive plans and policies that form the strategy of technology integration within the faculty" as dependant variable and technology integration practises as independent variable. Regression results show that there was moderate correlation at $r = .257$. R^2 value of

.066 shows that up to 6.6% of the presence of the barrier was caused by the technology integration fidelity of the subjects. The standardised coefficient of the relationship is significant at $\beta 2 = .314$ ($p < .05$).

In this study, using the multiple linear regression analysis, the relationship between the proposed mediating variables on the dependant and independent variables was examined. This analysis enabled researcher to further evaluate the effects of mediating variables in the population of study. It has been demonstrated that the presence of "Supportive plans and policies that form the strategy of technology integration within the faculty" or overcoming this barrier, will give a mediating effect (βM) as explained below:

$$\beta M = \beta 1 \text{ X } \beta 2 = .295 \text{ X } .314 = .093$$

The mediating effect of organisation and faculty's beliefs is smaller than the direct effect of technology integration (ICCM Scores) and pedagogical innovations, which has a β value (.65) greater than βM. Hence, 'organisation and faculty beliefs' is not a positive mediator of the independent and dependant variables in this study.

It was also showed that fidelity levels of technology integration practises has a significant linear relationship with "supportive plans and policies that form the strategy of technology integration within the faculty" [$F(2, 247) = 50.07$, $p < .05$], and the "ICT Used" dimension of pedagogical innovations [$F(2, 247) = 4.35$, $p < .05$].

4.3.8 Hierarchical Multiple Regression Analysis

Research question 8: Is the proposed model of technology integration practices based on ICCM score as a significant predictor to pedagogical innovativeness valid?

From the multiple linear regression analysis, the hierarchical multiple regression analysis was performed to further analyse the effects of the ten mediating variables on the relationship between the independent and dependant variables. In the "*stepwise*" method, “pedagogical innovativeness total score” was entered as the dependant variable. The ten mediating variables were then placed in the first “*block*” of independent variable, followed by the ICCM total score as next “*block*”. Hierarchical linear regression analysis had yielded the following results, as depicted in Tables 4.62 to 4.65. There were four models generated through the variables entered or removed as shown in Table 4.64.

Table 4.62

Variables Entered or Removed[a] for Hierarchical Linear Regression Analysis

Model	Variables Entered	Variables Removed	Method
1	Supportive plans and policies that form the strategy of technology integration within the faculty		Stepwise(Criteria: Probability-of-F-to-enter <=.50, Probability-of-F-to-remove >= .100)
2	Support from external agencies		Stepwise(Criteria: Probability-of-F-to-enter <=.50, Probability-of-F-to-remove >= .100)
3	Strong support from the university top management		Stepwise(Criteria: Probability-of-F-to-enter <=.50, Probability-of-F-to-remove >= .100)
4	Technology Integration Practices (ICCM Total Score)		Stepwise(Criteria: Probability-of-F-to-enter <=.50, Probability-of-F-to-remove >= .100)

Note: [a]Dependent Variable: Pedagogical innovativeness

Table 4.63 below shows the correlation between criterion variable “pedagogical innovativeness” and the four predictor variables from the regression analysis.

Table 4.63

Model Summary[e] of Regression Analysis

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.308[a]	.095	.093	11.146
2	.317[b]	.100	.098	11.119
3	.327[c]	.107	.103	11.088
4	.669[d]	.448	.445	8.724

Note:

a. Predictors: (Constant), Supportive plans and policies that form the strategy of technology integration within the faculty
b. Predictors: (Constant), Supportive plans and policies that form the strategy of technology integration within the faculty, Support from external agencies
c. Predictors: (Constant), Supportive plans and policies that form the strategy of technology integration within the faculty, Support from external agencies, Strong support from the university top management
d. Predictors: (Constant), Supportive plans and policies that form the strategy of technology integration within the faculty, Support from external agencies, Strong support from the university top management, Technology Integration Practices (ICCM Total Score)
e. Dependent Variable: Pedagogical Innovativeness

From Table 4.63, there are four significant predictors for pedagogical innovations. Three out of the ten organisation and faculty's beliefs mediating variables were found to be significant predictors. Model 1 shows the correlation between pedagogical innovativeness and "Supportive plans and policies that form the strategy of technology integration within the faculty" at r = .308. The R^2 value of .095 shows that 9.5 % of the variance in subjects' pedagogical innovativeness caused by "Supportive plans and policies that form the strategy of technology integration within the faculty".

Model 2 shows the correlation between pedagogical innovativeness and the combination of "Supportive plans and policies that form the strategy of technology integration within the faculty" and "Support from external agencies" at r = .317. The R^2 value of .100 shows that 10 % of the variance in subjects' pedagogical innovativeness was caused by "Supportive plans and policies that form the strategy of technology integration within the faculty" and "Support from external agencies".

Model 3 shows that the correlation between pedagogical innovativeness and the combination of “Supportive plans and policies that form the strategy of technology integration within the faculty”, “Support from external agencies” and “Strong support from the university top management” at $r = .327$. The R^2 value of .107 shows that 10.7 % of the variance in subjects’ pedagogical innovativeness was caused by “Supportive plans and policies that form the strategy of technology integration within the faculty”, “Support from external agencies” and “Strong support from the university top management”.

Model 4 shows that the correlation between pedagogical innovativeness and the combination of “Supportive plans and policies that form the strategy of technology integration within the faculty”, “Support from external agencies”, “Strong support from the university top management” and “Technology Integration Practices (ICCM Total Score)” at $r = .669$. R^2 value of .448 shows that 44.8 % of the variance in subjects’ pedagogical innovativeness was caused by “Supportive plans and policies that form the strategy of technology integration within the faculty”, “Support from external agencies”, “Strong support from the university top management” and “Technology Integration Practices (ICCM Total Score)”.

Table 4.64

ANOVA[e] Results of the Five Models for Regression Analysis

Model		Sum of Squares	*df*	Mean square	*F*	*Sig.*
1	Regression	8312.4	1	8312.4	66.9	.000[a]
	Residual	79379.6	247	124.2		
	Total	87692.0	248			
2	Regression	8810.8	2	4405.4	35.6	.000[b]
	Residual	78881.2	246	123.6		
	Total	87692.0	248			
3	Regression	9380.2	3	3126.7	25.4	.000[c]
	Residual	78311.9	245	122.9		
	Total	87692.1	248			
4	Regression	39292.6	4	9823.2	129.1	.000[d]
	Residual	48399.4	244	76.1		
	Total	87692.0	248			

Note:

a. Predictors: (Constant), Supportive plans and policies that form the strategy of technology integration within the faculty
b. Predictors: (Constant), Supportive plans and policies that form the strategy of technology integration within the faculty, Support from external agencies
c. Predictors: (Constant), Supportive plans and policies that form the strategy of technology integration within the faculty, Support from external agencies, Strong support from the university top management
d. Predictors: (Constant), Supportive plans and policies that form the strategy of technology integration within the faculty, Support from external agencies, Strong support from the university top management, Technology Integration Practices (ICCM Total Score)
e. Dependent Variable: Pedagogical Innovativeness

The ANOVA results show that there are significant effects between the four predictor variables and the criterion variable “pedagogical innovativeness” at $p < .001$ level. For “Supportive plans and policies that form the strategy of technology integration within the faculty”, the result is significant [F(1, 247) = 66.9, $p < .001$]. The ANOVA result for combination of “Supportive plans and policies that form the strategy of technology integration within the faculty” and “Support from external agencies” is significant [F(2, 246) = 35.6, $p < .001$]. The ANOVA result for the combination of “Supportive plans and policies that form the strategy of technology integration within the faculty”, “Support from external agencies” and “Strong support from the university top management” is significant [F(3, 245) = 25.4, $p < .001$].

ANOVA result for the combination of "Supportive plans and policies that form the strategy of technology integration within the faculty", "Support from external agencies", "Strong support from the university top management" and "Technology Integration Practices (ICCM Total Score)" is significant [$F(4, 244) = 129.1$, $p < .000$].

The results of the hierarchical multiple regression analysis show that technology integration practices (ICCM Total Score) predicted 44.8 % ($R^2 = .448$) of the variance in subjects' pedagogical innovativeness. This further explains that technology integration practices (ICCM Total Score) ($\beta = .61$, $p < .001$) is the main predictor in subjects' pedagogical innovativeness. Only one mediating variable, "supportive plans and policies that form the strategy of technology integration within the faculty" ($\beta = .17$, $p < .001$) was significantly accounted for the variance in subjects' pedagogical innovativeness in this study [$F(2,246) = 129.1$, $p < .001$].

The regression model could be represented as below:

Pedagogical Innovativeness=	.61[technology integration practices (ICCM Total Score)] + .17(supportive plans and policies that form the strategy of technology integration within the faculty)

Table 4.65

Coefficient[a] Values for the Regression Analysis

Model		Unstandardised Coefficients B	Std. Error	Standardised coefficients Beta	*t*	Sig.
1	(Constant)	53.0	1.53		34.65	.000
	Supportive plans and policies that form the strategy of technology integration within the faculty	3.50		.31**	8.18	.000
2	(Constant)	52.05	1.60		32.53	.000
	Supportive plans and policies that form the strategy of technology integration within the faculty	2.74	.57	.24**	4.81	.000
	Support from external agencies	1.14	.57	.10*	2.01	.05
3	(Constant)	53.68	1.77		30.40	.000
	Supportive plans and policies that form the strategy of technology integration within the faculty	3.33	6.30	.30**	5.28	.000
	Support from external agencies	1.54	.60	.14*	2.58	.010
	Strong support from the university top management	-1.32	.61	-.11*	-2.15	.032
4	(Constant)	24.24	2.03		11.92	.000
	Supportive plans and policies that form the strategy of technology integration within the faculty	1.92	.50	.17**	3.84	.000
	Support from external agencies	.74	.47	.07	1.58	.114
	Strong support from the university top management	-.93	.48	-.08	-1.94	.053
	Technology Integration Practices (ICCM Total Score)	.409	.02	.61**	19.83	.000

Note: [a] Dependent variable: Pedagogical innovativeness, *significant at $p < .50$ level, **significant at $p < .001$ level.

4.4 Summary

This chapter presents the findings from the data collected from the demographic characteristics of the 248 subjects from six selected HEIs in this survey. All subjects' demographic variables were not found to be statistically significant as moderators in the relationship between the dependant and independent variables in this study.

Research question one examined the technology integration practices of subjects based on the ICCM instrument at low (25-49), medium (50-74) and high (75-125) fidelity levels. Subjects (N = 248) t-test yielded mean total score of 82.97 (SD=18.70) was statistically significant from 75, t (247) = 69.87, p < .001. There was no difference in response rate for both modes of questionnaire.

Research question two examined the relationship between technology integration practices and demographic variables. It was found that none of the demographic variables were statistically significant in influencing the technology integration practices of subjects. Therefore, demographic variables as moderating variables could not be established.

Research question three looked into the relationship between technology integration practices and organisation and faculty's beliefs. It was found that all the ten variables were significant mediating variables exerting positive mediating effects on technology integration practices with r values greater than 0.

Research question four examined the pedagogical innovations profiles of subjects based on their total score of the 18-item instrument. The mean score of this instrument is 63.47 (SD = 12.19).

Research question five evaluated the relationship between pedagogical innovativeness and demographic variables. Again, demographic variables were not statistically significant in influencing the pedagogical innovativeness of the subjects. None of the demographic variables were statistically significant in influencing the technology integration practices of subjects. Therefore, demographic variables as moderating variables could not be established.

Research question six examined the relationship between pedagogical innovativeness and the ten organisation and faculty's beliefs. The ten variables were significantly correlated to subjects' pedagogical innovativeness. It was found that all the ten variables were significantly correlated to pedagogical innovativeness with *r* values greater than 0.

Research question seven and eight further explored the relationship between the technology integration practices as independent variable and pedagogical innovativeness as the dependant variable.

Research question seven examined the prediction strength of technology integration practices on pedagogical innovativeness was performed using multiple linear regression analysis. Technology integration practices based on the ICCM score of the 25-item instrument [$F(1, 247) = 467.1$, $p < .05$] significantly explained 42 % of variance ($R^2 = .42$) in the pedagogical innovativeness of the subjects. This means technology integration practices based on the ICCM score of the 25-items instrument ($\beta = .65$, $p < .05$) is the main predictor for subjects' pedagogical innovativeness. Organisation and faculty's beliefs is not a significant mediator of the technology integration and pedagogical innovations, except for "Supportive plans and policies that form the strategy of technology integration within the faculty".

Research question eight further explored the validity of the model proposed in this study. When mediating variables were taken into the hierarchical multiple regression analysis, it was found that the predictive significance of technology integration on pedagogical innovativeness was at 44.8% ($R^2 = .448$) at $\beta = .61$ ($p < .001$), together with one mediating variable "supportive plans and policies that form the strategy of technology integration within the faculty" ($\beta = .17$, $p < .001$) was significantly accounted for the variance in subjects' pedagogical innovativeness in this study [$F(2,246) = 129.1$, $p < .001$]. A relationship model was proposed based on this analysis.

CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the Study

This study on technology integration practices and pedagogical innovations in HEIs is premised on the Roger's (1995) theory of diffusion and the Hall and Hord's (2001) Concern-Based Acceptance Model (CBAM) theoretical framework. There is a plethora of contradictory findings on technology integration practices and pedagogical innovations.

This study first attempted to evaluate the fidelity level of technology integration among the HEIs that are granted Tier 5 status in Malaysia due to excellence in teaching and learning at the undergraduate level. The influence of subjects' demographic characteristics was also examined to further determine if subjects' fidelity level of technology integration practices is related to their faculty discipline, gender, age group, teaching experience, highest level of academic qualification attained and academic position held. The correlation between organisation and faculty's beliefs as barriers and technology integration practices was also examined.

Pedagogical innovations were interpreted through the levels of pedagogical innovativeness adapted from the SITES-M2 six dimensions framework. The profiles of pedagogical innovativeness among the HEIs subjects were also presented from the SITES Ms six dimensions framework. The influence of subjects' demographic characteristics on pedagogical innovativeness was also examined. The correlation between organisation and faculty's beliefs as barriers and pedagogical innovations was also examined.

The convergence of the two main variables of study, the technology integration practices and pedagogical innovations was evaluated for the presence of significant relationship through regression analysis. The significant prediction power of the technology integration practices for pedagogical innovations was the epitome of this study.

This research adopted a correlational design where quantitative data were collected using a simple random sampling survey method. Empirical data from 248 subjects working as fulltime academic staff was collected, compiled, coded and analysed using SPSS software.

Data for demographic characteristics was collected by six indicators: (a) faculty discipline, (b) gender, (c) age group, (d) teaching experience, (e) highest level of academic qualification attained, and (f) academic position held. The six questions formed Section A of the questionnaire.

The independent variable in this study was technology integration practices adapted from the ICCM instrument developed by Javeri and Persichitte (2007). This instrument has six components: (a) faculty demonstrate a sound or in-depth understanding of the technology operations and concepts, (b) faculty integration technology in planning and designing environments and experiences, (c) faculty integrate technology in the planning of the curriculum, (d) faculty integration technology in evaluation and assessment, (e) faculty integration technology to enhance their productivity and professional practice, (f) faculty understand the social, ethical, legal and human issues surrounding the use of technology. Data for the independent variable was collected using a 25-item instrument embedded in the questionnaire as part A.

The dependant variable in this study was pedagogical innovations adapted from the SITES-M2 six dimension framework. The six dimensions are: learning outcomes, teacher's roles, student's roles, ICT used, connectedness and multiplicity of outcomes exhibited. Data for dependant variable was collected using an 18-item instrument embedded in the questionnaire of this study as part C.

The presence of barriers that influenced the profiles of technology integration practices and pedagogical innovations was ascertained through the 10-item instrument embedded as part D of the questionnaire of the study.

A range of statistical analyses were employed to further understand the data collected in this study. These included descriptive statistics, *t*-test, univariate analysis, one-way ANOVA test, Pearson correlations, general linear stepwise multiple regression, and hierarchical linear multiple regression. The data collected was analysed and presented in chapter four.

The findings from this study are consistent with some previous research findings and reports in certain aspects of the study but contradictory to some. It has also further highlighted the paucity of data on current state of understanding and information pertaining to technology integration and pedagogical innovations. The findings in this study are unique to the subjects of the study at the time of data collection, the organisational culture and various environmental contexts. Therefore, conclusions and comparison of the research findings should be interpreted taking into consideration the methodologies and background of the study.

5.2 Summary of the Major Findings

There were 611 subjects identified in this study and 40.6 % of the subjects responded to the survey questionnaire. Online mode of questionnaire was not found to increase response rate among all the subjects targeted in this study. The major findings of this study are summarised as follows:

5.2.1 Research question 1: What are the fidelity profiles of technology integration practices among the subjects of this study?

The subjects (N = 248) in this study had an average technology integration practices score that is significantly higher than the cut-off value of 75 and the t-test yielded mean total score of 82.97 (SD = 18.70) which was statistically significant from the minimum cut-off value for high fidelity of 75, t (247) = 69.87, $p < .001$. As much as 65.7 % of the subjects had high fidelity (75 to 125) in technology integration practices as faculty of HEIs among the six HEIs. Nearly one-third of the subjects had medium fidelity in their technology integration practices (30.6 %). Surprisingly though only a small group of subjects were found to be of low fidelity (3.6 %). All of the subjects with low fidelity levels were academic staff at public HEIs. However, when subjects' fidelity levels were analysed by their HEIs ownership, there was no significant difference between the public and private subjects [$F(1,246) = .001$, $p > .05$].

5.2.2 Research question 2: Is there a significant relationship between technology integration practices and demographic characteristics?

From the results of univariate analyses, it was found that among the 248 subjects of this study, all the demographic variables do not have any significant effect on subjects' technology integration practices fidelity ($p > .05$).

5.2.3 Research question 3: Is there a significant relationship between technology integration practices and organisation and faculty's beliefs?

All the ten variables were significant mediating variables exerting positive mediating effects on technology integration practices with r values between .144 and .265 ($p <$ .05). However, this is a mild correlation according to Chua (2009) for r values between .01 and .30.

5.2.4 Research question 4: What are the profiles of pedagogical innovativeness among the HEIs subjects?

The mean score of this study was 63.47 (*SD* = 12.19) out of the total score of 90 based on the 18-item SITES-M2 instrument. The mean score in this study revealed that the subjects' pedagogical innovation profile was actually more than emergent (minimum score of 54) but not yet innovative (minimum score of 72).

Interestingly, the public universities, namely HEI A, HEI B and HEI C have higher than the mean score of the population sampled in this study. The total score of private universities, namely HEI D and HEI E are lower than their counterparts. Although HEI F subjects had the highest mean value of pedagogical innovativeness, due to the limited number of subjects (*n* = 11) it cannot be deduced that subjects of HEI F were pedagogically more innovative than the rest of the HEIs.

The specific pedagogical innovations profiles by HEIs and ownership of HEI (public and private HEIs) were presented in radar diagrams to provide a simple overview of comparisons. The subjects in this study had the highest mean value for the "learning objectives" dimension (*M* = 12.38, *SD* = 2.17). This is followed by the "ICT used" dimension (*M* = 11.52, *SD* = 2.51). The dimension "teachers' roles" (*M* = 10.65, *SD* = 2.81) had slightly higher mean value than "students' roles" (*M* = 10.63, *SD* = 2.66). "multiplicity of learning outcomes" had mean value of 10.06 (*SD* = 2.92) while the "connectedness" dimension had the lowest mean value (*M* = 8.26, *SD* = 3.18).

When the 248 subjects were grouped according to their HEIs' ownership, the three dimensions of pedagogical innovation profiles were significantly different between the two groups. The public HEIs subjects consistently had significantly higher means for "learning objectives" [$F(1,246) = 4.49$, $p < .05$], "student's roles" [$F(1,246)$

= 8.42, $p < .05$], whereas private HEIs subjects had higher mean for "connectedness" [$F(1,246) = 5.34$, $p < .05$].

5.2.5 Research question 5: Is there a significant relationship between pedagogical innovation profiles and demographic variables?

Demographic variables were not statistically significant in influencing the pedagogical innovativeness profiles of the subjects in this study ($p > .05$). None of the demographic variables were statistically significant in influencing the pedagogical innovativeness of the subjects. Therefore, the moderating effects of demographic variables on subjects' pedagogical innovativeness could not be established.

In-depth analyses to examine the relationship of each of the six dimensions of pedagogical innovation profiles revealed that for the dimension of 'learning objectives', 'age group' [$F(4,243) = 2.645$, $p <.05$] and 'academic position' [$F(6,241) = 2.157$, $p < .05$] are statistically significant mediators. However, the effect size of the two demographic variables is very small, 4.2 % and 5.1 % respectively. For the dimension of 'ICT used', only the 'academic position' of subjects is significant, [$F(6,241) = 2.294$, $p < .05$] with very small effect size at 5.4 %. For the dimensions of 'teacher's roles', 'student's roles', 'connectedness', and 'multiplicity of learning outcomes exhibited', none of the six demographic variables has significant effect on subjects' pedagogical innovativeness.

5.2.6 Research question 6: Is there a significant relationship between pedagogical innovativeness profile and organisation and faculty's beliefs?

The ten variables were significant mediating variables for subjects' pedagogical innovativeness. It was found that all the ten variables were significant mediating variables exerting positive mediating effects on pedagogical innovativeness with r

values greater than 0. By controlling the demographic variables, there was a significantly weak positive correlation between pedagogical innovativeness and the ten mediating variables identified in this study (*r* values were ranging from .163 to .331, $p < .05$).

The variable "technology integration is a valuable means for faculty members' ($r = .279$, $p < .001$) is the strongest correlation variable for the 'learning objectives' dimension of pedagogical innovations.

The variable "supportive plans and policies that form the strategy of technology integration within the faculty" ($r = .236$, $p < .001$) is the strongest correlation variable for 'teacher's roles' dimension of pedagogical innovations.

The variable "sufficient time to implement technology integration projects' has the highest correlation ($r = .267$, $p < .001$) for 'student's roles' dimension of pedagogical innovations.

The variable 'technology integration is a valuable means for faculty members' has the highest correlation ($r = .177$, $p < .05$) to the 'ICT used' dimension of pedagogical innovations.

The variable "supportive plans and policies that form the strategy of technology integration within the faculty' has the highest correlation ($r = .317$, $p < .001$) to the 'connectedness' dimension of pedagogical innovations.

The variable "supportive plans and policies that form the strategy of technology integration within the faculty' has the highest correlation ($r = .268$, $p < .001$) for the 'multiplicity of learning outcomes exhibited' dimension of the pedagogical innovations.

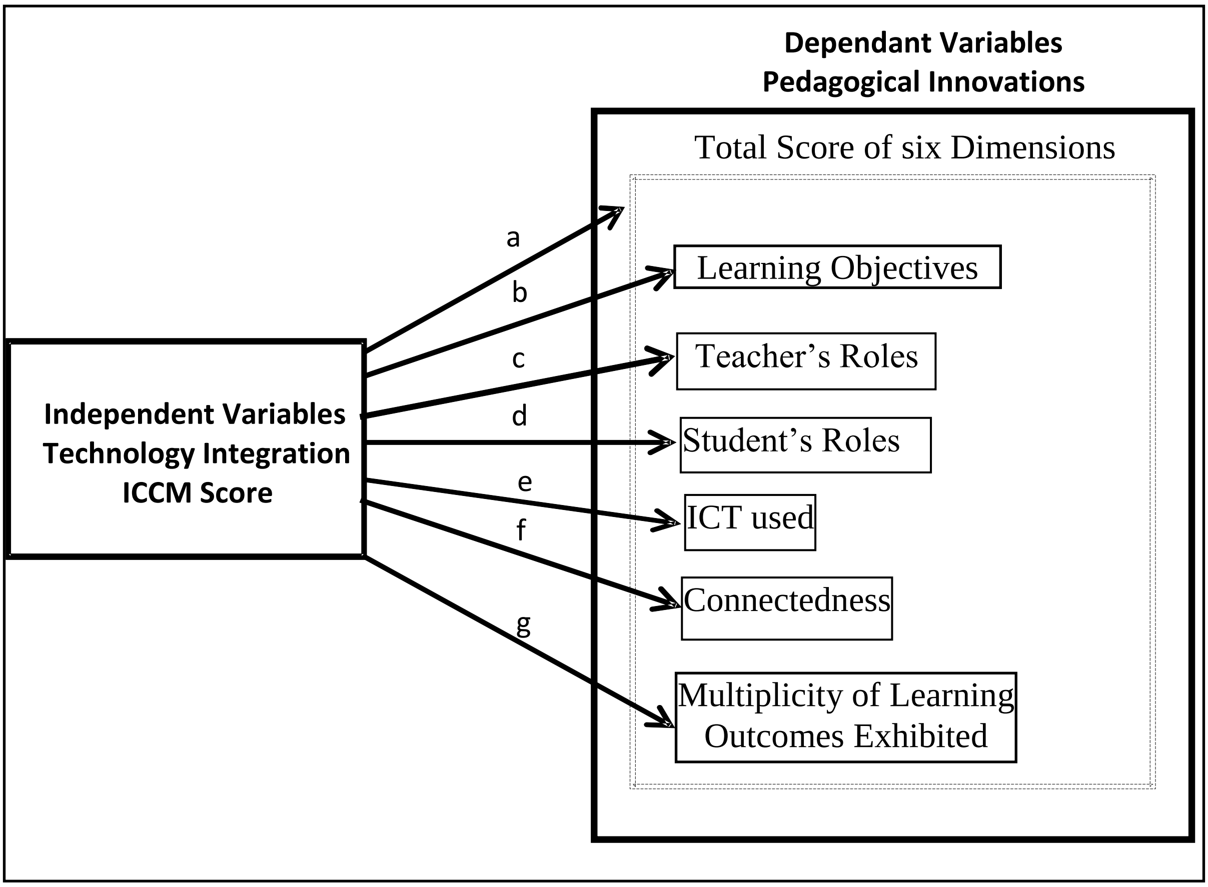
5.2.7 Research question 7: Is technology integration practices based on ICCM score a significant predictor to pedagogical innovativeness?

Technology integration practices based on the ICCM score of the 25-item instrument [$F(1, 246) = 467.1$, $p < .05$] significantly explained 42 % of variance ($R^2 = .420$) in the pedagogical innovativeness of the subjects at $r = .648$. This means technology integration practices based on the ICCM score of the 25-item instrument ($\beta = .65$, $p < .05$) is the main predictor for subjects' pedagogical innovativeness. The combination of the four dimensions of the technology integration practices, 'faculty integrate technology in evaluation and assessment' ($\beta = .23$, $p < .05$), 'faculty understand the social, ethical, legal, and human issues surrounding the use of technology and apply that understanding in practice' ($\beta = .23$, $p < .05$), 'faculty integrate technology to enhance their productivity and professional practice' ($\beta = -.21$, $p <.05$), and 'faculty integrate technology in planning and designing learning environments and experiences' ($\beta = -.17$, $p < .05$) only adds (46.2 % - 44.0 %) 2.2 % to the variance (R^2 of .462) of pedagogical innovativeness [$F(5,243) = 110.3$, $p < .05$].

Regression analysis on the mediating effects of the proposed ten organisation and faculty's beliefs as barriers showed that they do not enhance the direct relationship between technology integration practises and pedagogical innovations. "Supportive plans and policies that form the strategy of technology integration within the faculty" is a significant mediator but small predicting value of $\beta = .093$ ($p < .050$).

Fidelity level of a faculty member has a direct effect on the associated pedagogical practises in how he/she uses ICT in teaching and learning.

The linear regression model for ICCM and pedagogical innovations is presented as follow:



Note.

a. R^2 = .420 (42 %)
b. R^2 = .164 (16.4 %)
c. R^2 = .207 (20.7 %)
d. R^2 = .241 (24.1 %)
e. R^2 = .270 (27 %)
f. R^2 = .370 (37 %)
g. R^2 = .271 (27.1%)

Figure 5.1 Summary of ICCM as Predictors to Pedagogical Innovations

5.2.8 Research question 8: Is the proposed model of technology integration practices based on ICCM score as a significant predictor to pedagogical innovativeness valid?

When mediating variables were taken into the hierarchical multiple regression analysis, it was found that the predictive significance of technology integration on pedagogical innovativeness was at 44.8 % ($R^2 = .448$) at $\beta = .61$ ($p < .001$), together with one mediating variable "supportive plans and policies that form the strategy of technology integration within the faculty" [$F(2,246) = 129.1$, $p < .001$] significantly accounted for the variance in subjects' pedagogical innovativeness in this study ($\beta = .17$, $p < .001$) at $r = .308$. R^2 value of .095 shows that additional 9.5 % of the variance in subjects' pedagogical innovativeness caused by "Supportive plans and policies that form the strategy of technology integration within the faculty". A relationship model was proposed based on this analysis. The correlations model could be represented as below:

Pedagogical Innovativeness= .61[technology integration practices (ICCM Total Score)]
+ .17(supportive plans and policies that form the strategy of technology integration within the faculty)

5.3 Discussion

This section presents the discussion on technology integration and its relationship with pedagogical innovations and the associated effects of demographic variables and organisation and faculty's beliefs. The relationship among the four main variables of the study is also discussed. The strength of the conceptual framework in this study is reviewed and discussed.

5.3.1 Technology Integration Practices

In this study, ICCM was used as the instrument to measure the subject's technology integration fidelity levels. There were 25 items in this ICCM instrument. Each of the technology integration implementation components comprised of five variations of implementation fidelity. The highest fidelity of implementation was assigned a value of 5 and the lowest as 1, along the ICCM continuum. This ICCM has total score ranges from 25 to 125 and numeric coding decisions were made to allow for analysis of integration fidelity. For every ten subjects in this study population, more than six had high fidelity levels of technology integration with a minimum total score of 75. The population was also found to have high mean total score of 82.97 (SD = 18.70) which was significantly higher from 75, [t (247) = 69.87, $p < .001$].

The percentage of faculty members with high fidelity score (65.7 %) was higher than Javeri and Persichitte's (2007) finding of 56.7 %. One-third of the subjects had medium fidelity in their technology integration practices (30.6 %). There was a small group of subjects with low fidelity (3.6 %). All of the subjects with low fidelity were actually from public HEIs. Among the three public HEIs, there was a stark difference in subjects' response to data collection. HEI A had higher response of online questionnaire, HEI B had almost the same response rate for both paper and online questionnaire, whereas HEI C had eighty percent of subjects chose paper mode.

The public HEIs have an average establishment history of close to 50 years and the challenges faced in breaking the legacy of traditional pedagogical beliefs seems to be evident. Thus, the assumption that the underlying pedagogical beliefs exert an influence in a faculty member's choice and use of technology may be relevant in the context of public HEIs in Malaysia (Ertmer, 1999, Owston, 2007). On the contrary, the results for the group of private HEIs, with an average establishment history of 10 years, showed that none of the subjects had a low fidelity for technology integration practices.

The private HEIs were set up with clear goals as higher education demand absorbing institutions. Technology integration practices are vital as it is an effective strategy to enhance the quality of the teaching and learning process. Among the public HEIs, much effort has been dedicated to strengthen research, teaching and infrastructure. Consequently, some faculty members remained as ‘digital migrants’(Prensky, 2001). This finding has highlighted the dilemma of education institutions where computers are “oversold and underused” and as a result, failed to bring changes in the education goals pursuits (Cuban, 2001). In this study, it is worth stressing that public HEIs might have different priorities in innovative pedagogical practices through technology integration. The higher means for pedagogical innovation dimensions of “teacher’s roles” and “student’s roles” could explain the current best practises of public HEIs. However, it is also important to highlight that in the context of the study, most public funded HEIs set a higher priority for research rather than teaching. On the other hand, teaching is the core business of most privately funded HEIs.

This finding nevertheless can be explained by Roger’s (1995) diffusion theory who stressed that technology integration will grow over time. The public HEIs in Malaysia have started to adopt technology widely only in recent years as opposed to the private HEIs who are much younger in establishment. Technological advancement and change in public HEIs with a long history of tradition and establishment pose challenges not only to faculty members, but more so to the institutional leaders (Mehra & Monika, 2007).

The higher than minimum score of 75, has highlighted that in general, the faculty members of HEIs in Malaysia have mastered strong ICT skills and they are very comfortable with communication as they use various types of ICTs in their daily lives. The strong relationship among fidelity level and supportive plans and policies, and associated ICT used shows that more training should be provided to enhance the ICT skills of those with medium and low levels of fidelity.

5.3.2 Technology Integration Practices and Demographic Characteristics

This study revealed further that faculty discipline, gender, age group, teaching experience, highest level of academic qualification attained, and academic positions were not significant moderators to the subject's technology integration fidelity levels. This is actually contradicting to the previous findings (Lu, Tie, & Chua, 2013; Mehra & Monika, 2007).

5.3.3 Technology Integration Practices and Organisation and Faculty's Beliefs

Ertmer (1999) classified the barriers into first-order and second-order barriers to describe the external and internal barriers to teacher technology integration. First-order barriers are those that are the obstacles related to issues of adequate access to the technologies, training, and support during technology integration. Overcoming these first-order barriers does not necessarily indicate that technology integration will be successful and followed by the effective and innovative use of the technology.

Second-order barriers are those that are embedded in a teacher's philosophy of teaching and learning, which are more hidden and deeply rooted in daily practice (Ertmer 1999, 2005). These include a lack of vision or rationale for technology use, lack of relevance to the curriculum, and incompatibility with pedagogical practices.

In order for HEIs to maximise the return of benefits of technology integration, they need to focus on ramping up effort on addressing the first and second order barriers of technology integration.

The faculty members need better peer support so as to overcome their personal challenges in integrating technology effectively and for teaching and learning purposes.

HEIs should prioritise on wider engagement of faculty members as education technology enablers through dedicated and customised training for faculty members and should encourage faculty members to integrate technology into every aspect of their lives, not just teaching.

Most of the subjects in this study belonged to the age categories above 40 years old (52 %) and 72 % of the subjects have more than 5 years of working experience in HEIs. HEIs should develop and implement longitudinal plans in ensuring that their effort in integration technology will achieve better fruition with more strategically designed technology-related training for their faculty members. HEIs should cultivate the culture of "group practice" among faculty members so that they are aware of the expectations and support provided by the universities in embracing pedagogical innovations (Rogers, 1995).

All the six HEIs in this study have impressive campuses that house the best of teaching facilities and all are research-intensive HEIs. The faculty members perhaps do not think that the excellent infrastructure at these HEIs is helping much in addressing their students' learning. This could be due to the fact that faculty members were given the best in-house infrastructure but they were frustrated with their students' inability to cope with their own understanding and the actual values of integrating technology into their pedagogical practices. This finding actually points out that faculty members' perception and their fidelity levels in technology practices do not match their perceived students' learning efficacy (Law et al., 2008). This further highlighted the second order barrier where the underlying personal beliefs and psychology actually most influenced how faculty members perceive the values of integrating technology for pedagogical innovations (Ertmer, 1999). This could be that students actually expect the faculty members to engage them differently from what the HEIs are doing. Some HEIs are indeed too slow in implementing technology integration plans to ensure that most faculty members (digital immigrants) are at *par* with the students (digital natives) as highlighted by Prensky (2001) and Cuban (2001).

5.3.4 Pedagogical Innovations

The mean score of pedagogical innovativeness of the population of study is 63.47 which is interpreted as more than “emergent” (minimum score of 54) but not yet “innovative” (minimum score of 72). The pedagogical innovation profiles of the subjects in this study show that the population of study has barely reached the ‘innovative’ level. Subjects of this study had high scores of innovation on learning objectives and ICT used but lowest in connectedness. The lowest score dimension had led to the overall ‘lower than innovative’ profile. Subjects in this study had high ICT skills but not in using ICT to connect with external environment of learning. This asserts that the HEIs need to critically evaluate how to leverage technology to elicit pedagogical innovations. This could be embraced through further educational technology development in the areas of having more supportive plan and strategies to engage faculty members to use technology effectively, matching curriculum with the right ICT tools and engaging external experts in collaborative learning. Pedagogical innovation will lead to a highly innovative society that is formed by an innovative work force that is highly competitive in the global economy. Pedagogical innovation is a key enabler to student-centred and pragmatic learning where students will no longer need to feel left out in the traditional didactic learning.

The public HEIs were more innovative than the private HEIs in two of the six dimensions: teacher’s roles and student’s roles. The private HEIs had higher innovation in “connectedness”. The higher pedagogical innovations for teacher’s roles and student’s roles among the public HEIs could be due to the institutional and academic governance as all the public HEIs in this study had an average establishment history of 49.3 years. In addition to that, their research as core activities would have contributed to the higher pedagogical mastery among the faculty members. Research activities in the HEIs could have enhanced the pedagogical beliefs and practices by faculty members. This shows that faculty members at public HEIs have clear and well defined teacher's and student's roles when they teach their students.

The private HEIs had an average institution establishment history of 10.3 years which could have added some autonomy in faculty members to widely engage with external stakeholder such as professionals and academic experts to enhance their pedagogical practises in classrooms. Technology integration of high fidelity among the private HEIs could be best exemplified through their classrooms' connectedness with external environment to the HEIs. Exposing students to external learning environment will enhance student's critical thinking, inquiry and communication skills. Hence, the pragmatic and constructivist approach of pedagogical practices appear to be the guiding principle in designing curriculum that is delivered through technology integration at the public HEIs in Malaysia (Biggs, 2003). Nevertheless, HEIs and faculty members should always endeavour to be the content experts in their fields of research and teaching through an environment of learning that is collaborative and connected to the external experts.

It is important to note that technology integration practises and choices of technology medium such as online learning management systems should be designed carefully to match and deliver the intended learning goals of curriculum (Ertmer, 1999). Faculty members should be familiar with characteristics of pedagogical innovations such as outlined by the SITES-M2 six dimensions as a guide to their teaching and learning planning.

5.3.5 Pedagogical Innovations and Demographic Characteristics

Consistent with technology integration practices, demographic variables' were not proven to have a significant effect on the subjects' pedagogical innovativeness. However, when analysed according to the six dimensions of pedagogical innovations, there was a weak correlation for two dimensions: learning objectives and ICT used. For the learning objectives dimension, the two significant demographic variables were subject's age and academic position held. For the dimension of ICT used, only the academic position held by subjects was significant. All the variables were exerting on average less than 5 % effects on subjects' pedagogical innovativeness.

5.3.6 Pedagogical Innovations and Organisation and Faculty's Beliefs

By controlling the demographic variables, there was a significantly mild positive correlation between pedagogical innovativeness and the ten mediating variables identified in this study (*r* values were ranging from .163 to .331, $p < .05$). These findings concur with earlier reports on the barriers faced by faculty members in technology integration (Ertmer, 1999; Owston, 2007). When the total score of the pedagogical innovations was used, the variable supportive plans and policies that form the strategy of technology integration within the faculty was found to be the highest correlation factor though mildly positive. This shows that in the population of study, the environment of the HEIs present a greater barrier to the pedagogical innovations of faculty members than their own underlying pedagogical beliefs. In other words, faculty members are ready to embrace innovative pedagogical practices and what is lacking is perceived to be a clear set of guidelines, policies and plan that will ensure systematic implementation of technology integration within HEIs and among the faculty members. In Malaysia, the ministry of higher education has set out clear plan through the national higher education strategic plan 2007-2020 that technology has been earmarked as an enabler to widen access and enhance pedagogical practises (MoHE, 2007). HEIs leadership should also engage their respective leaders at the faculty level to ensure that the ICT infrastructure is developed according to the needs of the faculty. The common practice of adopting the most popular commercial ICT tools without faculty involvement will inevitably dampen the spirit of some faculty leaders in delivering the most innovative learning experience among their digital native students (Bennett, Bishop, Dalgarno, Kennedy, & Waycott, 2012).

5.3.7 Technology Integration Practices as Predictor for Pedagogical Innovations

The ICCM total score is found to be a stronger predictor of pedagogical innovativeness, compared to the various dimensions of ICCM instrument. This finding concurs with earlier findings that this instrument gives a more accurate technology integration profile of individuals or groups of learners compared to administering the instrument by six separate dimensions (Javeri & Persichitte, 2007).

The hierarchical regression model derived from the data of this study is illustrated in Figure 5.2. Technology integration practices of faculty members contributed 44.8% of innovative pedagogical practices based on the findings of this study. When there are supportive plans and policies that promote technology integration within the faculty, the positive effects of technology integration will be further enhanced by another 9.5%. Hence, combining the two, the total contribution will be 54.3%.

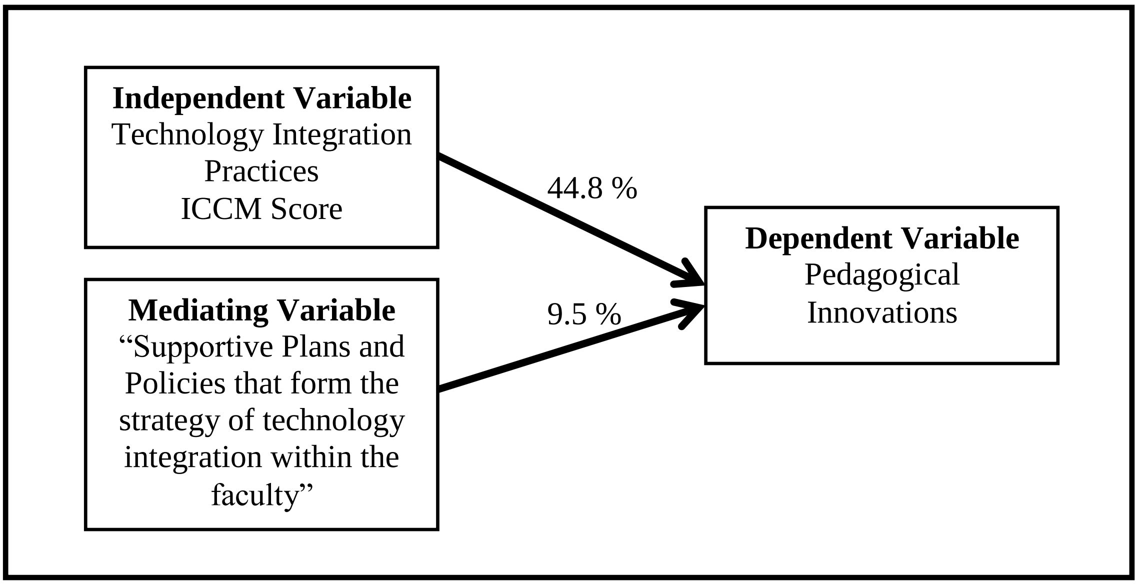


Figure 5. 2 Summary of Predictors for the study

5.4 Conclusion

All the HEIs selected in this study are excellent in their teaching and learning at the undergraduate level based on the SETARA 2011 rating report. The ICCM instrument scores pointed out that there is close to a third of the faculty members who did not meet the high fidelity level in their technology integration practices. The effort to integrate technology into every aspect of curriculum design, planning and delivery of HEIs should be continued to achieve higher success level or to reach complete saturation level. From the Roger's innovation diffusion theoretical perspective, technology integration as a form of innovation in HEIs will require continuous effort to convert the 'laggards' to be innovation users. Hence, training should be provided to address 'technophobia' among faculty members as well as there should be some form of incentive to encourage faculty members to master ICT skills for teaching and learning.

Although most Malaysian public HEIs focus on research and postgraduate teaching as the main core activities, faculty members' competency in using technology should not be viewed as a less critical agenda. Faculty staff development ought to be planned carefully. From the perspective of e-learning development status, trends and challenges in Malaysia, this study highlighted the urgency of ministry of higher education to formalise the proposed national policy on technology integration such as e-learning to guide all HEIs (Amin Embi, 2011). It was reported in 2011 that there is only 38.5% of HEIs had technology integration policies and the ministry of higher education was called to set a clear national policy on e-learning.

Technology integration is about using technology in a manner that enhances teacher's teaching and student's learning. Technology integration is not limited to using software but rather how the software and hardware are used flexibly, purposefully and creatively. Hence, e-learning tools such as learning management system (LMS) should be designed based on curriculum and innovative pedagogical practise. Technology integration should enable the curriculum to be the centre of technology usage, not having technology to shape the curriculum. Finally, technology integration is about organizing the goals of curriculum and technology into a coordinated, and harmonious whole (Dockstader & Jolene, 1999) that will improve and motivate learning.

Pedagogical innovations profiles based on ownership revealed that public HEIs were more innovative than the private HEIs in two of the six dimensions: learning objectives and student's roles. Private HEIs were more innovative in connectedness. Most of the subjects in this study belong to the age category of above 40 years old (52 %), and 72 % of the subjects have more than five years of working experience in HEIs. From the findings on demographic variables', it has been further ascertained that customisation of training and workshops based on participants demographic profiles could be a less critical factor. However, the availability of supportive plans and policies that form the strategies of technology integration within the faculty will further enhance the relationship in enhancing pedagogical innovations among faculty members. All HEIs need to review their strategy of e-learning and technology agenda to ensure that they are relevant and at par with the current trend of technology integration nationally and internationally.

When examining the innovativeness of pedagogical practices of faculty members by SITES-M2 six dimensions, subjects had the highest mean for ICT used but lowest for connectedness. This explains that most faculty members have high mastery of technological tools but might not be using the skills for innovative pedagogical practises. This finding resonates with the findings reported by Mohd Amin (2011) that slightly over half of the HEIs actually provide e-learning pedagogy training and e-content development. There was less than a-third of HEIs provided training to faculty members on the Web 2.0 applications which enhance collaborative learning. In addition to that, most applications used were communication (emails), course delivery, productivity, content development and administration. There was lack of evidence of collaborative teaching by external content experts and professionals. Again, this study highlighted the importance of training HEIs faculty members first on innovative pedagogical practises and followed by any form of chosen technology applications such as e-learning. This will ensure that all faculty members are clear with their pedagogical practises that are innovative and they are able to blend their teaching using various forms of technological applications.

This study has highlighted that most faculty members are competent in their ICT skills and with effective strategies and plans pedagogical innovation can be further achieved. Innovation in pedagogical practises could be persistently achieved through smart integration of technological tools.

5.5 Recommendations for Further Research

The six HEIs selected were all ranked as Tier 5 universities by the Ministry of Higher Education in the 2011 SETARA Ranking (MQA, 2011). There are several limitations that should be taken into account when discussing the findings.

First, all subjects participated in this study voluntarily through faculty leaders' invitation and also through email notifications that were sent out at fortnightly intervals over a span of 3 months. Although the analysis of subjects distribution matches the strata: Professor, Associate Professor, Senior Lecturer, Lecturer and Tutor; to select the subjects, there is absolutely no control over subjects participation that will accurately represent the faculty's state of technology integration and pedagogical practices. There is a possible bias when a faculty leader chooses or encourages selected members to participate in the survey.

Second, this study was conducted with a clear understanding that data gathering through web-based questionnaire could promote HEIs that have successfully integrated technology especially ICTs. To mitigate this effect, all invited faculties were also given 100 sets of printed questionnaire forms to be distributed to subjects through their respective academic support departments. Only the private HEIs leaders stated their clear choice of only allowing faculty members to participate in this study through online questionnaire. The analysis of the results indicates that HEIs with both lower and higher technology integration fidelities had participated in this survey.

Third, as technology integration as a predictor to pedagogical innovations study in HEIs is a relatively new research area in Malaysia, the findings and results can only be used and interpreted with caution. This study attempts to understand the dynamics of technology integration and pedagogical practices is a cross-sectional study. Therefore, results from correlation and regression analysis have to be further tested and verified with more studies of this nature. It is also recommended that students' perspective of technology integration in their learning should be examined and also their awareness of the changes in technology integration in learning. Student's technology integration competency will lead to faculty's anxiety level in technology integration.

Fourth, the subjects of this study were selected from six Tier 5 HEIs in Malaysia. As such, the findings and conclusions have to be restricted to the subjects from the six HEIs. HEIs of other Tiers could be further examined to evaluate the suitability of the proposed model from this study.

Fifth, this is a self-report study whereby subjects' over-estimations or under-estimations cannot be totally avoided. Many studies on teachers' and education leaders' pedagogical practices were nevertheless employed this research method. A longitudinal study following technology integration endeavours at each HEI and the associated pedagogical shifts is critical to ensure that all stakeholders of the higher education system in Malaysia could devise strategies to reap maximum benefits of technological investments. As cautioned by Cuban (2001), merely providing ICT hardware will not lead to pedagogical innovations among teachers. Devising effective plans to overcome barriers to technology integration is equally if not more important in ensuring technology is not a catch-up game but rather a true benefit to contemporary scholars and learners. The issues of barriers such as underlying pedagogical beliefs and environmental factors were not proven to be critical in the relationship between technology integration and pedagogical innovations. There was only one external barrier, which is 'supportive plans and policies that form the strategy of technology integration within the faculty', which contributed to 9.5 % of the pedagogical innovations of the subjects. Through the presence of 'supportive plans and policies that form the strategy of technology integration within the faculty', technology integration practices were found to be a strong predictor to pedagogical innovations at 44.8 %. The model predicts up to 54.3 % of variance in pedagogical innovations.

Further research should look into the aspects of HEI leadership role in setting technology investment strategies and policies on pedagogical innovations. The governance structure of HEIs whether public or private, leadership styles, management tools used in managing HEIs improvement and the associated cultural context of each HEIs are crucial factors in ensuring a culture of innovation in higher education (Christensen et al., 2011). These four tools of governance are worth exploring on how they predict the direct relationship between technology integration and pedagogical innovation.

It is hoped that through this study, the findings could be compared and contrasted with similar studies in other regions and countries. This study has contributed to the general body of knowledge on technology integration and pedagogical innovations. The model derived from this study could be further tested, refined and improved through longitudinal research within clearly defined contexts of higher education institutions.

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APPENDIX A

SETARA 2011 Report

KPT
KEMENTERIAN PENGAJIAN TINGGI

SISTEM PENARAFAN INSTITUSI PENGAJIAN TINGGI MALAYSIA 2011

SETARA '11

2011 RATING SYSTEM FOR MALAYSIAN HIGHER EDUCATION INSTITUTIONS

MQA
Agensi Kelayakan Malaysia
Malaysian Qualifications Agency

The 2011 Rating System for Malaysian Higher Education Institutions (SETARA '11) measures **quality of teaching and learning at level six of the Malaysian Qualifications Framework (undergraduate level)** in universities and university colleges in Malaysia.

The SETARA '11 rating instrument covers three generic domains of input, process and output to assess the quality of teaching and learning. The input domain addresses talent, resources and governance. The process domain focuses on curriculum matters and the output domain is on the quality of graduates and graduate satisfaction. The overall structure of the instrument could be accessed at **<http://www.mqa.gov.my/SETARA11>**.

The SETARA '11 exercise classifies its rating into six Tiers, ranging from Tier 1 as Weak to Tier 6 as Outstanding. The following is the full result, listed in alphabetical order:

TIER 6: OUTSTANDING

–

TIER 5: EXCELLENT

CODE	NAME OF INSTITUTION
2	ASIA PACIFIC UNIVERSITY COLLEGE OF TECHNOLOGY AND INNOVATION (now known as Asia Pacific University of Technology and Innovation)
2	BINARY UNIVERSITY COLLEGE OF MANAGEMENT AND ENTREPRENEURSHIP (now known as Binary University of Management and Entrepreneurship)
2	CURTIN UNIVERSITY OF TECHNOLOGY SARAWAK CAMPUS
2	CYBERJAYA UNIVERSITY COLLEGE OF MEDICAL SCIENCES
2	INTERNATIONAL MEDICAL UNIVERSITY
2	KUALA LUMPUR INFRASTRUCTURE UNIVERSITY COLLEGE (now known as Infrastructure University Kuala Lumpur)
2	MANAGEMENT AND SCIENCE UNIVERSITY
2	MONASH UNIVERSITY SUNWAY CAMPUS
2	MULTIMEDIA UNIVERSITY
2	NILAI UNIVERSITY COLLEGE (now known as Nilai University)
2	OPEN UNIVERSITY MALAYSIA (ODL)
2	SEGi UNIVERSITY COLLEGE (now known as SEGi University)
2	SUNWAY UNIVERSITY
2	SWINBURNE UNIVERSITY OF TECHNOLOGY SARAWAK CAMPUS
2	TAYLOR'S UNIVERSITY
1	UNIVERSITI ISLAM ANTARABANGSA MALAYSIA
1	UNIVERSITI KEBANGSAAN MALAYSIA
2	UNIVERSITI KUALA LUMPUR
1	UNIVERSITI MALAYA
1	UNIVERSITI MALAYSIA PAHANG
1	UNIVERSITI MALAYSIA PERLIS
1	UNIVERSITI PUTRA MALAYSIA
1	UNIVERSITI SAINS ISLAM MALAYSIA
1	UNIVERSITI SAINS MALAYSIA
1	UNIVERSITI TEKNIKAL MALAYSIA MELAKA
1	UNIVERSITI TEKNOLOGI MALAYSIA
1	UNIVERSITI TEKNOLOGI MARA
2	UNIVERSITI TEKNOLOGI PETRONAS
2	UNIVERSITI TENAGA NASIONAL
2	UNIVERSITI TUN ABDUL RAZAK
1	UNIVERSITI TUN HUSSEIN ONN MALAYSIA
2	UNIVERSITI TUNKU ABDUL RAHMAN
1	UNIVERSITI UTARA MALAYSIA
2	UNIVERSITY OF NOTTINGHAM MALAYSIA CAMPUS
2	WAWASAN OPEN UNIVERSITY (ODL)

TIER 4: VERY GOOD

CODE	NAME OF INSTITUTION
2	AIMST UNIVERSITY
2	HELP UNIVERSITY
2	INTI INTERNATIONAL UNIVERSITY
2	KOLEJ UNIVERSITI INSANIAH
2	KOLEJ UNIVERSITI ISLAM ANTARABANGSA SELANGOR
2	KUALA LUMPUR METROPOLITAN UNIVERSITY COLLEGE
2	TATi UNIVERSITY COLLEGE
2	TWINTECH INTERNATIONAL UNIVERSITY COLLEGE OF TECHNOLOGY
2	UCSI UNIVERSITY
2	UNIVERSITI INDUSTRI SELANGOR
1	UNIVERSITI MALAYSIA KELANTAN
1	UNIVERSITI MALAYSIA SABAH
1	UNIVERSITI MALAYSIA SARAWAK
1	UNIVERSITI MALAYSIA TERENGGANU
1	UNIVERSITI PENDIDIKAN SULTAN IDRIS
1	UNIVERSITI PERTAHANAN NASIONAL MALAYSIA

TIER 3: GOOD

CODE	NAME OF INSTITUTION
1	UNIVERSITI SULTAN ZAINAL ABIDIN

TIER 2: SATISFACTORY

–

TIER 1: WEAK

–

CODE CLASSIFICATION

1	Public Institution
2	Private Institution
ODL	Open and Distance Learning Institution

THE SETARA '11 COMMITTEE
The rating exercise was carried out by a committee appointed by the MQA, which comprises:
Muhamad Jantan (Universiti Sains Malaysia) (Chair)
Hazman Shah Abdullah (Universiti Teknologi MARA)
Walter Wong (INTI International University)
Arfah Salleh (Putra Business School)
Sharifah Norul Akmar Syed Zamri (Universiti Malaya)

VERIFICATION OF SETARA '11
An independent Verification Committee was set up for SETARA '11 to verify and endorse the SETARA '11 processes and instrument as well as verify data submitted by the higher education institutions.

NB: Two institutions participated but were excluded because of insufficient data.
Seventeen institutions cannot participate because they are new institutions and have not produced graduates.
One institution was not rated because it chose not to participate.
An Employer Survey for SETARA '11 was conducted jointly by GRADUAN® and MQA.

APPENDIX B

Questionnaire of the Study

Questionnaire on “Technology Integration, Organisation and Faculty’s Beliefs, and Pedagogical Innovations"

Dear Professors/Associate Professors/Visiting Lecturers/Senior Lecturers/Lecturers and Tutor of (*HEI name*) (Malaysia),

I am a PhD candidate from the Institute of Educational Leadership, UM. I would like to invite you to participate in this survey on "Technology Integration, Beliefs of Organisation and Faculty, and Pedagogical Innovations in Higher Education Institutions".

Your views are very important to assist the researcher to identify how faculty members of SETARA Tier 5 and research universities in Malaysia are integrating technology into teaching and learning to embrace pedagogical innovations. This survey shall not take more than 15 minutes of your precious time. Please return this filled questionnaire latest by 15th November 2012 (2 weeks).

Thank you and regards.

Lu Huong-Ying
YHA 110006
Institute of Educational Leadership

SECTION A: Some of your background information

1. Faculty: Science ☐ Arts ☐
2. Gender: Male ☐ Female ☐
3. Age group:
   - 20 to 30 years old ☐
   - 31 to 40 years old ☐
   - 41 to 50 years old ☐
   - 51 to 60 years old ☐
   - above 60 years old ☐
4. Years of teaching experience:
   - Less than 2 years ☐
   - 2 to 5 years ☐
   - 6 to 10 years ☐
   - 11 to 15 years ☐
   - 16 to 20 years ☐
   - More than 20 years ☐
5. Highest level of academic qualification
   - Bachelor of Arts ☐
   - Bachelor of Science ☐
   - Masters of Arts ☐
   - Masters of Science ☐
   - Masters of Philosophy ☐
   - Master in Business Administration ☐
   - Doctor of Philosophy ☐
   - Others, please state: ______________________
6. Position
   - Professor ☐
   - Associate Professor ☐
   - Assistant Professor ☐
   - Senior Lecturer ☐
   - Lecturer ☐
   - Tutor ☐

Section B: About how technology is integrated into your role as faculty member

As a faculty member, how do you intend to use technology in your teaching role?

Please tick ONE description in each row that most accurately describes you.

No.	Subsection	Never	Seldom	Sometimes	Frequent	Most Frequent
A1.	**I select appropriate technology tools before using them in my classroom based on my knowledge of how the tool will influence student learning**					
A2.	**I use the various capabilities of technology extensively in my teaching**					
A3.	**I use file management and archive plans efficiently in my roles as faculty member**					
A4.	**I use the various software such as multimedia presentation tools to create my own presentations**					
A5.	**I use online course management tools to support my on-line teaching**					
A6.	**I have created my own online database such as online portals to support various learning strategies need of the diverse learners**					
A7.	**I apply current research findings on teaching and learning with technology when planning learning environments and experiences**					
A8.	**I endeavour to identify and locate technology resources and evaluate them for suitability in supporting best practises teaching**					
A9.	**I endeavour to identify and apply instructional design principles associated with the development of technology resources**					
A10.	**I collaborate with others in planning and designing technology based learning environments**					
A11.	**I integrate technology to enhance learning environment that use distance learning systems, such as video conferencing**					
A12.	**I am an advocate of designing curriculum that incorporates integration of technology tools to enhance student learning**					
A13.	**I integrate technology to address multiple perspectives in the subject content of the course I teach**					
A14.	**I integrate technology to develop students' higher order skills**					
A15.	**I apply technology to assess student learning of subject matter using a variety of assessment techniques**					

No.	Subsection	Never	Seldom	Sometimes	Frequent	Most Frequent
A16.	**I apply technology to assess my own instructional practices to maximize student learning**					
A17.	**I apply multiple evaluation methods to assess student's appropriate use of technology resources for learning, communication and productivity**					
A18.	**I use technology resources to engage in my on-going professional development and lifelong learning**					
A19.	**I continually evaluate and reflect on my own professional practice to make informed decisions regarding the use of technology**					
A20.	**I apply technology to increase my own professional productivity**					
A21.	**I use technology to communicate and collaborate with peers, students, and peer professionals**					
A22.	**I advocate for copyright and ethical practises related to technology use.**					
A23.	**I conduct research to identify technology resources to support the diversity of my students.**					
A24.	**I constantly promote safe and healthy use of technology resources**					
A25.	**I facilitate equitable access to technology resources for all students**					

Please proceed to Section C on your pedagogical practises.

Section C: About your pedagogical practices in the current semester
Please indicate a subject you are currently teaching (or during the immediate past semester) and reflect on the following aspects of pedagogical practises that you have achieved.

Subject Name:______________________________Level: Foundation/Diploma/Degree/Postgraduate (*please circle one*)

Please tick ONE description in each row that most accurately describes you

No.	Aspects of Pedagogy Practises	*Never*				*Always*
B1.	**The setting of learning objectives**					
	B1.1 The learning objectives have been set to achieve critical thinking skills among my students					
	B1.2 The learning objectives have been set to achieve inquiry skills among my students					
	B1.3 The learning objectives have been set to achieve collaborative skills among my students					
B2.	**About your roles as faculty member**					
	B2.1 I practise co-teaching with other colleagues					
	B2.2 I support inquiry learning and always liaise with external parties to support my students' learning					
	B2.3 I support collaborative learning among my students, and between them and external parties.					
B3.	**Your students' roles in your class**					
	B3.1 My students always need to present the findings of their own learning					
	B3.2 My students always collaborate with external parties to achieve inquiry learning					
	B3.3 They always engage in student-centred learning and practise peer evaluation.					
B4.	ICT use in your class					
	B4.1 I use ICT as productivity tool such as Microsoft PowerPoint in all my teaching					
	B4.2 I use ICT for both face to face and off-campus communication with students					
	B4.3 I use ICT software to teach simulation and scenario planning.					
B5.	**How connected is your class to the external parties**					
	B5.1 I collaborate with faculty of other countries to teach my students.					
	B5.2 I practise collaborative teaching and learning among faculty members and students within the same university.					
	B5.3 I engage relevant external parties to design curriculum for my class.					
B6.	**Multiplicity of learning outcomes exhibited in your class**					
	B6.1 My students are assessed in groups through presentation using various media tools.					
	B6.2 My students are assessed through their learning portfolios of the semester.					
	B6.3 My students are assessed through peer inquiry and authentic products in their learning context.					

Section D Information about You and Your Faculty use of ICT
Please tick only one choice in each row.

No.	What is your experience in the following aspects related to technology integration in your faculty?	*Strongly Disagree* 1	2	*Not Sure* 3	4	*Strongly Agree* 5
1.	Support is always available among faculty members to integrate technology into pedagogical practises					
2.	There is sufficient professional development for the faculty members					
3.	There is excellent infrastructure that support students to use technology to learn					
4.	Technology integration is always perceived as a valuable means to support faculty's roles					
5.	There is excellent administrative support from the faculty to facilitate technology integration					
6.	There is a prominent technology leader in the faculty that drives the initiative					
7.	There is clear supportive plans and policies that form the strategy of technology integration within the faculty					
8.	There is always sufficient time to implement technology integration projects					
9.	There is support available from external agencies					
10.	There is strong support from the university top management in technology integration projects					

End of questionnaire. Thank you.

APPENDIX C

Letter of Seeking Endorsement from Ministry of Higher Education Malaysia

27th June 2012

YBhg. Dato' Prof. Dr. Rujhan Bin Mustafa
Ketua Pengarah
Pejabat Ketua Pengarah
Kementerian Pendidikan Tinggi Malaysia
Aras 9, No.2, Menara 2, Jalan P5/6, Presint 5,
62200 W.P. Putrajaya
Tel: 03-88706381
Faks: 03-88706840

Dear YBhg. Dato' Prof. Dr. Rujhan,

Seeking MoHE's Endorsement on Research on Technology Integration among Selected Tier-5 Universities

Pertaining to the above-mentioned, I would like to seek Prof's endorsement and support in conducting a quantitative research among leading universities in Malaysia. The title of this research is "Technology Integration, Organisation and Faculty's Beliefs, and Pedagogical Innovations in Higher Education Institutions".

Many international education performance monitoring reports such as: The Harvard Magazine, SITES (Second Information Technology in Education Study Module), The NMC (New Media Consortium), and CISCO Technology, have highlighted the gap between technological advancement and educational goals attainment. The study on technology integration and how it impacts on pedagogical practises among many education systems worldwide has warrant further research at higher education institutions level.

This study aims to examine the relationship among the three key variables: Technology integration, Organisation and Faculty's Beliefs, and pedagogical innovations; in the context of higher education institutions in Malaysia.

The pilot study of this research will be conducted between 19th July and 30th August 2012. In the actual field work of data collection (Sept ember to October 2012), I would like to administer 150-200 questionnaire forms to the faculty members of selected Tier-5 universities.

I would like to also take the opportunity to express my appreciation to receiving an endorsement for me to obtain cooperation from the faculty leaders and teaching members among Tier-5 universities.

Thank you.

Yours sincerely,

Lu Huong Ying
YHA 110006
Institute of Educational Leadership
Level 2, Block C, City Campus

University of Malaya,
Jalan Tun Ismail,
50480 Kuala Lumpur
MALAYSIA
Tel : (603) 26173023 / 3021 / 3022
Fax : (603) 26173020

cc:
-Director of Institute of Educational Leadership, UM
-Professor Dr. Tie FH, Supervisor

APPENDIX D

Letter of Approval from Ministry of Higher Education Malaysia

JABATAN PENGAJIAN TINGGI
TIMBALAN KETUA PENGARAH (SEKTOR IPTA)
ARAS 9, NO. 2, MENARA 2, JALAN P5/6, PRESINT 5,
62200 WILAYAH PERSEKUTUAN PUTRAJAYA
Tel : (603) 8870 6391 Faks : (603) 8870 6841 Web : http://jpt.mohe.gov.my

JPT(TKPA)1000/016/033 Jld 2(24)
5 Julai 2012

Lu Huong Ying
Institut Kepimpinan Pendidikan
Aras 2, Blok C, Kampus Kota,
Universiti Malaya
Jalan Tun Ismail
50480 Kuala Lumpur
Tel:03 26173023/3021/3022
Faks: 03 26173020

Tuan/Puan,

PELAKSANAAN KAJIAN *TECHNOLOGY INTEGRATION, ORGANISATION AND FACULTY'S BELIEF AND PEDAGOGICAL INNOVATIONS IN HIGHER EDUCATION INSTITUTIONS*

Sukacita saya merujuk kepada perkara di atas.

2. Sukacita dimaklumkan bahawa Jabatan **tiada halangan** dalam pelaksanaan kajian *Technology Integration, Organisation and Faculty's Belief and Pedagogical Innovations in Higher Education Institutions* yang sedang dilaksanakan oleh Lu Huong Yin, pelajar Ijazah Kedoktoran Universiti Malaya.

3. Sehubungan itu, mohon jasa baik pihak tuan/puan untuk membantu penama diatas dalam melaksanakan dan menjayakan kajian beliau. Segala perhatian dan kerjasama yang diberikan saya dahulukan dengan ucapan terima kasih.

Sekian.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(PROF. DR. MORSHIDI SIRAT)
Jabatan Pengajian Tinggi
b.p Ketua Setiausaha
Kementerian Pengajian Tinggi

APPENDIX E

Pilot study Invitation

28th June 2012

Professor Datuk Dr. Khairuddin Ab Hamid
Vice Chancellor UNIMAS
Office of The Vice-Chancellor
Penthouse,
CAUH Building, West Campus,
Universiti Malaysia Sarawak
94300 Kota Samarahan,
Sarawak. MALAYSIA
Phone : +6 082 581221 begin
Fax : +6 082 665111

Dear Prof. Datuk Dr. Khairuddin,

Seeking Permission to Conduct Pilot Study at UNIMAS

Pertaining to the above-mentioned, I would like to seek Prof's permission in conducting a pilot study of quantitative research on "Technology Integration, Organisation and Faculty's Beliefs, and Pedagogical Innovations in Higher Education Institutions" at UNIMAS.

Many international education performance monitoring reports such as: The Harvard Magazine, SITES (Second Information Technology in Education Study Module), The NMC (New Media Consortium), and CISCO Technology, have highlighted the gap between technological advancement and educational goals attainment. The study on technology integration and how it impacts on pedagogical practises among many education systems worldwide has warrant further research at higher education institutions level.

This study aims to examine the relationship among the three key variables: Technology integration, Organisation and Faculty's Beliefs, and pedagogical innovations; in the context of higher education institutions in Malaysia.

Criteria of respondents for this pilot study are as follow:

- 35 faculty members from a faculty of science discipline (FRST or FENG)
- 35 faculty members from a faculty of arts discipline (FSS or FEB)
- Minimum of two years of teaching experience at UNIMAS or other universities
- Active teaching staff during the immediate past semester and current academic year

The pilot study will be managed in the following order:

- 13th July 2012: Meeting faculty leaders for teaching and learning or academic delivery
- 19th July 2012: administering questionnaire forms at identified sites within campus and collecting completed forms

- 26th July 2012: collecting balance of completed from respondents

I would like to be present in UNIMAS for the three dates above to minimize the distraction of faculty members' work commitment. I would also like to take the opportunity to express my appreciation to receiving your consent for me to obtain cooperation from the faculty leaders and teaching members at UNIMAS.

Thank you.

Yours sincerely,

Lu Huong Ying
YHA 110006 (email: luhy@siswa.um.edu.my)
Institute of Educational Leadership
Level 2, Block C, City Campus
University of Malaya,
Jalan Tun Ismail,
50480 Kuala Lumpur
MALAYSIA
Tel : (603) 26173023/3021/3022
Fax : (603) 26173020
mobile: 019 8877321
cc:
-Director of Institute of Educational Leadership, UM
-Professor Dr. Tie FH, Supervisor

APPENDIX F

Personalised Email to Deans of Pilot Study HEIs

From: YHA110006 Student <luhy@siswa.um.edu.my>
To: spencer@fss.unimas.my
Date: 07/03/2012 05:36 PM
Subject: Fwd: Memohon Kebenaran Menjalankan "Pilot Study" Di
(Fakulti)
UNIMAS

Dear Professor Dr Spencer,

Greetings to you from Institute of Educational Leadership, UM.

As appended in the email from Puan Noreen below, I would really like
to
gain some valuable feedback from FSS lecturers with min. 2 years of
teaching experience on my reserach :Technology Integration,
Organisational
and Faculty's Beliefs and Pedagogical Innovations in Higher Education
Institutions".

Do you think i can meet you on 16th or 17th July to discuss this
further? I
intend to administer the questionnaire on 19th July in a 1 hour
session,
where i could be around to explain the concepts of the survey to your
faculty member. If it is not too troublesome, i would like to conduct
this
with help from one of your administrator so that response rate of FSS
faculty members could be maximise.

Thank you very much and hope to receive your reply soon, Prof.

Regards
Lu HY

APPENDIX G

Invitation to Faculty Members at Pilot Study HEI

On Tue, Jul 17, 2012 at 2:54 PM, Mohamad Zaky Gardafi Ibrahim <izaky@fss.unimas.my> wrote:
Selamat petang,

Dipanjangkan untuk makluman semua staf akademik. Semua yang berkelapangan dijemput hadir untuk sesi penerangan dan maklumbalas seperti yang diperlukan untuk membantu Cik Lu HY. Sekian, harap maklum.

----- Forwarded by Mohamad Zaky Gardafi Ibrahim/ADM/FSS/UNIMAS on 07/17/2012 02:50 PM -----
Re: Fwd: Memohon Kebenaran Menjalankan "Pilot Study" Di (Fakulti) UNIMAS

YHA110006 Student to: izaky, ssamsina
07/17/2012 02:49 PM

Dear Tuan Haji Zaki,

Thank you for meeting me on conducting my survey at FSS of UNIMAS on 19th July.

May i have your assistance to book the Bilik Mesyuarat 1, Aras 2 of FSS for the following purpose:

1. To meet faculty members (academic) to administer my questionnaire which will only take not more than 15 minutes to complete.
2. To explain the purpose of the study to faculty members, based on the framework of the questionnaire. The title of my survey is "Technology Integration, Organisation and Faculty's Beliefs, and Pedagogical Innovations in Higher Education Institutions".

The date and time to meet faculty members of FSS shall be:

Date: 19th July 2012
Time: 2:00pm-3:00pm
Venue: Bilik Mesyuarat 1, Aras 2, FSS.

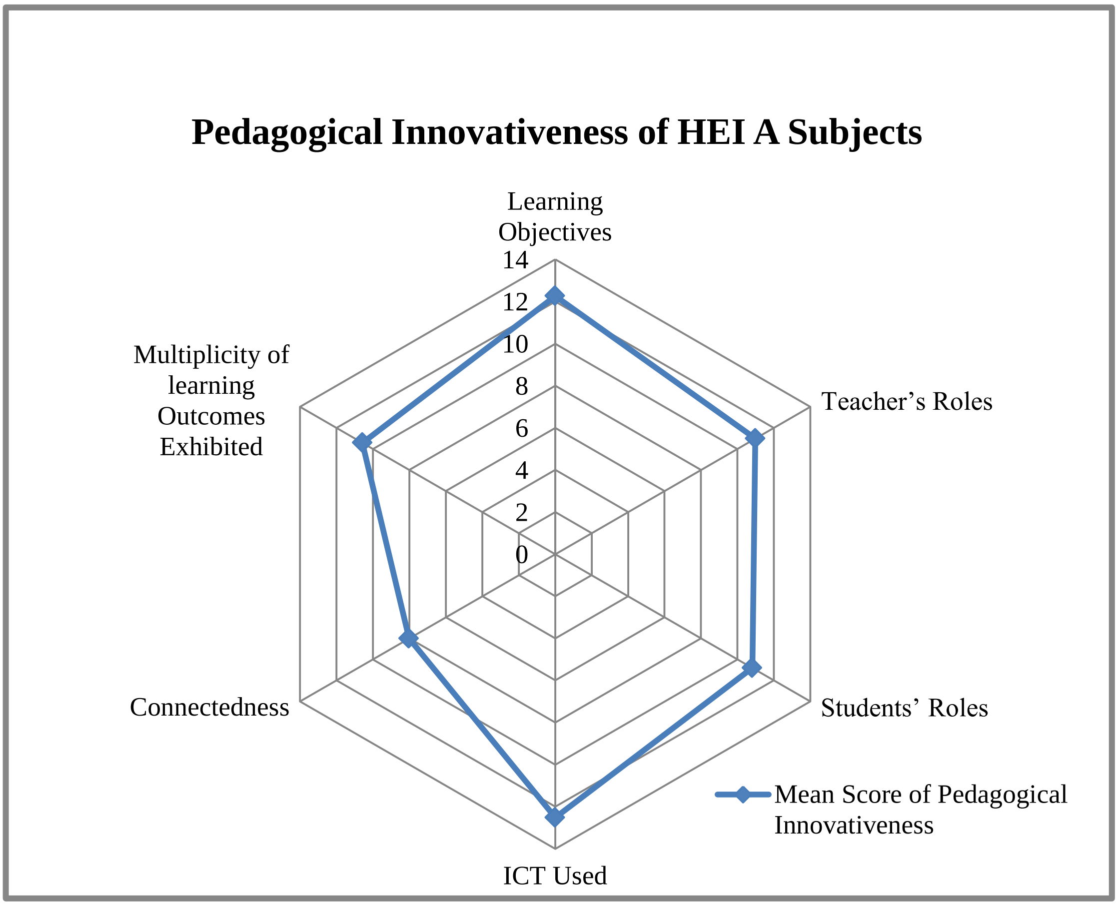
For each respondent participating in this survey, I would also seek your consent to return my gratitude with a little token of appreciation.
I need 35 faculty members (from Tutors to Professors) to ensure that the data collected is not biased.

Thank you and regards
Lu HY (YHA 110006, Institute of Educational Leadership, University Malaya)

APPENDIX H

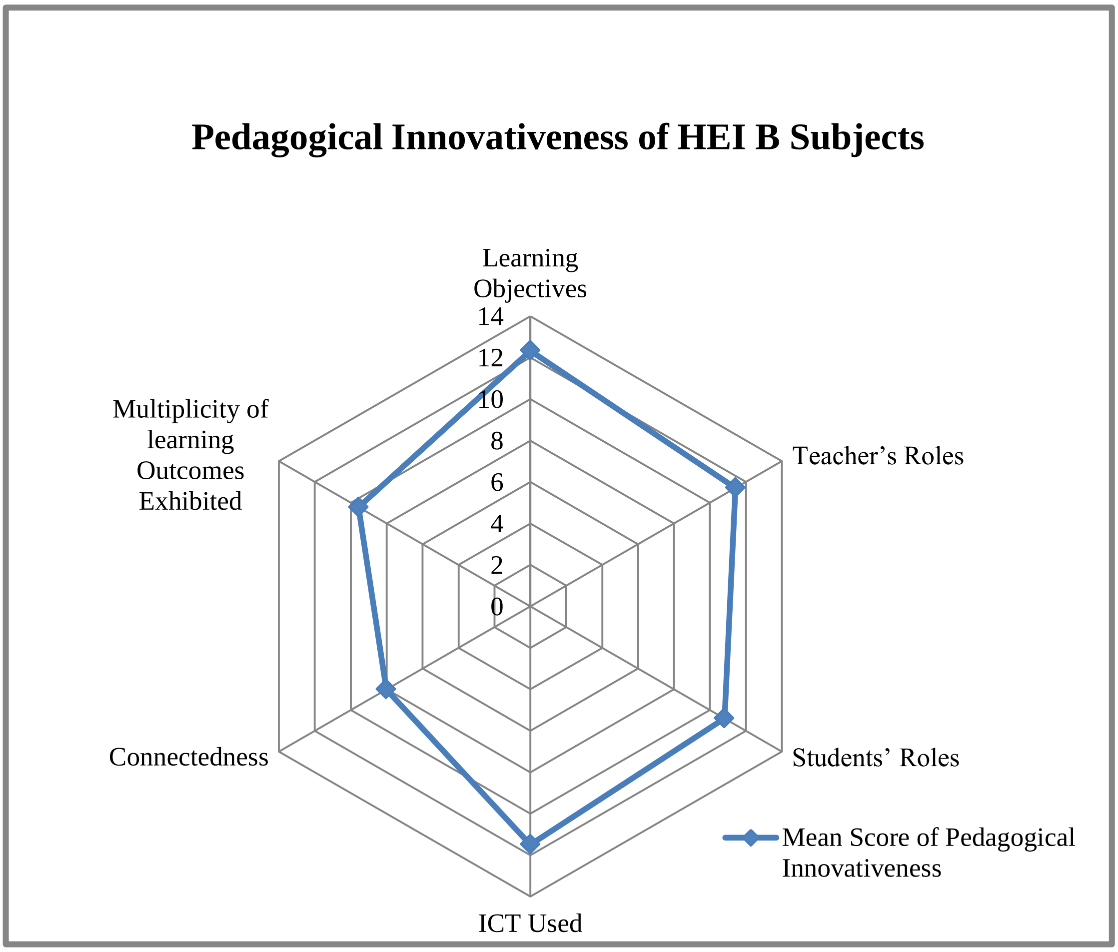
Pedagogical Innovations Profiles of HEIs A to F

HEI A

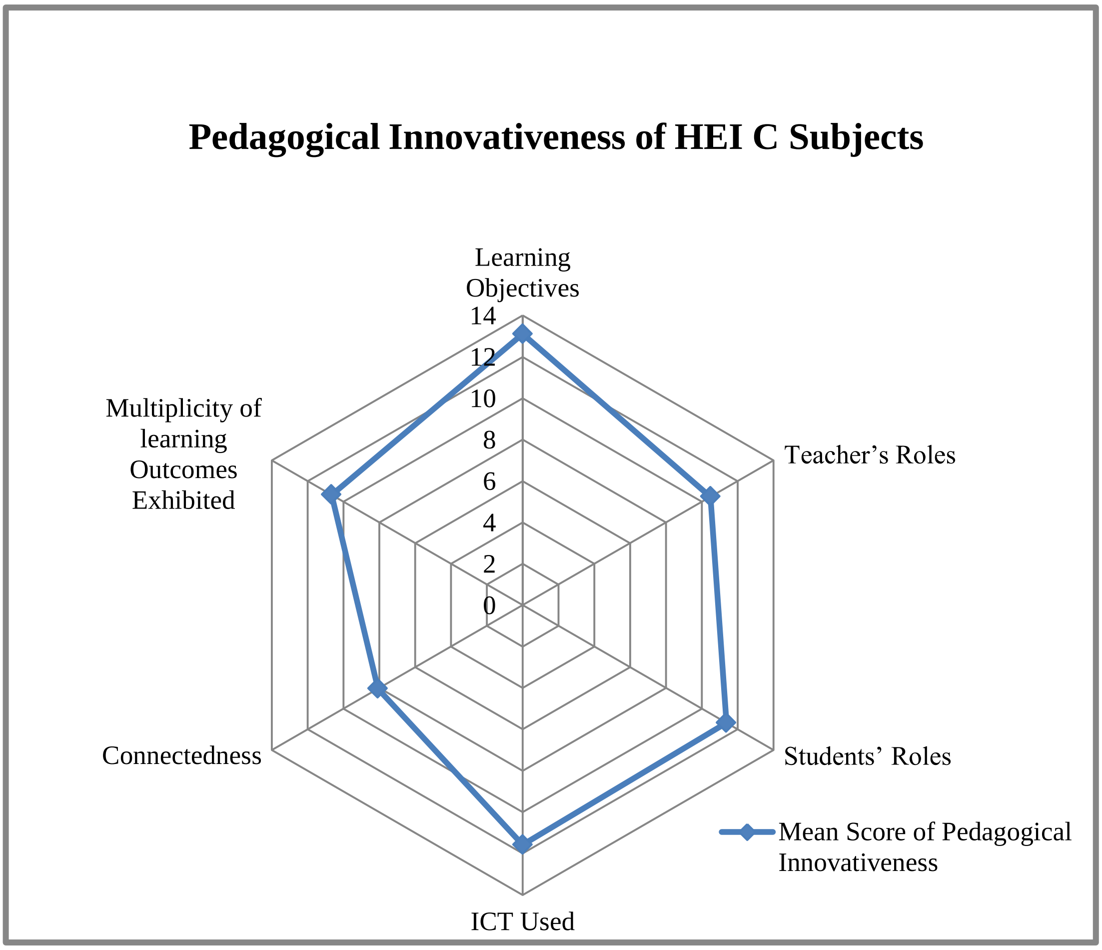


Pedagogical Innovativeness of HEI A Subjects
Learning Objectives
14
12
10
8
6
4
2
0
Teacher's Roles
Students' Roles
ICT Used
Connectedness
Multiplicity of learning Outcomes Exhibited
Mean Score of Pedagogical Innovativeness

HEI B

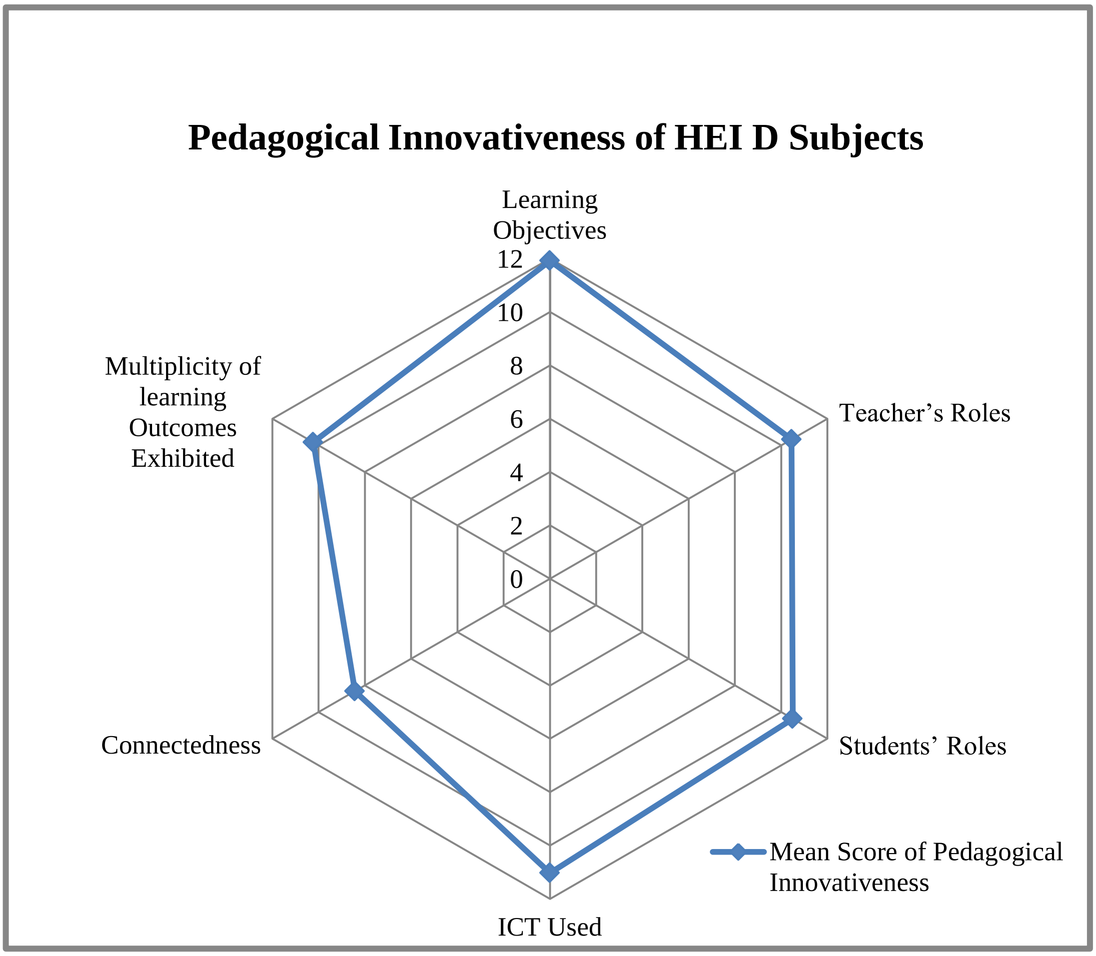

Pedagogical Innovativeness of HEI B Subjects
Learning Objectives
14
12
10
8
6
4
2
0
Teacher’s Roles
Students’ Roles
ICT Used
Connectedness
Multiplicity of learning Outcomes Exhibited
Mean Score of Pedagogical Innovativeness

HEI C



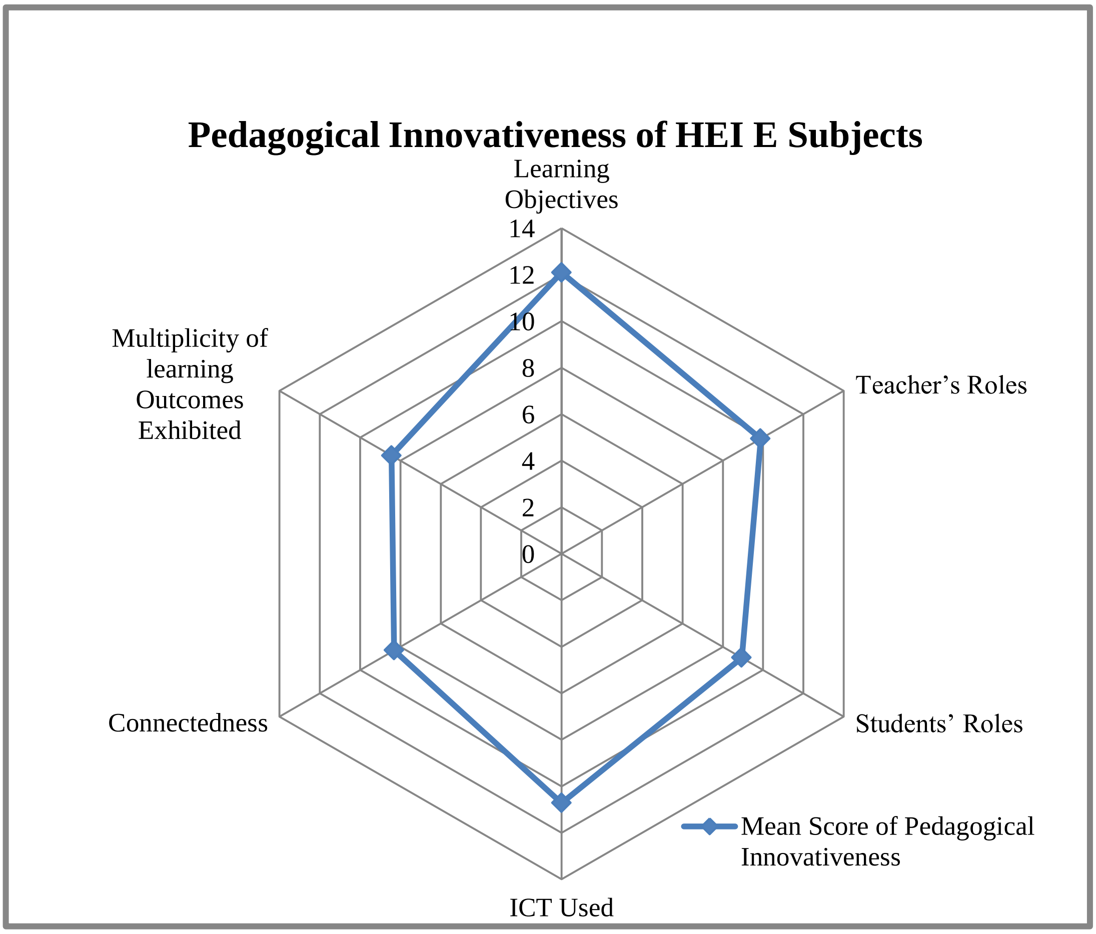
Pedagogical Innovativeness of HEI C Subjects
Learning Objectives
14
12
10
8
6
4
2
0
Teacher's Roles
Students' Roles
ICT Used
Connectedness
Multiplicity of learning Outcomes Exhibited
Mean Score of Pedagogical Innovativeness

HEI D



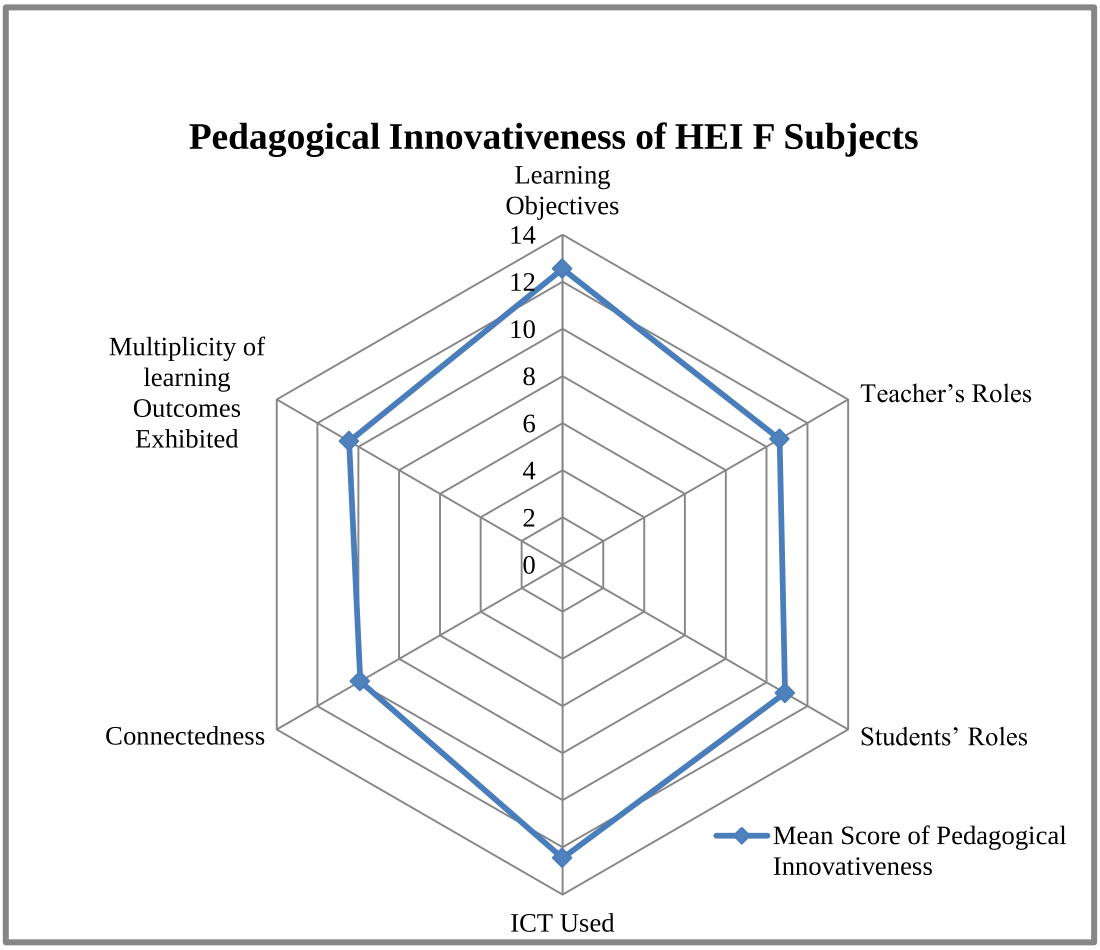
Pedagogical Innovativeness of HEI D Subjects
Learning Objectives
12
10
8
6
4
2
0
Teacher’s Roles
Students’ Roles
ICT Used
Connectedness
Multiplicity of learning Outcomes Exhibited
Mean Score of Pedagogical Innovativeness

HEI E



Pedagogical Innovativeness of HEI E Subjects
Learning Objectives
14
12
10
8
6
4
2
0
Teacher's Roles
Students' Roles
ICT Used
Connectedness
Multiplicity of learning Outcomes Exhibited
Mean Score of Pedagogical Innovativeness

HEI F



Pedagogical Innovativeness of HEI F Subjects
Learning Objectives
14
12
10
8
6
4
2
0
Teacher's Roles
Students' Roles
ICT Used
Connectedness
Multiplicity of learning Outcomes Exhibited
Mean Score of Pedagogical Innovativeness

APPEDNIX I

Correlational analysis between pedagogical innovations and organization and faculty's beliefs

Correlations between the 11 Predictor Variables

Control Variables	Predictor Variables	1	2	3	4	5	6	7	8	9	10	11
Faculty Discipline & Gender & Age Group & Teaching Exp & Academic Qualification & Position Held	1. Support is always available among faculty members to integrate technology into pedagogical practices	-	.681**	.617**	.599**	.629**	.688**	.606**	.543**	.438**	.619**	.246**
	2. Sufficient professional development for faculty members		-	.613**	.579**	.640**	.630**	.618**	.520**	.495**	.614**	.206*
	3. Excellent infrastructure that supports students to use technology to learn			-	.603**	.651**	.566**	.539**	.554**	.486**	.558**	.162*
	4. Technology integration is a valuable means for faculty members				-	.610**	.595**	.572**	.510**	.445**	.555**	.189*
	5. Excellent administrative support for faculty to facilitate technology integration					-	.663**	.696**	.654**	.489**	.619**	.215*
	6. Prominent technology leader that drives the initiative of technology integration						-	.769**	.654**	.592**	.645**	.259**
	7. Supportive plans and policies that form the strategy of technology integration within the faculty							-	.773**	.666**	.661**	.332**
	8. Sufficient time to implement technology integration projects								-	.757**	.713**	.287**
	9. Support from external agencies									-	.615**	.275**
	10. Strong support from the university top management										-	.180*
	11. Pedagogical Innovation SumScore											-

Note: Correlations significant at * $p < .05$, ** $p < .001$ levels