Investigating the Enabling Role of Web 2.0 Technology for Interactive e-learning in Australian and Sri Lankan Higher Education

A thesis submitted in fulfilment of the requirements for the

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Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis/project is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

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List of abbreviations

AGFI	Adjusted goodness-of-fit Index
AMOS	Analysis of Moment Structures
AVE	Average variance extracted
BCHEAN	Business College Human Ethics Advisory Network
CDs	Compact disks
CFA	Confirmatory factor analysis
CFI	Comparative fit index
COL	Collaboration
DF	Degree of freedom
EFT	Effectiveness of e-learning
GFI	Goodness-of-fit index
GOF	Goodness-of-fit
HTML	Hypertext markup language
ICTA	Information and Communication Technology Agency
ICTs	Information and communication technologies
INS	Delivery of instructional support
ITSs	Intelligent tutoring systems
LMSs	Learning management systems
LRS	Management of learning resources
MERLOT	Multimedia educational resources for learning and online teaching
MUVEs	Multi-user virtual environments
NIBM	National Institute for Business Management
NODES	National Online Distance Education Service

OUA	Open University in Australia
OUSL	Open University of Sri Lanka
PKM	Personal knowledge management
PLEs	Personal learning environments
RMSEA	Root mean square error of approximation
RSS	Really Simple Syndication
SEM	Structural equation modelling
SFL	Standard factor loading
SLIIT	Sri Lanka Institute of Information Technology
SPSS	Statistical Package for Social Sciences
TLI	Tucker Lewis index
P	Probability value
WEB	Web 2.0 technology
$\chi 2$	Chi-square
$\Delta\chi 2$	Chi-square difference

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Abstract

Interactions are at the heart of online learning. They enable learners to actively develop knowledge and various skills. Furthermore, interactions develop the sense of belonging and satisfaction in learners which influences the learners' continuity of e-learning. Due to these benefits, much attention is paid on developing interactive e-learning systems that facilitate active interactions between learners and learning resources, instructors and peer learners.

Numerous technologies such as simulation technology, virtual world and Web 2.0 technology are used to facilitate interactive e-learning to date. Those technologies support learners to interact with learning resources, instructors and peer learners to different extents. To facilitate effective interactive e-learning, it is important for educators and e-learning developers to understand how well technologies as above support interactions in e-learning.

Web 2.0 technology has become popular in both developed and developing countries recently due to their ease of use, portability and high availability. Much research has been done on how Web 2.0 technology could be used for interactive e-learning. Existing research, however, has several limitations. For example, a majority of research has investigated how a specific Web 2.0 tool supports a specific kind of interactions in e-learning such as learner-learner interaction. Furthermore, much of existing research on Web 2.0 based interactive e-learning is conducted in developed countries. Whether Web 2.0 technology supports interactive e-learning in both developing and developed countries in a similar manner, or whether developing countries could learn lessons from developed countries on the use of Web 2.0 technology for interactive e-learning are, therefore, not clear.

This research aims to investigate the enabling role of Web 2.0 technology for interactive e-learning in higher education in Australia, a developed country and Sri Lanka, a developing

country. To meet the aim, a quantitative research approach is adopted. With the use of this research approach, a conceptual framework on Web 2.0 based interactive e-learning is developed based on a comprehensive review of the relevant literature. The conceptual framework is then validated using the survey data collected from learners in universities in Australia and Sri Lanka.

The validation of the conceptual framework reveals that Web 2.0 technology supports learner-learning resources, learner-instructor and learner-learner interactions in both Australia and Sri Lanka to a great extent. Furthermore, no significant differences are found on how Web 2.0 technology supports interactive e-learning in the above countries. The implication of these findings is that Web 2.0 tools such as blogs, wikis and social bookmarks could be used to improve the interactivity of e-learning. Another implication of this research is that new and more interactive e-learning systems can be developed by using Web 2.0 technology, in particular, for the purposes of management of learning resources, personal knowledge management, and delivering instructional support and collaboration in order to improve the effectiveness of e-learning in today's dynamic environment.

From a practical perspective, this study presents an in-depth investigation of how Web 2.0 technology can be used for improving the interactivity of e-learning in Australia and Sri Lanka. It also provides specific guidelines for developing interactive e-learning environments using Web 2.0 technology. Such guidelines are, in particular, useful for improving the interactivity of e-learning in Sri Lanka and other developing countries which are at the early stages of adopting Web 2.0 technology for e-learning. From a theoretical perspective, this research finds that Web 2.0 technology could be used in developing countries and developed countries to improve the three major interactions in e-learning, namely, learner-learning resources, learner-instructor and learner-learner interactions in a similar manner.

Chapter 1

INTRODUCTION

1.1 Background

E-learning is generally referred to as the application of information and communication technologies (ICTs) to deliver teaching and learning online (Rosenberg, 2001; Sife, Lwoga & Sanga, 2007; Wangpipatwong & Papasratorn, 2007). It offers many benefits to learners such as anytime and anywhere learning, increased access to teaching and learning, and self-regulated learning (Harasim, 2000; Volery & Lord, 2000; Ally, 2004; Bates, 2005). Due to these benefits, e-learning is increasingly being used to provide education and training in schools and universities worldwide (Sun, Tsai, Finger, Chen & Yeh, 2008; Ahmed, 2010).

Interaction is an essential element of e-learning which helps learners to develop their knowledge and skills (Moore, 1989; Bates, 1997; Sims, 1997). It usually refers to the reciprocal communication among individuals or between individuals and objects which influence each other (Wagner, 1994). There are three major types of interactions that occur in e-learning, namely, (a) learner-learning resources interactions, (b) learner-instructor interactions, and (c) learner-learner interactions (Moore, 1989; Sabry & Baldwin, 2003). Learner-learning resources interactions happen when learners use and understand content delivered through learning resources (Moore, 1989). Learner-instructor interactions occur when learners obtain learning support from instructors (Moore, 1989). Learner-learner interactions happen when learners work together to meet common learning goals (Moore, 1989). Much attention is paid in e-learning to facilitate the aforementioned types of interactions for improving the effectiveness of e-learning (Ravenscroft, 2001; Anderson & Hatakka, 2010; Luo & Lei, 2012).

Selecting appropriate technologies is critical for delivering e-learning in an interactive manner (Hannafin & Land, 1997). Rapid advances in ICTs have very much facilitated delivering e-learning in a more interactive manner (Luo & Lei, 2012). Numerous technologies such as hypermedia and multimedia (Laurillard, 2010), artificial intelligence (Wijekumar, 2009), simulation (Kindly, 2002), gaming technology (Squire, 2008) and virtual worlds (Duncan, Miller & Jiang, 2012) are used to facilitate interactions in e-learning. Simulation, for example, is usually used to provide learners with realistic learning experience that mimic the experience that learners may receive in real world environments (Kindley, 2002). Gaming technology allows learners to develop knowledge through participation in interactive games (Squire, 2008). Much of the above technologies are, however, are adopted unevenly across the world, due to the costs and high technical requirements associated with them (Fernando, 2008; Warburton, 2009; Laurillard, 2010).

During the past few years, the popularity of Web 2.0 technology as a technology that facilitates interactive e-learning in higher education across the world has been increasing (Boulos, Maramba & Wheeler, 2006; Ahmed, 2011; Stern & Willits, 2011). Web 2.0 technology refers to a set of web based tools available for creating and aggregating web content, sharing information, and communicating mostly free of charge (O'Rilley, 2005; Bates, 2010). Blogs, wikis, social bookmarking and YouTube are examples of Web 2.0 tools. Using such tools, learners are able to communicate and collaborate with peer learners and instructors, to contribute to discussions and learning resources, to participate in learning activities, and to publish content more actively (McLoughlin & Lee, 2007; Ajjan & Hartshorne, 2008; Bernsteiner, Ostermann & Staudinger, 2008).

Much research is conducted to investigate how Web 2.0 tools support different kinds of interactions in e-learning. Wheeler, Yeomans, and Wheeler (2008), for example, show how

wikis support learner-learner interactions in a study conducted in the United State of America. Ruyters, Douglas, and Law (2011) investigate how blogs and wikis can be used for facilitating learner-learner interactions in a study conducted in Australia. Through a study conducted in Australia, Saeed and Yang (2008a) show that blogs and social bookmarks can be used for facilitating learner-learner and learner-instructor interactions. These studies, however, have not provided a comprehensive understanding of how Web 2.0 technology supports interactive e-learning. Many existing studies only investigate how a particular Web 2.0 tool such as blogs or wikis supports interactive e-learning (Wheeler, 2009; Uzunboylu, Bicen & Cavus, 2011; Laru, Näykki & Järvelä, 2012). There is a lack of empirical studies that investigate whether Web 2.0 technology supports all three types of interactions in an e-learning environment (Huang & Nakazawa, 2010). Furthermore, existing studies have not much investigated whether Web 2.0 technology can be used to increase the interactivity in e-learning in different cultures.

To address the limitations of existing research on the Web 2.0 based interactive e-learning as above, this research aims to investigate the enabling role of Web 2.0 technology for interactive e-learning in Australia, a developed country, and Sri Lanka, a developing country. Specifically, this research investigates how Web 2.0 technology supports learner-learning resources, learner-instructor and learner-learner interactions in e-learning. To achieve the aim of this research a conceptual framework on Web 2.0 technology based interactive e-learning is developed based on a comprehensive review of the related literature. The developed framework is tested and validated using quantitative data collected from learners studying in universities in Australia and Sri Lanka.

The remaining sections of this chapter are organized as follows. Firstly, the rationale for this research is explained in section 1.2. The aim of the research and the research questions for

this research are presented in section 1.3, followed by section 1.4 which discusses the research methodology used to achieve the aim of this research. Finally, the outline of the thesis is presented in section 1.5.

1.2 Rationale for the research

There are three reasons for undertaking this research. The lack of comprehensive research on the enabling role of Web 2.0 technology for interactive e-learning is the primary motivation for undertaking this research. Existing research on Web 2.0 technology has two major limitations in terms of revealing the enabling role of Web 2.0 technology in interactive e-learning. Firstly, much existing research on Web 2.0 based e-learning investigates how Web 2.0 tools support a specific type of interactions in e-learning such as learner-learner interactions, learner-instructor interactions or learner-learning resources interactions (Huang & Nakazawa, 2010). How Web 2.0 technology supports all three types of interactions has not been adequately investigated to date. Secondly, existing research focuses more on how a single Web 2.0 tool supports interactive e-learning (Wheeler, 2009; Uzunboylu et al., 2011; Laru et al., 2012). How the interactivity of e-learning can be improved by adopting multiples Web 2.0 tools for teaching and learning is unclear in the existing literature.

A lack of research on the extent to which Web 2.0 technology supports interactive e-learning in Sri Lanka is another motivation for conducting this research. Many developing countries such as Sri Lanka are taking initiatives to introduce Web 2.0 technology for improving the interactivity of e-learning in higher education (Ahmed, 2010; Yapa et al., 2012). In line with this, much research is done for investigating how Web 2.0 technology could be used to improve the interactivity of e-learning in those countries. However, there is a scarcity of research conducted on Web 2.0 based e-learning to date in Sri Lanka. Existing research, in

particular, critically lacks explaining how well learners in Sri Lanka use Web 2.0 technology for interacting with learning resources, instructors and peer learners. Such a study would help instructors to understand how Web 2.0 technology could be effectively used to improve the interactivity in e-learning in higher education in Sri Lanka.

A lack of research which compares how Web 2.0 technology supports interactive e-learning in different cultures is another motivation for this research. A large body of research has investigated how Web 2.0 technology could be used to improve interactive e-learning in various countries. There is, however, a dearth of research which compares how Web 2.0 technology supports interactive e-learning in different cultures. In particular, to the best of author's knowledge, there is a scarcity of studies which compare how Web 2.0 technology supports interactive e-learning in developing countries and developed countries. Could Web 2.0 technology support interactive e-learning in developing countries to the same extent it does in developed countries? What are the lessons that developing countries could learn about the application of Web 2.0 technology for interactive e-learning from developed countries? Such questions, therefore, remain unanswered.

1.3 Aims of the research and research questions

The primary aim of this research is to investigate the enabling role of the Web 2.0 technology for interactive e-learning in Australian and Sri Lankan higher education. Specifically this research aims to:

a. Investigate the extent to which Web 2.0 technology supports learner-learning resources interaction in Australian and Sri Lankan higher education,
b. Investigate the extent to which Web 2.0 technology supports learner-instructor interaction in Australian and Sri Lankan higher education,

c. Investigate the extent to which Web 2.0 technology supports learner-learner interaction in Australian and Sri Lankan higher education.

To fulfil the aim of this research, a primary research question is formulated as "How does web 2.0 technology support developing interactive e-learning in Australian and Sri Lankan higher education?". To facilitate answering the primary research question, several subsidiary research questions are formulated as follows:

a. To what extent does Web 2.0 technology support learner-learning resources interactions in e-learning in Australian and Sri Lankan higher education?
b. To what extent does Web 2.0 technology support learner-instructor interactions in e-learning in Australian and Sri Lankan higher education?
c. To what extent does Web 2.0 technology support learner-learner interactions in e-learning in Australian and Sri Lankan higher education?

1.4 Research methodology

The primary research aim of this research is to investigate the enabling role of Web 2.0 technology for interactive e-learning in Australian and Sri Lankan higher education. To fulfil the aim of this study, a quantitative research strategy is adopted (Creswell, 2009). A quantitative research strategy enables evaluating specific hypotheses to answer the research questions (Neuman, 2007, Creswell & Plano Clark, 2011). In particular, a quantitative strategy is useful for examining how well-defined hypotheses are supported by numeric data representing viewpoints of a population (Creswell & Plano Clark, 2011).

Quantitative research strategy is considered suitable for meeting the objectives of this research over other research strategies due to two reasons. Firstly, quantitative research

strategy is considered suitable over qualitative research strategy for this research for obtaining results that could be generalized to a large population and for drawing strong inferences from data through statistical analysis (Steckler et al., 1992; Landman, 2003; Creswell, 2009). Secondly, quantitative research is found to be appropriate for this research over qualitative research strategy and mixed method research strategy due to convenience in collecting data and comparing perceptions of learners on Web 2.0 based interactive e-learning. Comparing perceptions using mixed method research strategy is time consuming and complicated, in particular, in comparing perceptions across multiple cultures (Weber, Festing & Dowling, 2013). Comparison in qualitative research strategy requires richer information to make comparisons which is difficult to collect (Landman, 2003).

As shown in Figure 1.1, this research follows six phases to fulfil the aim of the study using the quantitative research strategy. The research is initiated with the formulation of research questions in the first phase. During the second phase of the research, the literature related to the research is reviewed. The review of related literature leads to a better understanding of how interactive e-learning could be facilitated using technology and how Web 2.0 tools could be used for interactive e-learning. Such an understanding leads to the development of a conceptual framework for Web 2.0 based interactive e-learning in the third phase of the research. In this phase, several hypotheses are developed based on the relationships among the theoretical constructs of the conceptual framework.

In the fourth phase of the research, the research instrument is developed. During this phase, data is also collected from learners in universities in Australia and Sri Lanka using the developed survey instrument. In the fifth phase of the research, the collected data is used to validate the proposed conceptual framework using structural equation modelling (SEM) techniques (Byrne, 2010). This validation reveals whether the proposed hypotheses on Web

2.0 based interactive e-learning are valid in Australian and Sri Lankan higher education. Finally, in the sixth phase of the research, the results of the data analysis are interpreted to draw specific conclusions to adequately answer the research questions.

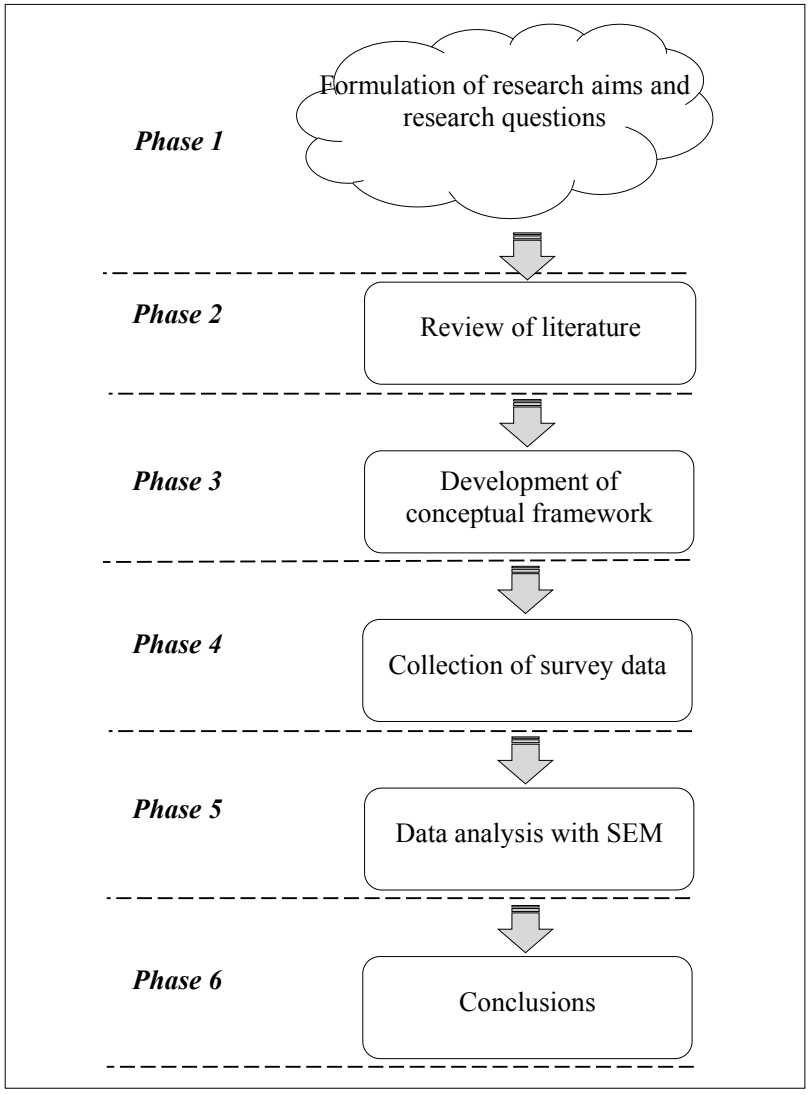

Figure 1.1: Research methodology

1.5 Outline of the thesis

Chapter 1 of this thesis provides an introduction to the research. The chapter presents a brief description of the background of the research, the rationale for the research, the research aims, and the research methodology used to meet the research objectives.

Chapter 2 provides a comprehensive review of the literature relevant to this research. The review of literature in this research is presented in three phases. Firstly, the research context is discussed with an emphasis on the differences in Australian and Sri Lankan contexts in terms of higher education, e-learning and culture. Secondly, interactive e-learning is discussed in details. The theories for supporting interactive e-learning, different types of interactions in e-learning, and the constructs in e-learning environments that facilitate interactive e-learning are discussed. Finally, the application of technologies for interactive e-learning is discussed with a special focus on how Web 2.0 technology could be used to develop interactive e-learning. The gaps in existing research on Web 2.0 based interactive e-learning are highlighted.

Chapter 3 of this thesis explains how a conceptual framework for Web 2.0 based interactive e-learning is developed by considering how different interactions in e-learning could be facilitated using Web 2.0 technology. The individual hypotheses proposed based on the conceptual framework are discussed in this chapter. Furthermore, the theoretical constructs of the framework and indicator variables related to each construct are described.

Chapter 4 explains in detail the research methodology used in this research to meet its objectives. An overview of different research philosophies and research strategies are presented in this chapter. How this research is designed to meet its objectives using the selected research strategy is explained. In particular, the development of the survey instrument, the data collection process, the steps taken to enhance the reliability and the validity of the research, and the implementation of the data analysis process are explained.

Chapter 5 details how preliminary data analysis is carried out on the data collected in this research. The chapter discusses how the collected data is screened for those issues with data such as missing values, outliers and non-normality. The steps taken to address such issues are explained. The demographic information of the collected data samples is summarized. The

descriptive statistics for the data distribution of each measurement variable of the conceptual framework are presented. In addition, the results of the tests for the common method bias are discussed.

Chapter 6 explains the process of SEM followed in this research to validate the conceptual framework. The chapter also explains how the SEM measurement model in this research is validated using the confirmatory factor analysis. How the measurement model is developed and assessed, and the steps taken to improve the fitness of the measurement model are explained in detail. In addition, the chapter also examines the validity of the developed measurement model across the two samples.

Chapter 7 explains how the data collected in this research are used to validate the SEM structural model to examine the validity of the proposed conceptual framework. The chapter also discusses the tests conducted to assess the validity of the structural model across the two samples. The results of the above tests are presented and the findings are discussed.

Chapter 8 provides the conclusion of the research. It presents a summary of the research findings. The implications of the research findings are also discussed. The contribution of this research to the existing body of knowledge on the enabling role of Web 2.0 technology for interactive e-learning is discussed. Finally, the chapter provides a brief discussion of the limitations of the present study and how this research work can be extended in future.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

The popularity of Web 2.0 technology as effective tools for providing entertainment has risen worldwide in the past decade (Boyd, 2007). More recently, educators too have found that Web 2.0 tools also have a greater potential in delivering effective e-learning (Bates, 2010; Dabbagh & Kitsantas, 2012). Web 2.0 tools such as blogs, wikis, YouTube and social bookmarks are now increasingly being used in e-learning (Bates, 2010). Such tools are, in particular, useful for improving learners' participation in learning and interactive collaboration (McLoughlin & Lee, 2007; Dabbagh & Kitsantas, 2012).

This chapter reviews the literature related to this research, especially, the literature that reveals the enabling role of Web 2.0 technology for interactive e-learning in Australian and Sri Lankan higher education. The literature discussed in this chapter falls in to three categories. Firstly, this chapter discusses how e-learning is delivered in Australia and Sri Lanka with a special focus on technologies used to deliver e-learning, and cultural dimensions which influence learners in those countries to use technologies in specific ways. Secondly, the chapter discusses what interactive e-learning is, the theories supporting interactive e-learning and how interactive e-learning is facilitated in modern e-learning systems. Thirdly, this chapter discusses different technologies used to deliver interactive e-learning with a special focus on Web 2.0 technology. The limitations of existing research on Web 2.0 based interactive e-learning are also highlighted.

The remaining sections of the chapter are organized as follows. Firstly, section 2.2 discusses how e-learning is facilitated in Australia and Sri Lanka. Section 2.3, then, presents an overview of e-learning followed by section 2.4 which discusses the theories of learning which are often referred to in designing e-learning. Sections 2.5 and 2.6 discuss different types of interactions that happen in e-learning and how the interactivity of e-leaning could be improved by facilitating such interactions. Section 2.7 presents a discussion of the popular tools and technologies used for facilitating e-learning followed by section 2.8 which presents a comprehensive review of the popular Web 2.0 tools, their current use for e-learning and the current research on Web 2.0 based interactive e-learning. Finally, section 2.9 presents the conclusion of the chapter.

2.2 E-learning in Australia and Sri Lanka

2.2.1 Higher education in Australia and Sri Lanka

Higher education in Australia is provided by both self-accrediting and non-self-accrediting institutions (Australian Bureau of Statistics, 2013). Self-accrediting institutions include universities which are authorized to award formal qualifications. Non-self-accrediting institutions include education providers such as business colleges which are accredited by state or territory authorities (Australian Bureau of Statistics, 2013). Admission to higher educational institutions as above is done based on learners' performance in secondary schools, completion of entry exams or bridging courses, or based on prior experience (Australian Bureau of Statistics, 2013). In year 2010, 1.2 million learners were enrolled in higher educational programs in Australia. 72% of these learners were domestic learners whereas 28% were international students (Australian Bureau of Statistics, 2013).

Universities in Australia deliver online education to a large number of learners. The Open University in Australia (OUA) plays a leading role in providing online and distance education (Open Universities, 2013). The university is owned by seven universities, namely, Curtin University, Griffith University, Macquarie University, Monash University, RMIT University, Swinburne University of Technology and the University of South Australia (Open Universities, 2013). OUA provides a wide range of higher educational courses online (Open Universities, 2013). Many other universities such as Deakin University and University of Central Queensland also offer a large number of higher educational programs online.

The government of Sri Lanka provides free education to learners from the primary level to the tertiary level (Karunanayaka & Wijeratne, 2005). There are 15 public universities in Sri Lanka which provide higher education to learners free of charge (UGC, 2012a). Due to a lack of resources and adequate infrastructure those public universities are, however, able to deliver education only to a limited number of learners (Thowfeek & Hussin, 2008). For example, among a total of 141,411 learners who were qualified for higher education in year 2011, only 28,908 learners were able to be accommodated in public universities (UGC, 2012b). Learners who could not be admitted to public universities could obtain higher education from the Open University of Sri Lanka (OUSL) and several private educational institutes including Sri Lanka Institute of Information Technology (SLIIT) and National Institute for Business Management (NIBM) which also provide higher education to learners with the approval of the University Grants Commission of Sri Lanka (Karunanayaka & Wijeratne, 2005; Thowfeek & Hussin, 2008). There are also several other educational institutes including the aforementioned institutes which offer higher educational programs in collaboration with foreign universities. However, the number of learners accommodated in such institutions is low.

The government of Sri Lanka and universities in Sri Lanka have recognized the benefits of providing learners with education through e-learning (Fernando, 2008). Several initiatives have been implemented to deliver teaching and learning to learners online (Fernando, 2008). Universities such as the Open University of Sri Lanka, University of Colombo and University of Moratuwa offer courses online (Andersson, 2008; Mozelius, Hewagamage & Hansson, 2011). The Ministry of Higher Education in Sri Lanka has also started NODES (National Online Distance Education Service) access centres through which both local universities and private educational institutes are able to deliver educational programs to students across the country (Mozelius et al., 2011). There are 26 NODES access centres established in Sri Lanka. Information and Communication Technology Agency (ICTA) of Sri Lanka has also established distance and e-learning (DeL) centres attached to universities located in rural areas with the aim of facilitating learners to learn in virtual classrooms (Thowfeek & Hussin, 2008). In addition, knowledge centres which are referred to as 'Nenasala' centres in Sinhala are developed around the country to disseminate knowledge in rural areas (Mozelius et al., 2011). Such centres offer computer based training programs and access to large e-libraries and periodicals useful for learners.

2.2.2 Technology use and cultural differences

Numerous technologies are used to facilitate teaching and learning online in Australia. Many universities in Australia use commercial learning management systems (LMSs) such as BlackBoard to deliver teaching and learning (Gosper, Malfroy, McKenzie & Rankine, 2011). Systems such as Blackborad contain several tools such as discussion forums, quizzes, assignment submission systems to support teaching and learning. In addition to LMSs, there are several other tools which are used in e-learning in Australia such as virtual worlds, e-

libraries, multimedia technology and Web 2.0 tools including blogs, wikis, podcasts, Google docs and Google talk (Saeed & Yang, 2008a; Gosper et al., 2011).

Similar to universities in Australia, public universities in Sri Lanka use a LMS as the main tool to deliver e-learning. The aforementioned LMS, namely, Moodle is an open source LMS. Tools available in Moodle assist instructors to post learning resources such as slides and video lectures, conduct quizzes and create forums for holding discussions (Andersson & Grönlund, 2009). In addition to Moodle, e-learning centres developed by ICTA and the Ministry of Higher Education in Sri Lanka provide services such as web TV, webcasting and online examinations to support the delivery of teaching and learning (Thowfeek & Hussin, 2008). Furthermore, Web 2.0 tools are used on a small scale across the country to provide teaching and learning online (Yapa et al., 2012).

Numerous technologies such as LMSs, web casting and Web 2.0 tools are used in delivering e-learning in Australia and Sri Lanka. The introduction of the technologies as above for e-learning, however, does not necessarily guarantee that learners would readily use them (Bates, 1997). Technology adoption by learners in e-learning is often influenced by the cultural dimension **(**Straub, Keil & Brenner, 1997; Li, Chau & Slyke, 2010**).** Learners from different cultures respond to technologies used for teaching and learning in different ways (Li & Kirkup, 2007).

To understand the cultural differences that may influence the adoption of Web 2.0 technology in e-learning in Australia and Sri Lanka, Hofstede's (1986) cultural dimensions are used in this study. Hofstede (1983) identifies four dimensions, namely, power distance, individualism/collectivism, masculinity/femininity, and uncertainty avoidance to differentiate national cultures as follows.

a) Power distance – Hofstede (1997) defines power distance as "the extent to which the less powerful members of institutions and organizations expect and accept that power is distributed unequally" (p. 307). It means that nations with lower power distance offer teaching and learning which is centred on learners (Hofstede, 1997). Instructors in such nations are facilitators of teaching and learning. Learners are actively engaged in discussing, solving problems and developing their own knowledge (Hofstede, 1997; Edmundson, 2007). Teaching and learning in nations with high power distance, on the other hand, is instructor centred (Hofstede, 1997). Instructors are solely responsible for creating learning activities and initiating discussions (Hofstede, 1997; Edmundson, 2007).

b) Individualism/collectivism – Hofstede (1980) defines individualistic cultures as those "in which ties between individuals are loose" (p. 51). Collectivistic cultures are considered as cultures "in which people from birth onwards are integrated in strong, cohesive in groups which throughout people's lifetimes continue to protect them in exchange for the unquestioned loyalty" (Hofstede, 1980, p. 51). Learners in cultures with high individualism prefer to work as individuals to achieve their learning goals. Furthermore, they expect each individual to be treated as equal (Edmundson, 2007). In contrast learners in collectivist cultures work towards achieving learning goals in groups. Furthermore, they expect preferential treatment based on their ethnicity or class (Hofstede, 1986; Edmundson, 2007).

c) Masculinity/femininity – Hofstede (1997) states that the masculine cultures are cultures that "strive for the maximum distinction between what men are expected to do and what women are expected to do. They expect men to be assertive, ambitious and competitive, to strive for material success, and to respect whatever is big, strong, and fast" (Hofstede, 1997, p. 308). In feminine cultures "men need not be ambitious or

competitive but may go for a different quality life than material success" (Hofstede, 1997, p. 308). In high masculine cultures learners compete openly and achieve their learning goals. In a low masculine culture learners have "more relaxed expectations" (Edmundson, 2007, p. 272).

d) Uncertainty avoidance – Hofstede (1997) defines uncertainty avoidance as "the extent to which the members of the culture feel threatened by uncertain or unknown situations" (p. 308). Learners belonging to cultures with weak uncertainty avoidance are comfortable with unstructured learning activities (Hofstede, 1986). They are able to provide multiple solutions to solve a given learning problem (Edmundson, 2007). Instructors acts as the facilitators for learning. In contrast, learners belonging to the cultures with strong uncertainty avoidance "prefer a structured learning environment, precise objectives, precise answers and reward for accuracy" (Edmundson, 2008, p. 272).

Table 2.1 shows the estimates obtained for power distance, individualism/collectivism, masculinity/femininity, uncertainty avoidance for Australia and Sri Lanka from the Hofstede Centre (The Hofstede Centre, 2014). Figure 2.1 shows the graphical representation of the values in Table 2.1

Table 2.1 : Cultural dimensions of Australia and Sri Lanka

Country	Power distance	Individualism	Masculinity	Uncertainty avoidance
Australia	36	90	61	51
Sri Lanka	80	35	10	45

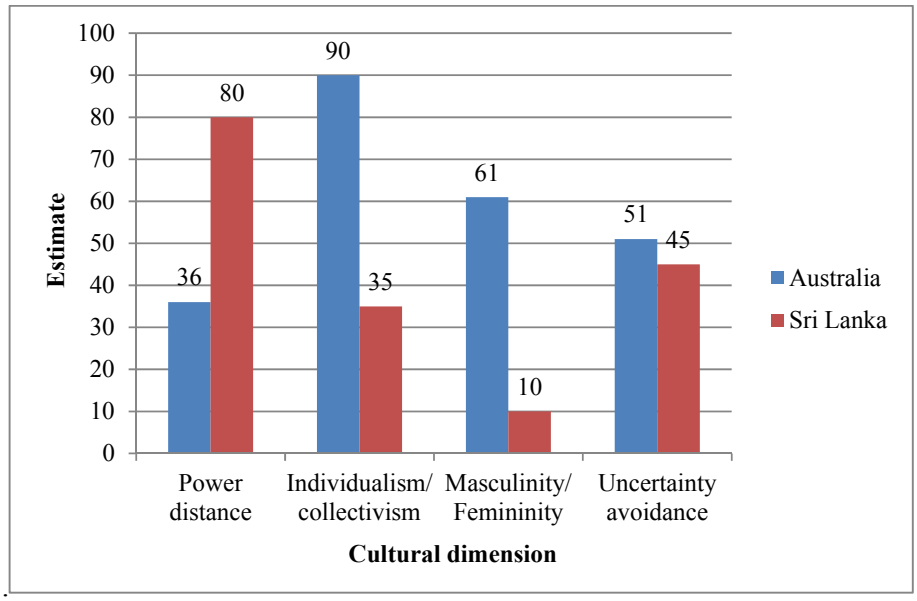

Figure 2.1: Cultural dimensions of Australia and Sri Lanka

The results shown in Table 2.1 and Figure 2.1 highlight several differences between the Australian and Sri Lankan cultures. As shown in Table 2.1, the estimate obtained for power distance in Australia is low. Such a value implies that teaching and learning in Australia is more likely to be centred on learners. In comparison to the estimate obtained for the power distance in Australia, the estimate obtained for the power distance in Sri Lanka is high. This value implies that teaching and learning in Sri Lanka is most likely to be centred on instructors than on learners. Table 2.1 shows that the estimate obtained for individualism in Australia is very high, whereas the estimate obtained for individualism in Sri Lanka is low. The high estimate for individualism in Australia implies that learners in Australia are more like to work on their own towards achieving learning goals. The low estimate obtained for individualism in Sri Lanka, on the other hand, implies that learners in Sri Lanka are more likely to work in groups to achieve learning goals. Furthermore, learners would expect preference from instructors based on the class and the ethnicity. The estimate obtained for the masculinity for Australia is high. Such a value implies that learners in Australia are more likely to openly compete to achieve learning objectives. On the other hand, the low value

received for the masculinity in Sri Lanka implies that learners in Sri Lanka are more likely to have relaxed expectations regarding achieving learning objectives. Estimates obtained for uncertainty avoidance in Australia and Sri Lanka are not low. The above estimates indicate that learners in both Australia and Sri Lanka prefer structural learning environments and precise objectives in a similar manner.

2.3 An overview of e-learning

E-learning generally refers to facilitating teaching and learning using ICTs (Sife et al., 2007). Existing research have defined e-learning in numerous ways. For example Rosenberg (2000) defines e–learning as the application of Internet technology for the delivery of solutions that improve knowledge and performance of individuals. Wangpipatwong and Papasratorn (2007) refer to e-learning as an alternative method of teaching and learning delivered through a wide range of electronic media such as Internet, audio/video tapes and compact disks (CDs). Meredith and Newton (2003) define e-learning as teaching and learning facilitated through web-based technologies "that create connectivity between people and information and create opportunities for social learning approaches" (Meredith & Newton, 2003, p. 43). Ally refers to e-learning as the "use of Internet to access learning materials; interact with the content, instructor, and other learners; and to obtain support during learning process in order to acquire knowledge, to construct personal meaning and to grow from the learning experience" (Ally, 2004, p. 1).

The definitions such as above highlight a number of features of e-learning. Firstly, the definitions highlight that e-learning facilitates teaching and learning using ICTs such as CD, audio/video and Internet (Meredith & Newton, 2003; Wangpipatwong & Papasratorn, 2007). Secondly, the definitions highlight that e-learning enables learners to improve their

knowledge by interacting with other individuals and information (Rosenberg, 2000; Meredith & Newton, 2003; Ally, 2004). Thirdly, the definitions imply that e-learning could be used to both replace and enhance teaching and learning that occur in classrooms (Wangpipatwong & Papasratorn, 2007).

E-learning can be classified in various ways based on how it is offered (Ahmed, 2010). For example, e-learning is often categorized as hybrid e-learning or pure e-learning, and synchronous e-learning or asynchronous e-learning (Zhang & Nunamaker, 2003; Ahmed, 2010). Categorizing e-learning as hybrid e-learning or pure e-learning is done based on whether face-to-face learning in classrooms is used along with e-learning. Teaching and learning delivered online along with teaching and learning delivered face-to-face in classrooms is referred to as hybrid e-learning (Ahmed, 2010). Hybrid e-learning is also known as a mixed mode of e-learning (Harasim, 2000) or blended e-learning (Garrison & Kanuka, 2004; Bates, 2010). Teaching and learning offered solely online with no face-to-face learning, is referred to as pure e-learning (Ahmed, 2010).

E-learning can also be categorized as synchronous or asynchronous e-learning. Categorizing e-learning as synchronous e-learning or asynchronous e-learning is done based on whether e-learning is offered at real time (Zhang & Nunamaker, 2003). Teaching and learning delivered online with the simultaneous online presence of instructors and learners is referred to as synchronous e-learning. Synchronous e-learning allows two-way communication among the participants of e-learning simultaneously (Zhang & Nunamaker, 2003). Teaching and learning delivered online that does not require simultaneous online presence of the instructors and learners is referred to as asynchronous e-learning. In asynchronous e-learning, learners could learn according to their own schedule (Zhang & Nunamaker, 2003).

There are numerous benefits that e-learning can offer. These benefits include the ability to expand education, obtain economic benefits, provide convenience in learning, and to provide unlimited and equal access to learning (Volery & Lord, 2000; Bates, 2005; Selim, 2007; Appana, 2008). Since e-learning does not require learners to be allocated with physical resources such as classrooms, laboratories and text books, more learners could be enrolled to e-learning courses than to traditional courses. As a result, education could be provided to a larger community than it is possible with traditional learning (Volery & Lord, 2000; Bates, 2005; Appana, 2008). In addition, the costs of developing and printing learning materials, providing classrooms, and labour costs are reduced. The economic benefits could, therefore, be obtained by educational institutions with the introduction of e-learning (Zhang & Nunamaker, 2003; Bartley & Golek, 2004; Bates, 2005; Selim, 2007; Appana, 2008). E-learning benefits learners who cannot follow classes due to work or family commitments by allowing them to learn from anywhere and at any time(Harasim, 2000; Leung, 2003; Zhang & Nunamaker, 2003; Wangpipatwong & Papasratorn, 2009; Duncan & Young, 2009; Ahmed, 2010). Furthermore, learners have the benefit of accessing the learning content any time and equally voicing their opinions (Harasim, 2000; Zhang & Nunamaker, 2003; Ahmed, 2010).

There are many challenges to designing and implementing e-learning systems in order to improve the effectiveness of e-learning. These challenges include lack of digital resources, lack of trained staff, resistance of existing staff towards e-learning, lack of information technology infrastructure and meeting expectations of stakeholders (Rajesh, 2003; Fernando, 2008). Universities taking initiatives for e-learning may have to re-create learning resources that they have in a paper format in digital format. Such re-developments of resources would consume much time and effort. In addition, academic staff in universities may resist adopting e-learning due to their technical anxieties and due to their fears about the job security (Fernando, 2008; Andersson & Grönlund, 2009). A lack of such infrastructure is also a major

challenge to facilitate the development of e-learning (Anderson, 2008; Fernando, 2008). To develop the infrastructure for facilitating e-learning, upgrading the existing infrastructure and purchasing equipment would be required with additional costs. A summary of the above discussion is presented in Table 2.2.

Table 2.2 : Summary of overview of e-learning

Definition	Facilitating teaching and learning using ICTs
Categorizations	▪ Hybrid e-learning (blended, mixed mode)/pure e-learning o *Hybrid e-learning: e-learning as a supplement for teaching and learning in classrooms* o *Pure e-learning: teaching and learning is offered solely online* ▪ Synchronous e-learning/ asynchronous e-learning o *Synchronous learning: Teaching and learning online with simultaneous presence of learners and instructors* o *Asynchronous learning: Teaching and learning online which does not require simultaneous presence of learners and instructors*
Benefits	▪ Expand education ▪ Obtain economic benefits ▪ Provide convenience in learning ▪ Provide unlimited and equal access to learning
Challenges	▪ Lack of digital resources ▪ Lack of trained staff ▪ Resistance of existing staff towards e-learning ▪ Lack of information technology infrastructure

2.4 Theories of learning

The theories of learning explain different assumptions on how learning takes place (Ertmer & Newby, 1993; Alonso, López, Manrique & Viñes, 2005). Such assumptions are useful for educators in designing teaching and learning activities which are more effective (Ertmer & Newby, 1993; Dabbagh, 2005). The behaviourist theory, the cognitivist theory, the constructivist theory and the connectivism are the examples of prominent learning theories

(Alonso et al., 2005). The assumptions made in these learning theories are often used when teaching and learning activities are designed in both face-to-face and online learning (Dabbagh, 2005; Wangpipatwong & Papasratorn, 2007).

2.4.1 Behaviourist theory

The behaviourist theory of learning (Skinner, 1974) defines learning as an "observable change in behaviour" (Kahiigi, Ekenberg, Hansson, Tusubira, & Danielson, 2008, p. 79). The central theme of the theory is that the behaviour of individuals could be shaped through reinforcements (Case & Bereiter, 1984). According to this theory, a trial-and-error method is used for teaching and learning. The teaching starts with the provision of some external stimulus to which learners have to respond. Based on the correctness of leaners' response, positive or negative reinforcements are given to shape leaners' behaviour towards providing the correct response to the stimulus in the future (Ertmer & Newby, 1993; Barnes & Tynan, 2007). "Learning is accomplished when a proper response is demonstrated following the presentation of a specific environment stimulus" (Ertmer & Newby, 1993, p. 48). Behaviourism does not explain how learners' mind is involved in learning. As a result, a black box approach is often used as a metaphor to explain the nature of learners' mind in behaviourism (Jonassen, 1991).

There are several disadvantages of following the behaviourist theory in designing teaching and learning. One of the major limitations of teaching and learning designed following the behaviourist theory is that learning is centralized on instructors. Learners are, therefore, not given opportunities to actively participate in learning and construct their knowledge (Barnes & Tynan, 2007). In addition, instructors who follow the behaviourist theory often find designing teaching and learning difficult and impractical (Case & Bereiter, 1984).

2.4.2 Cognitivist theory

The cognitivist theory of learning is widely influenced by the work of Bruner (1966), Merrill (1983), Reigeluth and Stein (1983), and Gagne, Briggs and Wager (1992). The theory views learning as "the acquisition or reorganisation of the cognitive structures through which humans process and store information" (Alonso et al., 2005, p. 219). Learners' mind is considered as a 'processor of information' (Hung, 2001; Alonso et al., 2005). Memory is also given a prominent role in the process of learning (Ertmer & Newby, 1993). Knowledge is considered as something external that instructors are responsible for transferring to leaners (Jonassen, Davidson, Colling, Campbell, & Haag, 1995).

The learning process is centred on the instructor. Learners store and organize their knowledge transferred by instructors in the memory and retrieve the stored knowledge later (Good & Brophy, 1990; Ertmer & Newby, 1993; Alonso et al., 2005). Learning is considered effective when learners store or 'mirror' the knowledge transferred to them in the most optimal manner and reproduce them when it is required (Jonnasen, 1991; Ertmer & Newby, 1993; Bates 2010). To improve the effectiveness of learning of this nature, instructors pay more attention to how knowledge can be presented to learners in a well-organized manner such that they can integrate and store the new knowledge with the existing knowledge with ease (Ertmer & Newby, 1993). Teaching aids such matrices, hierarchical charts and comparisons are often used for presenting learning content in a structured manner for improving the effectiveness of learning (Ertmer & Newby, 1993).

There are several disadvantages of following the cognitivist learning theory in designing teaching and learning. Firstly, the cognitivist theory suggests that instructors should decompose and simplify the knowledge and problem to be solved by learners to make the knowledge transferring process easier (Jonnasen, 1991; Ertmer & Newby, 1993). This

simplification often leads to hiding the true nature of the complex real world problems that learners would have to work with outside the boundaries of the classroom (Jonnasen, 1991). Secondly, teaching and learning following the cognitivist theory is centred on the instructor (Jonassen et al., 1995). Similar to the behaviourist theory, the cognitivist theory of learning, therefore, too fails to recognize that learners could construct their knowledge by actively participating in learning.

2.4.3 Constructivist theory

The constructivist theory is influenced by the work of Dewey (1938), Bruner (1960), Piaget (1977), and Vygotsky (1978). One major noteworthy assumption of the constructivist theory over the other learning theories is the assumption that learners can actively participate in constructing their own knowledge (Jonnasen, 1991; Ertmer & Newby, 1993; Du & Wagner, 2007). With such assumptions, the constructivist theory states that learners can filter information from their learning environments, interpret the information based on their experience and produce new knowledge (Jonnasen, 1991; Ertmer & Newby, 1993; Jonassen et al., 1995; Alonso et al., 2005). Each learner is, therefore, capable of constructing their own personal realities (Ertmer & Newby, 1993; Jonassen et al., 1995).

The constructivist learning theory recognizes the importance of the social aspects of learning (Foroughi, 2011). It states that interacting with peer learners and instructors can enable learners to develop their knowledge (Foroughi, 2011). Unlike behaviourist learning, however, instructors in constructivist learning do not deliver knowledge to learners (Barnes & Tynan, 2007). An instructor in constructivist learning prepares complex and loosely defined problems which learners have to solve by raising questions, evaluating multiple perspectives, reflecting, and discussing with other learners (Jonassen et al., 1995).

There are many benefits of following the constructivist learning theory in designing teaching and learning. Firstly, teaching and learning designed following the constructivist theory provides learners with opportunities to actively participate in learning (Wangpipatwong & Papasratorn, 2007). Secondly, teaching and learning designed following the constructivist theory encourage the adoption of a deep learning approach where learners gain an in-depth understanding of problems and tailor existing knowledge to situations rather than reproducing knowledge (Ertmer & Newby, 1993). Thirdly, the above type of learning enables learners to develop their knowledge as well as numerous skills such as critical thinking and reflecting (Andrade et al., 2005). Due to the benefits as above, the constructivist learning theory is the predominant theory that influences teaching practice in both classroom settings and online settings at present (Karagiorgi & Symeou, 2005; Wangpipatwong & Papasratorn, 2007).

2.4.4 Connectivism

Connectivism is a theory which considers learning as connecting to knowledge sources and discovering meaning from them (Siemens, 2005; Barnes & Tynan, 2007). The central message of the connectivism is that knowledge can exist outside individuals (Siemens, 2005). Knowledge sources are referred to as nodes. Nodes may range from images, videos, information sets to other individuals (McLoughlin & Lee, 2010a). Each node may connect with other nodes for forming a network (Kop & Hill, 2008; McLoughlin & Lee, 2010a). With the advancements of technologies, learners are capable of using numerous technologies to connect to and network with knowledge sources. Sustainable learning could be achieved by strengthening and maintaining connections between nodes (Siemens, 2005). Table 2.3 presents a summary of the learning theories discussed above.

Table 2.3 : Summary of learning theories

	Behaviourist theory	Cognitivist theory	Constructivist theory	Connectivism
Learning process	Learning is the change of observable behaviour. Learning is considered as a black box (Kahiigi et al., 2008)	Learning is the acquisition or reorganisation of cognitive structures through which humans process and store information (Alonso et al., 2005)	Learning is the ability to construct knowledge through experience and interactions with other individuals (Jonnasen, 1991; Ertmer & Newby, 1993)	Learning is connecting to knowledge sources and discovering meaning from them (Siemens, 2005; Barnes & Tynan, 2007)
Important elements in teaching and learning	Stimuli, reinforcement (Siemens, 2006)	Well-structured knowledge (Ertmer & Newby, 1993)	Experience, interactions with other individuals (Siemens, 2006)	Strength of the knowledge network (Siemens, 2006b)
Nature of learning	Teacher-centred learning, Learning is passive	Teacher-centred learning, Learning is passive	Learner-centred learning, Learning is active	Learner-centred learning, Learning is active
Nature of learning tasks	Trial and error problem solving (Siemens, 2006)	Solving simple problems (Ertmer & Newby, 2003)	Solving complex loosely defined problems (Ertmer & Newby, 2003)	Complex learning that requires connecting to knowledge sources (Siemens, 2006)

2.5 Interactions in e-learning

Leading learning theories such as the constructivist learning theory and the connectivism identify interactions as an influential factor for effective learning (Wangpipatwong & Papasratorn, 2007). Interactions are the reciprocal events involving individuals or objects during which the objects and individuals influence each other (Wagner, 1994; Swan, 2002). It is a key element in both face-to-face and online learning (Dillion & Gunawardena, 1995; Garrison & Cleveland-Innes, 2005; Woo & Reeves, 2007). Lack of interactions in e-learning

often results in creating feelings of stress and isolation in learners which adversely affect their continuation in learning (Davies & Graff, 2007).

Interactions in e-learning take place for different purposes. For example Wagner (1997) describes twelve kinds of interactions that can occur in an e-learning environment for different purposes as follows:

a. Interaction to increase participation – interactions that improve learners' engagement in learning. Those interactions happen when learners actively participate in learning by "discovering and constructing meaning from information and experience" (Wagner, 1994, p. 22).
b. Interaction to develop communication – interactions through which learners share information and express themselves freely with peer learners and instructors without a sense of anxiety.
c. Interaction to receive feedback – interaction through which learners obtain information related to their performance. Such information could be obtained from instructors, peer learners or learning content.
d. Interaction to enhance elaboration and retention – interactions through which examples and alternative explanations are presented, and manipulation of information is done to enhance learners' understandings.
e. Interaction to support learner control/self-regulation – interactions to provide learners with information to make them manage the depth and the range of content to learn. Such support is useful to assist learners to become life-long learners.
f. Interactions to improve motivation – interactions to improve learners' motivation to learn. Such interactions focus on assisting learners to overcome their fears, worries and insecurities.

g. Interactions for negotiating and understanding – interactions which take place between individuals to reveal misconceptions and develop shared understanding of the learning content.
h. Interactions for team building – interactions to develop a sense of a team spirit during learning. Such interactions are important for learning activities that require team work.
i. Interactions for discovery – interactions to structure information to develop new understanding.
j. Interactions for exploration – interactions to define new understandings and distinguish the new understanding from the existing understandings.
k. Interactions for clarification and understanding – interactions to reveal whether individuals' articulations are correct as they are originally explained to them.
l. Interactions for closure – interactions among individuals to reflect on learning expectations of learning tasks and assess whether the learning expectations are met at the end of the task.

Interactions in e-learning as above could positively influence the effectiveness of e-learning in many ways. For example, interactions that require learners to explore and manipulate information, and discuss and share ideas with peer learners enable learners to construct their own knowledge (Barker, 1994; Chou, 2003; Luo & Lei, 2012). Such interactions enable learners to develop skills such as critical thinking, reflecting, communicating and team work (Johnson & Johnson, 1986; Woo & Reeves, 2007; Luo & Lei, 2012). Increased interactions with peer learners and instructors also improve learners' satisfaction with e-learning (Alavi, 1991; Baker, 1994). Furthermore, increased interactions between individuals in e-learning reduce the perceived psychological distance among learners (Moore, 1991). Reducing the perceived psychological distance in e-learning positively influences learners' motivation to participate in e-learning as well as ensuring the continuity of learning (Moore, 1991).

Interactions that occur in e-learning are classified in a number of ways. The most popular classification of interactions in e-learning is provided by Moore (1989). The above classification identifies three main types of interactions that occur in e-learning namely, learner-learning resources interactions, learner-instructor interactions and learner-learner interactions (Moore, 1989). Learner-learning resources interactions refer to the interactions that occur when the learners refer to and understand the learning content (Moore, 1989). Learner-instructor interactions refer to interactions between instructors and learners where the learners are provided with learning support (Moore, 1989). Learner-learner interactions refer to interactions among leaners for achieving common learning objectives (Moore, 1989). These interactions are explained in details in what follows.

2.5.1 Learner-learning resources interactions

Learner-learning resources interactions are the most basic kind of interactions that can take place in e-learning (Moore, 1989). Such interactions happen when learners develop new understanding from the learning content and integrate those understandings with existing knowledge (Moore, 1989; Wang, Woo & Zhao, 2009). The learning resources that learners interact with can be either course learning resources provided by instructors or learning resources found by learners themselves from various sources such as the Internet to assist them in meeting their learning goals (Sabry & Baldwin, 2003; Dabbagh & Kitsantas, 2012).

Learner-learning resources interactions are in particular important in e-learning for enabling learners to develop their knowledge and skills (Moore, 1989; Hsu, Ching & Grabowski, 2009). Learners could develop knowledge when they think, question and dialogue with themselves as a result of consuming learning resources (Berge, 2002). Such developments of knowledge are in line with the development of knowledge described in the constructivist and the connectivist learning theories (Wang et al., 2009). When learners think and question as a

result of interacting with content they are also able to develop specific skills such as critical thinking and reflection (Hsu et al., 2009; Dabbagh & Kitsantas, 2012).

2.5.2 Learner-instructor interactions

Learner-instructor interactions refer to the interactions that take place when instructors provide learners with learning support (Moore, 1989). It is the most important type of interactions in e-learning from the perspective of learners (Marks, Sibley & Arbaugh, 2005). Learning support provided by instructors could be categorized as managerial, social and technical (Berge, 1998). Managerial support provided by instructors includes creating learning activities and selecting learning materials. Social support provided by instructors includes stimulating learners' interest in learning, making clarifications, motivating, and communicating feedbacks (Moore, 1989; Berge, 1998). Technical support provided by instructors refers to the support that instructors provide to learners in using educational tools (Berge, 1998).

Learner-instructor interactions positively influence the effectiveness of e-learning in many ways (Bouhnik & Marcus, 2006). For example, frequent interactions between learners and instructors in the form of feedbacks and clarifications enable learners to reveal their misconceptions and better understand the content, thus better achieving their learning goals (Moore, 1989; Hackman & Walker, 1990; Bouhnik & Marcus, 2006; Eom, Wen & Ashill, 2006). Learner-instructor interactions also improve learners' satisfaction in e-learning (Hackman & Walker, 1990; Poelmans & Wessa, 2013). In addition, learner-instructor interactions are important in e-learning to reduce the perceived psychological distance between learners and instructors (Moore, 1991; Dennen, Darabi & Smith, 2007).

2.5.3 Learner-learner interactions

Learner-learner interactions refer to the interactions that take place among learners for meeting their common learning goals (Alavi, 1994). Such interactions may occur in the forms of discussions, sharing learning resources, and performing learning tasks collaboratively such as collaborative writing (Shee & Wang, 2000; Bouhnik & Marcus, 2006). Learner-learner interactions are one of the most influential features of teaching and learning online (Berge, 2002).

Learner-learner interactions could influence the effectiveness of e-learning in many ways. For example, learners are able to collaboratively construct their knowledge as explained in the constructivist learning theory when they share ideas, evaluate each other's opinions and discover misconceptions (Jonassen et al., 1995; Johnson & Johnson, 1996; Berge, 2002). Learners can also develop a wide range of skills such as team work, negotiation and communication skills through learner-learner interactions (Alavi, 1994; Jonassen et al., 1995). In addition, learner-leaner interactions can positively influence learners' satisfaction with e-learning (Fuller & Morena, 2004).

There are a few other types of interactions that could occur in e-learning. Hillman, Willis and Gunawardena (1994), for example, identify a forth type of interactions that can occur in e-learning, namely, learner-interface interactions. The above interactions refer to the interactions between learners and the technological medium (Vrasidas & McIsaac, 1999). Sutton (2001) finds the fifth type of interactions that can occur in e-learning which is known as vicarious interactions. This kind of interactions refers to actively observing the interactions among learners or the interactions between learners and instructors.

The focus of this research is on how learners can use Web 2.0 technology for directly interacting with learning resources and other individuals for learning. In this research how Web 2.0 technology is used for only learner-learning resources, learner-instructor and learner-learner interactions are considered. The classification of interactions in e-learning in the existing research is summarized in Table 2.4.

Table 2.4 : Classifications of interactions in e-learning

	Moore (1991)	Hillman, Willis and Gunawardena (1994)	Sutton (2001)
Type of interactions	1. Learner-content interactions 2. Learner- instructor interactions 3. Learner-learner interactions	1. Learner-content interactions 2. Learner- instructor interactions 3. Learner-learner interactions 4. Learner- interface interactions	1. Learner-content interactions 2. Learner- instructor interactions 3. Learner-learner interactions 4. Learner- interface interactions 5. Vicarious interactions

2.6 Interactive learning

The term "interactivity" refers to the capability of technologies to facilitate interactions in a specific environment (Wagner, 1994). To quote Wagner (1994), interactivity "appears to emerge from descriptions of the technological capability for establishing connections from point to point (or from point to multiple points) in real time" (p. 20). In detail, the interactivity of a technology, therefore, determines the extent to which users can be involved in accessing and modifying content and communicating using the technology (Steuer, 1992).

In e-learning, the interactivity is crucial for improving the effectiveness of teaching and learning delivered. For example, the interactivity in e-learning is helpful to enhance the

learning potential of learners (Moore, 1989; Chou, 2003). The increased interactivity in a learning environment positively influences learners' attitude towards e-learning, learners' satisfaction of e-learning and their motivation for e-learning (Moore, 1989; Violante & Vezzetti, 2013). Due to the above reasons, improving the interactivity is a fundamental concern in designing teaching and learning environments (Chou, 2003; Luo & Lei 2012).

A review of existing research reveals a number of variables of the interactivity to be considered when interactive web systems such as e-learning systems are implemented. For example, Heeter (1989) identifies six interactivity variables, namely, the complexity of choices available, the effort that users must exert, the responsiveness to the users, the easiness of adding information, monitoring the information and the system use, and the facilitation of interpersonal communications that should be considered in designing interactive web systems. The complexity of choices available refers to "the extent to which users are provided with a choice of available information" (Heeter, 1989, p. 222). Web systems with higher interactivity enable users to browse different types of information such as text, graphic, audio and video in the system. The effort that users must exert refers to the "amount of effort that a user of a media system must exert to access information" (Heeter, 1989, p. 222). Web systems that require less effort from users to access information in the system are more interactive. The responsiveness to users refers to "the degree to which a medium can react responsively to a user" (Heeter, 1989, p. 223). A web system has higher interactivity when users of the system get responses from other individuals and resources that they interact with. Monitoring of information use refers to the ability to track how users of the web system use information within the system. The easiness of adding information refers to "the degree to which users can add information that a mass, undifferentiated audience can access" (Heeter, 1989, p. 224). A web system that facilitates its users to add information and resources to the system has higher interactivity. Facilitating interpersonal interactions refers to the extent to which the

web system enables communications between specific users (Heeter, 1989). A web system that allows its users to have a higher degree of interpersonal communications has a higher degree of interactivity.

Borsook and Higginbotham-Wheat (1991) identify seven interactivity variables that should be considered in an interactive e-learning system, namely, immediacy of responses, non-sequential/non-linear access to information, adaptability, feedback, user options, bi-directional communication, and interruptability. The immediacy of responses refers to the ability of e-learning systems to promptly response to the requests of learners for information (Borsook & Higginbotham-Wheat 1991; Chou, 2003). E-learning systems with high immediacy of responses have better interactivity. Non-sequential/non-linear access to information corresponds to facilities in e-learning systems to allow its learners to access a large number of information and resources simultaneously (Borsook & Higginbotham-Wheat 1991; Chou, 2003). An e-learning system with the above facility is said to have better interactivity. The adaptability refers to the ability of e-learning systems to provide customized responses to individual learners based on their inputs (Allen, Walls, & Reilly, 2008). An e-learning system that provides such responses increases the interactivity of the learning system. Feedback is the customized responses provided to learners through the e-learning system (Chou, 2003). User options refer to the availability of choices for learners to select content to learn (Allen et al., 2008). An e-learning system that offers learners with more options is said to be more interactive. Bi-directional communications refer to enabling learners to have two-way conversations with instructors and peer learners. A higher degree of bi-directional communications in an e-learning system indicates a higher interactivity of the system. The interruptability refers to maximizing learners interactions with the e-learning system by reducing the delays between the sequence of instructions provided to learners

(Chou, 2003; Allen et al., 2008). Lower delay in instructional sequences increases the interactivity of an e-learning system.

Chou (2003) identifies nine interactivity variables, namely, choice, non-sequential access of information, responsiveness to learner, monitoring information use, personal choice helper, adaptability, playfulness, facilitation of interpersonal communication and ease of adding information. The variables choice, non-sequential access of information, responsiveness to learner, monitoring information use, adaptability, facilitation of interpersonal communication and ease of adding information are defined by Chou (2003) in a similar manner to Borsook and Higginbotham-Wheat(1991) and Heeter(1989). The personal choice helper refers to facilities in the e-learning system to enable learners to select appropriate instructional content from the system (Chou, 2003). Such a feature enables learners to filter content that they need to better meet their learning outcomes. Playfulness refers to information that "helps to arouse learners' curiosity and to entertain themselves" (Chou, 2003, p. 270).

Reeves (1997) also identifies a number of interactivity variables in an e-learning system, namely, the facilities to navigate through system, ability to select relevant information, ability to respond to questions, ability to solve problems, ability to complete challenging tasks, facilities to create knowledge representations, facilities to collaborate with other individuals and ability to engage in meaningful learning activities. Luo and Lei (2012) identify six features which are actively engaging learners in meaningful learning activities, providing prompt feedback and opportunities for reflection, allowing learners to customize their own learning pace, facilitating interpersonal communication, encouraging learners to contribute to learning resources and the body of knowledge and integrating various cognitive tools to support learning process. Interactive features discussed above are summarized in Table 2.5.

Table 2.5 : Interactive variables of e-learning systems

Heeter(1989)	Borsook and Higginbotham Wheat (1991)	Chou (2003)	Reeves (1997)	Luo and Lei (2012)
1. Complexity of choice available	1. Immediacy of response	1. Choice	1. Facilities to navigate through system	1. Actively engage in learning activities
2. Responsiveness to the users	2. Non-sequential/non-linear access to information	2. Non-sequential access of information	2. Ability to select relevant information	2. Prompt feedback and opportunities to reflect
3. Effort users must exert	3. Adaptability	3. Responsiveness to learner	3. Respond to questions	3. Customize learning pace
4. Ease of adding information	4. Feedback	4. Monitoring information use	4. Ability to solve problems	4. Facilitate communication
5. Monitoring the information and the system use	5. User options	5. Personal choice helper	5. Ability to complete challenging tasks	5. Contribute to the learning resources
6. Facilitation of interpersonal communication	6. Bi-directional communication	6. Facilitation of interpersonal communication	6. Facilities to create knowledge representations	6. Integrate cognitive tools
	7. Interruptability	7. Playfulness	7. Facilities to collaborate with others	
		8. Adaptability	8. Ability to engage in meaningful learning activities	
		9. Ease of adding information		

Interactive variables shown in Table 2.5 could be grouped into four constructs considering the types of interactions enabled by those variables. These constructs are management of learning resources, personal knowledge management, delivery of instructional support and collaboration. Management of learning resources refers to maintaining learning resources in learning resources repositories in a usable manner (Sridharan, Deng, & Corbitt, 2010). Facilities to navigate resources, contribute to resources, efficiently access resources and access to a large number of different type of resources are examples of the features of e-learning systems which effectively manage learning resources (Heeter, 1989; Borsook & Higginbotham-Wheat, 1991; Reeves, 1997; Chou, 2003; Luo & Lei, 2012). The aim of management of learning resources is to organize and present learning resources of different types in learning resources repositories in a manner that learners could easily find so as to meet their learning outcomes.

Personal knowledge management refers to maintaining one's personal information and resources in an effective manner (Cigognini, Pettenati, & Edirisingha, 2010). E-learning systems enable personal knowledge management through features such as facilities to add information, create knowledge representations such as e-portfolios, and to maintain reflections (Heeter, 1989; Reeves, 1997; Chou, 2003; Luo & Lei, 2012). The aim of personal knowledge management is to enable learners to maintain information and resources that would help them to better meet their learning objectives.

The delivery of instructional support refers to the provision of learning support to learners (Berge, 1998). E-learning systems that enable instructors to effectively deliver instructions consist of features to design learning activities, monitor how learners use information, communicate with learners and provide feedback (Heeter, 1989; Reeves, 1997; Chou, 2003;

Luo & Lei, 2012). The aim of the delivery of instructional support is to facilitate and guide learners towards achieving their course learning objectives (Alavi, 1994).

Collaboration refers to active interactions between learners to meet their academic goals (Alavi, 1994). Facilities to provide peer feedback, communicate with peers and perform collaborative tasks are examples of the features in e-learning systems that provide effective collaboration (Heeter, 1989; Borsook & Higginbotham-Wheat, 1991; Reeves, 1997; Chou, 2003; Luo & Lei, 2012). The aim of collaboration is to facilitate learners to collaboratively meet their learning goals and co-construct their knowledge (Murphy, 2004).

The constructs discussed above contribute to facilitating different types of interactions in e-learning. Management of learning resources and personal knowledge management are useful to facilitate learner-learning resources interactions. For example, effectively managed learning resources enable learners to efficiently find learning resources and understand content (Sridharan et al., 2011). Personal knowledge management, on the other hand, enables learners to create representations of knowledge and maintain reflections through which learners could better understand the learning content (Du & Wagner, 2007). The delivery of instructional support enables learner-instructor interactions. In particular, learner-instructor interactions are facilitated through learning support such as the creation of learning activities, and the provision of feedback and encouragements (Berge, 2002). Collaboration supports effective learner-learner interactions. In particular, learner-learning interactions are facilitated through peer feedback, peer communication and collaborative tasks (Alavi, 1994; Johnson & Johnson, 1996). How interactive e-learning is enabled through the constructs discussed above is shown in Figure 2.2.

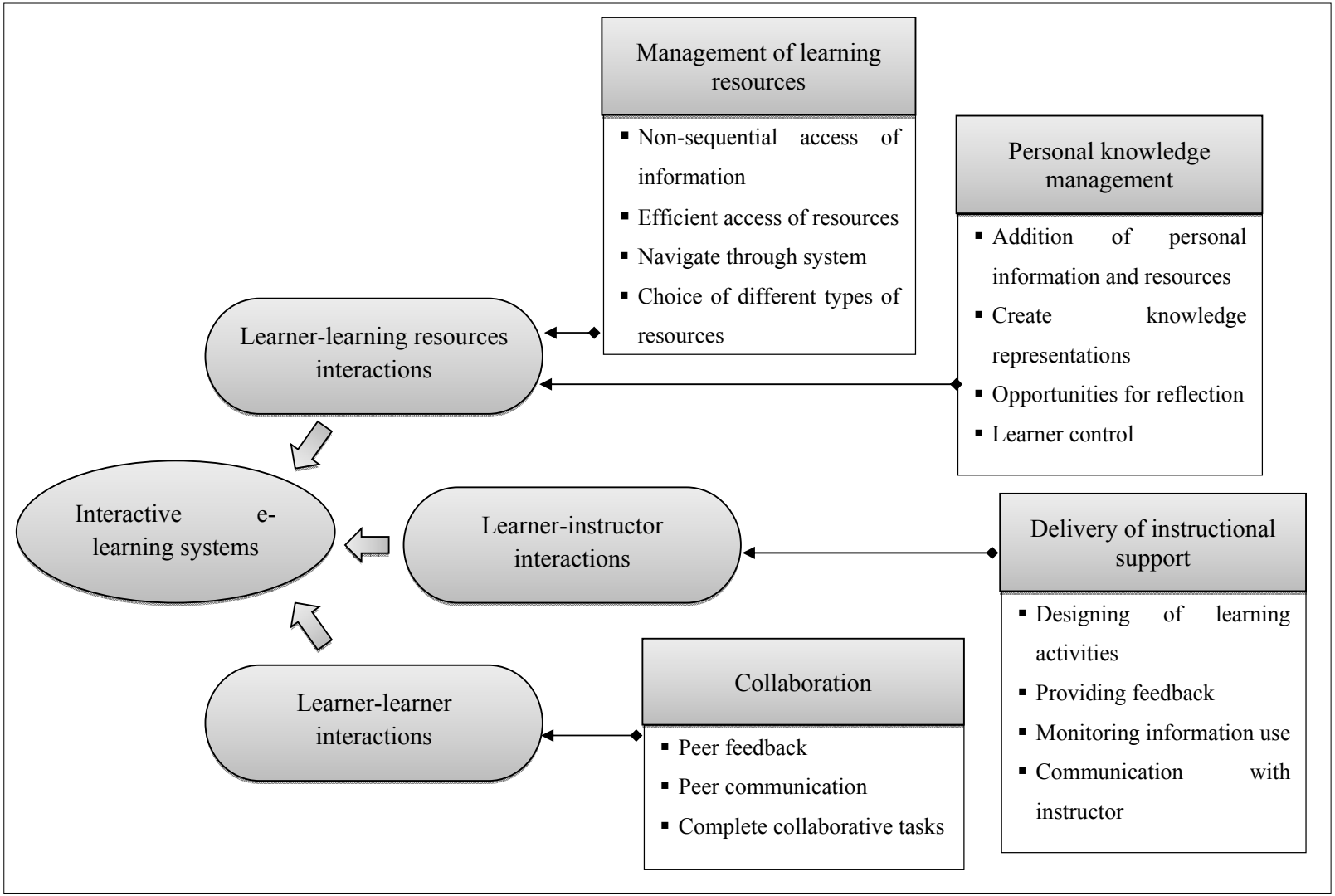

Figure 2.2: Constructs of interactive e-learning

2.7 Technology enabled interactive e-learning

Technologies are the backbone of e-learning (Bates, 2005). They enable online learning by offering a set of tools that could be used by instructors to deliver teaching and learning and learners to learn (Bagley & Hunter, 1992; Hannafin & Land, 1997). Technology capabilities in an e-learning system determine what types of content could be delivered, what types of interactions are possible, and what types of teaching and learning strategies could be adopted by instructors (Hannafin & Land, 1997).

There are a number of technologies which have been used for delivering e-learning to date. E-learning is initially delivered through technologies such as audio tapes and TV (Laurillard, 2010). The development of personal computers and communication networks in the middle of 1980s has made e-learning accessible to a much larger community of learners. Tools such as CDs were introduced during the above period to support computer based training (Kahiigi et al., 2008). Emailing is used for communications between learners and instructors (Bates, 2010).

The introduction of the World Wide Web which is also known as the Internet in late 1980s has revolutionized how teaching and learning occurs online (Bates, 2010; Laurillard, 2010). With the Internet, educators are able to share learning content over the web through the Hypertext Markup Language (HTML) pages (Bates, 2010). Later on web-based e-learning packages known as LMSs are developed commercially to support teaching and learning (Bates, 2010). Currently, a large number of innovative and interactive tools are being used in e-learning. These include applications such as intelligence tutoring systems, simulation applications, gaming applications, virtual worlds and Web 2.0 technology (Laurillard, 2010).

Intelligent Tutoring Systems (ITSs) are e-learning applications that are designed to mimic the services of a human tutor (Ross, 1987; Wijekumar, 2009). They are capable of diagnosing the level of knowledge of individual learners and tailoring instructions based on the level of knowledge of learners (Ross, 1987; Akhras & Self, 2002; Wijekumar, 2009). ITSs are also capable of assessing learners immediately and providing feedback on their performance (Wijekumar, 2009). ITS designers pay special attention to how the instruction should be properly sequenced to help learners to learn the content (Ross, 1987; Akhras & Self, 2002). One major limitation of ITSs in providing interactive e-learning is that they primarily allow learners to interact with learning content. Although ITSs attempts to mimic the interactions between learners and instructors, by providing customized instructions and feedback, providing comprehensive feedback is still massive challenges for ITSs (Merrill, Reiser, Ranney, & Trafton, 1992).

LMSs are software packages consisting of numerous tools that are designed to facilitate teaching and learning online (Dalsgaard, 2006; Sife et al., 2007; Stern & Willits, 2011). It is the widest used e-learning application among all other available e-learning applications at present (Dalsgaard, 2006). Popular LMSs include proprietary products such as Blackboard, WebCT and Desire2Learn, and open source products such as Moodle and Sakai (Sridharan et al., 2010; Väljataga et al., 2010; Stern & Willits, 2011). Among those, commercial LMSs such as Blackboard and WebCT are widely used in developed countries and open source LMSs such as Moodle are adopted in developing countries due to financial limitations (Fernando, 2008).

LMSs contain a wide variety of tools such as discussion forums, file sharing systems, assignment submission systems, quizzes and grade books (Dalsgaard, 2006; Bates, 2010; Stern & Willits, 2011). These tools could be used by instructors to post lecture slides and

assignment questions, communicate grades, provide feedback and to collect assignments submitted by learners (Bates, 2010). LMSs primarily enable learners to interact with learning content posted by instructors. Many LMSs, however, do not support functions such as searching and sharing learning resources. Furthermore, helping learners to maintain personal learning resources and information is scarcely allowed in LMSs (Chatti, Jarke, Frosch-Wilke, 2007). Most LMSs contain tools such as chat and forums where learners can interact with each other. However, these tools do not provide the flexibility provided by tools such as Web 2.0 tools in interacting with each other (Stern & Willits, 2011).

Simulation-based e-learning applications take "a serious attempt to accurately represent a real phenomenon" (Crawford, 1984, p. 4). They are useful for providing learners with realistic experience of complex and critical situations that mimic real work environment before they work in real world environments (Kindley, 2002; Davidovitch, Parush, & Shtub, 2008). Simulation applications differ from traditional intelligent tutoring systems on their ability to provide experiential learning as if learners are working in real world environments for gaining skills (Kindley, 2002). Disciplines such as engineering and medical studies widely adopt simulation applications (Gordon, Oriol, & Cooper, 2004; Davidovitch et al., 2008). Simulation applications allow learners to acquire and improve specific skills that they would need in work environments by facilitating repeated practice (McGaghie, Issenberg, Petrusa, & Scalese, 2006). From the perspective of interactive e-learning, simulation applications do not facilitate learners to directly interact with the course learning resources, instructors and peer learners. One practical limitation of applying simulation tools for e-learning is that they require high technical infrastructure (Welsh, Wanberg, Brown, & Simmering, 2003).

Game-based learning applications are computer based applications where learners learn by playing a role in a responsive story (Squire, 2008; Marsh, 2011). Such applications position

learners in complex situations where they are presented with many challenges (Squire, 2008). Situations as above assist learners to gain knowledge both individually and collaboratively, and gain competencies such as decision making and team work (Green & McNeese, 2007; Pivec, 2007). Additionally, game-based learning provides more engaging and enjoyable learning experience to learners (Pivec, 2007). From the perspective of interactive e-learning, gaming applications do not allow direct interactions between learners and learning resources and instructors similar to simulation applications. Furthermore, similar to simulation applications, need for high technical infrastructure is a barrier for using gaming technology for e-learning (Torrente, Moreno-Ger, Martínez-Ortiz, & Fernández-Manjón, 2009).

Multi-user virtual environments (MUVEs) are digital environments where participants can make themselves virtually present in the form of avatars for accessing the content and interacting with other participants (Dede, Nelson, Ketelhut, Clarke, & Bowman, 2004; Bates 2010). They inherit several aspects of simulation applications and multi user gaming applications (Warburton, 2009; Duncan et al., 2012). Recently, MUVEs have gained momentum as educational tools (Warburton, 2009; Duncan et al., 2012). MUVEs have the potential to assist learners to develop their knowledge through numerous active and constructivist learning activities such as role plays and games where learners actively interact with peer learners and instructors (Warburton, 2009; Bates, 2010; Duncan et al., 2012). The requirement of a high technical infrastructure, however, is a barrier for the widespread use of MUVEs (Warburton, 2009).

2.8 Web 2.0 technology

Web 2.0 technology refers to a set of web based tools that are available over the Internet for users to create content over the web, consume content created by others, remix content

created together and communicate (O'Reilly, 2005). The term "social media" is often used to refer to Web 2.0. Blogs, wikis, social bookmarks, YouTube and Flicker are examples of popular Web 2.0 tools (McLoughlin & Lee, 2007; Bates, 2010). Using the web as the platform, those Web 2.0 tools provide a wide range of services including creating content, aggregating content, easy editing of content, distributing content, communicating synchronously and building networks (McLoughlin & Lee, 2007; Bates, 2010; Minocha, Schroeder, & Schneider, 2011; Schneckenberg, Ehlers, & Adelsberger, 2011).

Web 2.0 technology is increasingly being used among web users for several reasons. One major reason for the popularity of Web 2.0 tools is the ease of creating content over the web (Hsu et al., 2009). With the adoption of Web 2.0 tools, all web users can create and manipulate content over the web with minimal technical knowledge (Bernsteiner et al., 2008; Hsu et al., 2009; Schneckenberg et al., 2011). Prior to the introduction of Web 2.0 technology, creating content over the web is impossible for users who did not have a significant amount of technical skills (Bernsteiner et. al, 2008; Hsu et al., 2009). Another reason for the popularity of Web 2.0 tools is their availability. Due to the lightweight nature and the platform independence of Web 2.0 tools, users could easily access Web 2.0 tools with any computer with an Internet connection (Bates, 2010; Minocha et al., 2011). Furthermore, most Web 2.0 tools are available to web users free of charge (Bates, 2010). Brief descriptions of popular Web 2.0 tools are given in what follows.

Web logs known shortly as blogs are web-based journals or diaries that individual users can use to write their thoughts, link content with other web resources and store artefacts (Duffy & Bruns, 2006; Du & Wagner, 2007; Hall & Davison, 2007; Hsu, Ching, & Grabowski, 2009; Hung, 2011). The content in the blog appear in a chronological manner with latest posts appearing at the top (Hall & Davison, 2007; Bernsteiner et al., 2008; Hsu et al., 2009).

Content can also be archived by category names or dates (Duffy & Bruns, 2006). The other web users can browse through blog posts and add comments on the content (Renner, 2006; Hall & Davison, 2007; Hung, 2011). Furthermore, many blogs allow web users to subscribe to their favourite blogs such that they get notified when the blog is updated (Dalsgaard, 2006; Bernsteiner et al., 2008).

Wikis are web pages of a website that allow multiple users to add and edit the content on it (Dalsgaard, 2006; Renner, 2006; Bernsteiner et al., 2008). Wiki pages are linked with each other (Hsu et al., 2009). Each page may contain textual and graphical content, and links to other pages (Wheeler et al., 2008). Wikis also contain the feature of version control. This feature could be used to keep track of the changes applied to the web pages by different authors (Dalsgaard, 2006; Wheeler et al., 2008; Hsu et al., 2009). The most popular wiki site among web users is Wikipedia (Dalsgaard, 2006).

Social bookmarking allows users to save bookmarks to web pages on the web rather than on the browser (Dalsgaard, 2006). Each bookmark is saved by associating a tag with it. A tag is a user-defined keyword generally describing the content of the web page being bookmarked (Dalsgaard, 2006; Hsu et al., 2009; Lee & Ge, 2010; Luo, 2010; Ching & Hsu; 2011). The saved bookmarks could be retrieved by searching using the keyword (Renner, 2006). In addition to the personal use, bookmarks created by users could be easily shared with other users. Users could also see how the other users have tagged the same page they are bookmarking (Dalsgaard, 2006; Hsu et al., 2009; Luo, 2010).

Web 2.0 based multimedia repositories such as YouTube and Flicker are increasingly becoming popular among web users. They allow users to publish their multimedia content over the web easily (Luo, 2010; Bates, 2010). Users could also associate keywords with the content to describe the content being published. These keywords are useful to other users for

searching and accessing content in the repositories easily. Multimedia repositories facilitate other applications to share and reuse their content. Furthermore, users can add useful comments and ratings on the content (Franklin & Harmelen, 2008). While YouTube and Flicker are multimedia repositories which are generally popular among web users for providing entertainment, much attention is also being paid to using Web 2.0 features to implement multimedia repositories with a specific focus of facilitating teaching and learning. TeacherTube and MERLOT (Multimedia Educational Resources for Learning and Online Teaching) are two such applications.

Instant messengers are communication tools that facilitate real time communications between two or multiple users (Sandars & Schroter, 2007). They are very popular among web users. The instant messengers allow users to communicate by exchanging text messages or having audio or video chats. Yahoo Messenger, MSN Messengers, Google Talk and Skype are examples of well-known instant messengers (Bakker, Sloep & Jochems, 2007; Bates, 2010).

Really Simple Syndication (RSS) is a format that is used by Internet users to subscribe to content in the web which are frequently updated (Duffy & Bruns, 2006). Once users subscribe to the content, they could receive the updated content as RSS feeds which could be read using RSS readers (Duffy & Bruns, 2006; Bernsteiner et al., 2008; Franklin & Harmelen, 2008). RSS is useful for web users to keep themselves updated about multiple web sites they are interested in by subscribing.

2.8.1 Web 2.0 based e-learning

A review of existing research shows that Web 2.0 tools such as blogs, wikis and social bookmarks could be used for the effective delivery of e-learning. For example, Du and Wagner (2007), Hourigan and Murray (2010) and Mansor (2011) show that blogs could be

used for maintaining reflective journals. Such studies also find out that using blogs for maintaining reflective journals influences, the effectiveness of e-learning by developing learners' knowledge and skills and by improving learners' satisfaction. Wheeler et al. (2008), and Ruyters et al. (2011) state that wikis could be used for collaborative writing and role plays. Saeed and Yang (2008a), and Lee and Ge (2010) demonstrate that social bookmarks are useful for instructors to maintain and share web references. Such use of social bookmarks improves the satisfaction of learners in e-learning. A summary of how Web 2.0 tools could be used for e-learning as explained in the existing research is given in Table 2.6.

Table 2.6 : The use of web 2.0 tools for e-learning

Web 2.0 tools	Use for e-learning	References
Blogs	▪ Could be used by learners to maintain e-portfolios and reflective journals. ▪ Could be used by learners to provide peer feedback ▪ Could be used by instructors to share ideas and resources with the learners. ▪ Monitoring learners' progress, providing feedback and authentic assessment could be done on leaners' blogs.	Du and Wagner (2007), Churchill (2009), Hung (2011), Minocha et al. (2011), Dabbagh and Kitsantas, (2012)
Wikis	▪ Could be used by learners for brainstorming and ongoing documentation. ▪ Could be used by instructors to trace how learners develop content for the purpose of authentic assessment.	Duffy and Bruns (2006), Franklin and Harmelen (2008), Wheeler et al. (2008), Minocha et al. (2011)
Social bookmarks	▪ Could be used by learners for keeping track of important web pages and sharing them with learners.	Grosseck (2009), Hsu et al. (2009), Lee and Ge (2010), Luo (2010)
Multimedia repositories	▪ Could be used by learners for uploading content such as reports and oral presentations to be reviewed by the peers and instructors. ▪ Could be used by instructors for disseminating materials.	Franklin and Harmelen (2008), Grosseck (2009), Bates (2010), Luo, (2010), Hung (2011)

There are various models and frameworks developed in the existing research for effective Web 2.0 based e-learning. For example, Dabbagh and Kitsantas (2012) propose a framework for facilitating self-regulated learning within personal learning environments (PLEs) created using a number of Web 2.0 tools such as blogs, wikis and social bookmarking. Figure 2.3 shows this framework. It shows three levels in which Web 2.0 tools could be introduced to learners to gradually develop their self-regulation skills. These three levels are personal

information management, social interaction and collaboration, and information aggregation and management.

In personal information management Web 2.0 tools such as blogs, wikis and social bookmarks are used by learners to maintain personal knowledge bases where information and resources from which learners could develop understanding are maintained. For example, blogs could be used by learners to maintain personal journals. Furthermore, Social bookmarks could be used by learners to maintain course content.

In social interaction and collaboration, collaboration and interaction among learners take place using Web 2.0 tools such as blogs and wikis. Using such tools learners can share information and resources, and provide feedback. For example, learners can visit one another's blogs and provide feedback. Learners could also use social bookmarks to share lists of bookmarks relevant to their course content.

In information aggregation and management, learners analyse the information they have obtained by themselves and through social learning to gain more knowledge. Information aggregation and management also enables learners to interact with information and resources, and develop understanding.

	(Level 1) Personal information management→	(Level 2) Social interaction and collaboration →	(Level 3) Information aggregation and management →
Blogs	Instructor encourages students to use a blog as a private journal to set learning goals and plan for course assignments and tasks	Instructor encourages students to enable the blog comment feature to allow for instructor and peer feedback enabling basic interaction and sharing	Instructor demonstrates how to configure a blog to pull in additional content and how to add the blog to RSS aggregation services
Wikis	Instructor encourages students to use a wiki as a personal space for content organization and management	Instructor encourages students to enable the wiki's collaborative editing and commenting features for feedback	Instructor demonstrates how to view a wiki's history to promote student self-evaluation of their learning across time
YouTube or Flickr	Instructor encourages students to use Flickr or YouTube to set up a personal media archive related to course content	Instructor encourages students to enable the sharing feature of the media archive and join similar media archives created by peers	Instructor demonstrates how to aggregate media from several media archives to refine their personal archive
Social networking Sites	Instructor encourages students to create an academic and career profile on LinkedIn	Instructor encourages students to connect to online communities related to their professional goals	Instructor asks students to engage in self-reflection with the goal to restructure their profile and social presence
Social Bookmarking	Instructor encourages students to use a social bookmarking tool (e.g., Delicious) to organize course content	Instructor encourages students to collaborate with other classmates and create a shared list of bookmarks related to a specific learning topic or project	Instructor asks students to self-reflect on their personal and group bookmarks to enhance the desired learning outcome

Figure 2.3: A framework for using social media to support self-regulated learning in PLEs (Dabbagh & Kitsantas, 2012)

McLoughlin and Lee (2010a) propose "Pedagogoy 2.0", a Web 2.0 technology based framework for facilitating innovative teaching and learning capitalizing on the capabilities of Web 2.0 tools. As shown in Figure 2.4, this framework contains three elements, namely, personalization, participation and productivity that can enhance teaching and learning with the use of Web 2.0 technology. In Pedagogy 2.0, participation refers to enabling learners to communicate, collaborate, and connect with peer learners, instructors and experts in the community using Web 2.0 tools.

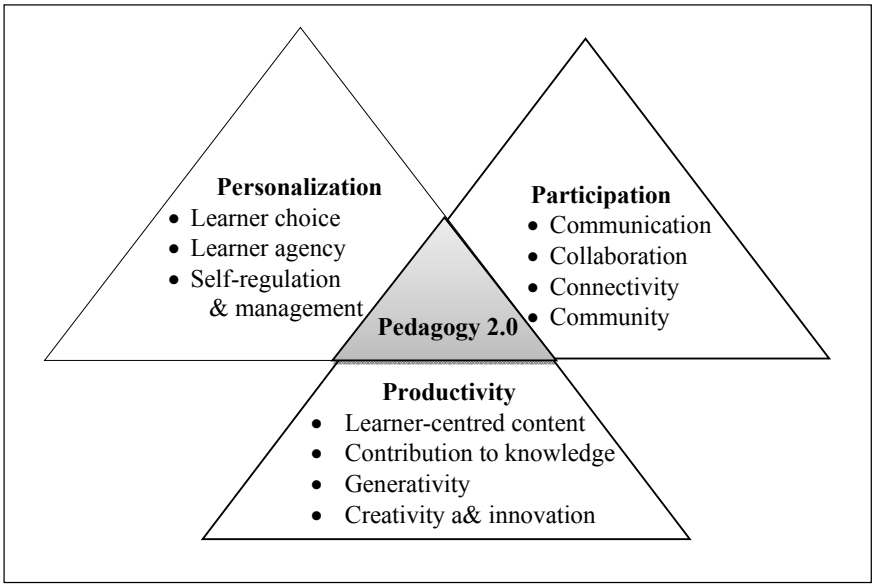

Figure 2.4: Pedagogy 2.0 (McLoughlin & Lee, 2010a)

Personalization in the framework refers to enabling learners to seek learning resources of their own interest using numerous Web 2.0 tools. The aim of personalization is to enable learners to use tools and resources to improve their knowledge and gain more control over learning. Productivity in the framework refers to enabling learners to actively participate in learning by constructing their own knowledge and contributing to collaborative generation of knowledge in the community.

Chatti, Klamma, Jarke and Naeve, (2007) propose a conceptual framework for Web 2.0 driven learning which is shown in Figure 2.5. Their framework aims to enhance learning by incorporating Web 2.0 tools for three purposes, namely, networking and collaboration, knowledge creation, and intelligent search. Networking and collaborating refers to building communities and sharing knowledge using numerous Web 2.0 tools such as blogs and social bookmarking. Through networking and collaboration learners are able to form virtual groups and work together to meet common learning goals. Intelligent search refers to the availability of search mechanisms capable of filtering relevant information from the massive amount of information available on the web. Knowledge creation refers to the continuous process of sharing knowledge, articulating concepts, storing contents systematically and internalizing knowledge.

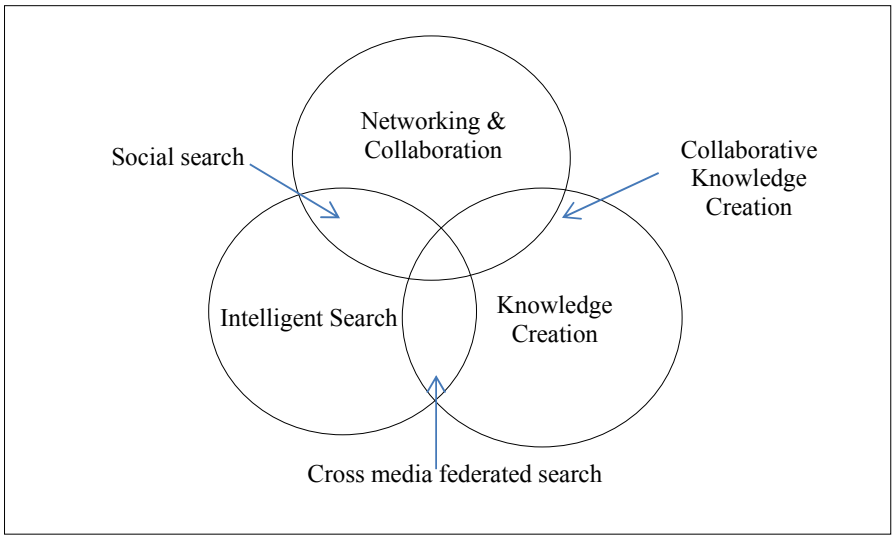

Figure 2.5: A framework for web 2.0 driven learning (Chatti et al., 2007)

Hsu et al. (2009) provide a model that shows how Web 2.0 tools could be used for improving the knowledge of learners individually as well as in groups. Figure 2.6 shows this model. Individual cognition in the model refers to the development of individuals' knowledge by using a number of Web 2.0 tools such as blogs and social bookmarks for accessing, categorizing, organizing and integrating information and resources. Social construction of

knowledge refers to co-construction of knowledge using Web 2.0 tools such as wikis and social bookmarks for sharing ideas, providing peer feedback and participating in group-reflection.

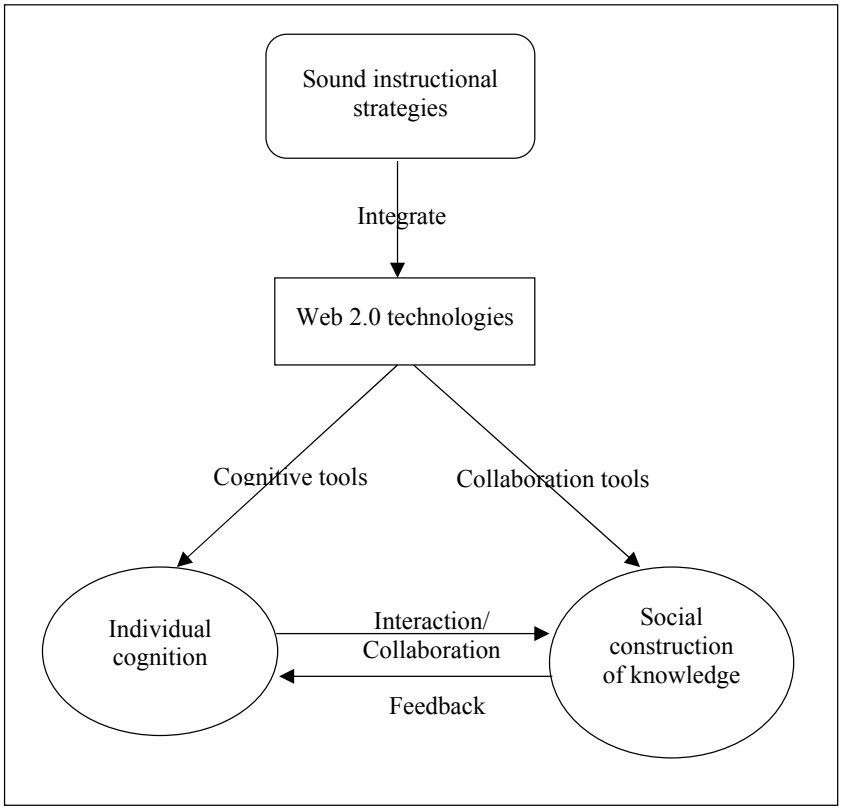

Figure 2.6: Web 2.0 tools as cognitive and collaboration tools (Hsu et al., 2009)

2.8.2 Research on web 2.0 based interactive e-learning

Much research has investigated how Web 2.0 technology could be used for learner-learner and learner-instructor interactions in e-learning. For example, Wheeler et al. (2008) and Buckley and William (2010) investigate how wikis are useful for facilitating effective interactions among learners. The above studies show that wikis are useful for sharing ideas and resources. Furthermore, these studies demonstrate that the use of wikis for facilitating interactions among learners improves the quality of teaching and learning. Du and Wagner (2007) show that blogs are useful for learner-learner interactions. Especially, the above study shows that blogs are effective for sharing content, accessing shared content and providing

feedback. Using blogs for facilitating interaction among learners positively influences the effectiveness of e-learning. In particular, using blogs for learner-learner interactions improves learners' satisfaction of e-learning and their ability to meet their learning outcomes. Saeed and Yang (2008a) illustrate how blogs and social bookmarks could be used for facilitating interactions among learners and interactions between learners and instructors. They show that blogs are useful for sharing ideas between learners and also for communication between learners and instructors. Their study shows that social bookmarks are useful for instructors and learners to share web based resources. Furthermore, using blogs and social bookmarks for facilitating interaction among learners improves the satisfaction of learners. Huang and Nakazawa (2010) investigate how wikis could be used for improving the interaction among learners and the interaction between learners and instructors. The study shows that wikis are useful for collaborative writing and providing feedback.

As discussed above, existing research as above has shown that Web 2.0 technology could be used to improve the interactivity of e-learning to a great extent. However, several gaps are seen in those existing research on the extent to which Web 2.0 technology supports interactive e-learning. Firstly, much research has focused on investigating whether Web 2.0 technology supports one or two types of interactions such as learner-learner interactions and learner-instructor interactions. There is a scarcity of research investigating whether Web 2.0 technology supports all three major types of interactions of e-learning which are learner-learning resources, learner-instructor and learner-learner interactions. Thus, the full potential of Web 2.0 technology in supporting interactive e-learning may not have been revealed through the existing research.

Secondly, despite the recommendations made by the existing research that multiple Web 2.0 tools could be used to deliver more interactive e-learning, a majority of existing research is

focused on investigating how a particular Web 2.0 tool supports specific interactions in e-learning (Wheeler, 2009; Uzunboylu et al., 2011; Laru et al., 2012). As a result, the full potential of Web 2.0 technology in supporting interactive e-learning may not have been revealed. Thirdly, there is a scarcity of empirical evidences as to whether Web 2.0 tools support interactive e-learning across multiple cultures in a similar manner. In particular, whether Web 2.0 technology could support interactive e-learning in both a developed country and a developing country in a same way has not much been investigated. A majority of the existing research on Web 2.0 based interactive e-learning are conducted in developed countries. Although, initiatives have been taking place on using Web 2.0 technology for interactive e-learning in developing countries, less evidence is found in the existing literature on the extent to which Web 2.0 technology supports interactive e-learning in developing countries (Ahmed, 2011). Would learners in developing countries find that Web 2.0 tools could improve the learner-learning resources, learner-instructor and learner-learner interactions in e-learning to a similar extent as in developed countries? Such questions are not answered in the existing literature.

2.9 Conclusion

This research aims to investigate the enabling role of Web 2.0 technology for interactive e-learning in higher education in Australia and Sri Lanka. This chapter reviewed the literature related to this research with a special focus on how effective interactive e-learning could be facilitated using technologies. The review of literature found three kinds of interactions, namely, learner-learning resources, learner-instructor and learner-learner interactions which are important in facilitating effective interactive e-learning. It also found four constructs that could facilitate the three aforementioned types of interactions in e-learning namely, management of learning resources, personal knowledge management, delivery of instructional

support and collaboration. The review of literature on technologies used for interactive e-learning revealed that tools such as virtual worlds and multi user games are among tools that provide for a higher degree of interactivity in e-learning. However, it was shown that there are limitations in applying such tools for interactive e-learning across the world in a similar manner due to their costs and high infrastructure requirements.

Special attention is paid in the review of literature on the application of Web 2.0 technology for e-learning. Web 2.0 technology is recognised as a set of user friendly, light weight tools which offer high interactivity at lower or no cost. The review of the existing literature on Web 2.0 based e-learning finds that Web 2.0 tools could be used for facilitating effective interactions in e-learning. However, it was revealed that there are several limitations in the existing research on revealing the extent to which Web 2.0 technology supports interactive e-learning. Lack of research on how Web 2.0 technology supports all three major types of interactions and lack of research on how Web 2.0 technology supports interactive e-learning in cross cultural setting are among those limitations. Due to limitations as above there is a need of a comprehensive research on the enabling role of Web 2.0 technology for interactive e-learning. In the next chapter of this thesis, a conceptual framework on Web 2.0 based interactive e-learning is developed based on the review of literature presented in this chapter. The framework is developed considering how Web 2.0 technology could support learner-learning resources, learner-instructor and learner-learner interactions.

Chapter 3

A CONCEPTUAL FRAMEWORK

3.1 Introduction

E-learning has become a promising solution to the growing need for effective education worldwide (Volery & Lord, 2000). It is used to support teaching and learning in classrooms as well as delivering distance education (Ahmed, 2010; Bates, 2010). As a classroom aid, e-learning improves interactive collaboration between and among learners and the delivery of learning resources (Ahmed, 2010; Bates, 2010). As a method of delivering distance education, e-learning enables learners from geographically disperse locations to learn content effectively any time (Harasim, 2000; Zhang & Nunamaker, 2003). Due to the above uses of e-learning it has caught the attention of educators around the world (Harasim, 2000).

Technology is the foundation of e-learning (Bates, 2005). In the past few decades, a variety of technologies which have enabled e-learning are developed (Bates, 2010; Laurillard, 2010). Those technologies range from basic technologies that facilitate the delivery of content to advanced technologies that are capable of providing personalized instructions (Bates, 2010; Laurillard, 2010; Zhang, 2003). A combination of such technologies has enabled the development of powerful e-learning systems that provide learners with an experience similar to what they obtain in classrooms (Hannafin & Land, 1997; Zhang, 2003; Laurillard, 2010).

One major role of technologies used to facilitate e-learning is to enable learners to interact with learning resources, instructors and peer learners (Bates, 1997; Sims, 1997; Laurillard, 2010). Technologies enable learners to search and access learning resources, communicate with instructors and collaborate with peer learners (Moore, 1991; Wagner, 1997). The extent

to which different technologies support learners to interact with learning resources, instructors and peer learners, however, is very much dependent on the capabilities of technologies in supporting such interactions (Hannafin & Land, 1997; Väljataga et al., 2010).

The purpose of this chapter is to develop a conceptual framework for Web 2.0 based interactive e-learning. Such a framework is useful for investigating the extent to which Web 2.0 technology supports interactive e-learning in higher education in Australia and Sri Lanka using a quantitative research strategy. The framework shows how Web 2.0 technology supports interactive e-learning based on the review of literature conducted in the second phase of this research. The chapter also proposes eight hypotheses on Web 2.0 based interactive e-learning corresponding to the relationships shown among constructs in the conceptual framework.

This chapter is organized as follows. Firstly, section 3.2 explains the role of technology in interactive e-learning. Section 3.3 presents a conceptual framework for Web 2.0 based interactive e-learning with a detailed description of the constructs of the conceptual framework and the hypotheses developed corresponding to the relationships between those constructs. Finally, section 3.4 presents the conclusion of the chapter.

3.2 Technology in interactive e-learning

Interactive e-learning refers to teaching and learning where interactions play a major role in developing learners' knowledge and skills (Wagner, 1994; Chou, 2003; Luo & Lei, 2012). Three types of interactions, namely, (a) learner-learning resources, (b) learner-instructor and (c) learner-learner interactions mainly contribute to develop learners' knowledge in interactive e-learning (Moore, 1989). For example, learners may develop their knowledge when they navigate, access and manipulate information and resources to understand content

(Chou, 2003). Learners may also develop their knowledge and skills such as team work and communication skills when they collaborate and communicate with other individuals such as peer learners and instructors (Moore, 1989). E-learning systems, therefore, are specially designed to facilitate learners to interact with learning resources, instructors and peer learners in the above manner (Hannafin & Land, 1997; Luo & Lei, 2012).

The literature review conducted in the previous chapter shows that management of learning resources, personal knowledge management, delivery of instructional support and collaboration are commonly used for improving the interactivity of e-learning environments (Alavi, 1991; McLoughlin & Lee, 2010; Sridharan et al., 2010; Ahmed, 2010). Effective management of learning resources enables learners to proactively search and access learning resources (Moore, 1989; Sridharan et al., 2010). Facilities to manage personal knowledge help learners to collect important information and resources to better understand learning content (Cigognini et al., 2010). Facilities to deliver instructional support are useful for instructors to provide learning support such as feedback and encouragement to learners (Berge, 1998). Facilities to collaborate enable learners to interact with peer learners to co-construct knowledge (Moore, 1989, Alavi, 1991).

New technologies are being introduced to the market at a rapid pace (Laurillard, 2010). Those technologies have different attractive features such as facilities for efficient retrieval of resources, provision of personalized instructions and feedback, subscription to content and flexible arrangement of content (Laurillard, 2010; Luo & Lei, 2012). For example, artificial intelligence technology is capable of providing customized instructions (Ross, 1987). Semantic web technology could be used for retrieving content through advanced queries (Sridharan et al., 2011). Much attention is paid to adopting these technologies for e-learning (Laurillard, 2010). Application of modern technologies with attractive features as above,

however, does not necessarily improve the interactivity of e-learning (Bates, 1997; Hannafin & Land, 1997). It is, therefore, important for instructors to understand how well the interactivity of e-learning could be improved through the capabilities of different technologies.

Existing research makes several attempts to reveal the extent to which modern technologies used in e-learning support interactive e-learning. For example, Craig, Driscoll and Gholson (2004) find that artificial intelligence technology could be used to deliver instructional support effectively. Petrakou (2010) reveals that virtual worlds could facilitate effective collaboration of learners. Sridharan et al. (2011) state that semantic web technology could be used for effective management of learning resources.

Much research has been also conducted on how different Web 2.0 tools support interactive e-learning. There are, however, several limitations of existing research on Web 2.0 based interactive e-learning as discussed in Chapter 1. To address those limitations, this research proposes a conceptual framework for Web 2.0 based interactive e-learning in the next section of this chapter.

3.3 Development of the conceptual framework and hypotheses

To investigate the enabling role of Web 2.0 technology in interactive e-learning in Australian and Sri Lankan higher education, this research develops a conceptual framework for Web 2.0 based interactive e-learning as shown in Figure 3.1 based on the review of the related literature. The conceptual framework hypothesizes that management of learning resources, personal knowledge management, delivery of instructional support and collaboration with the adoption of Web 2.0 technology improve the effectiveness of e-learning. Those hypotheses are defined as H1, H2, H3 and H4 respectively. The framework further hypothesizes that Web

2.0 technology supports management of learning resources (H5), personal knowledge management (H6), delivery of instructional design (H7) and collaboration (H8). The above hypotheses are formulated based on the assumption that, Web 2.0 technology supports learner-learning resources, learner-instructor and learner-learner interactions (Moore, 1989).

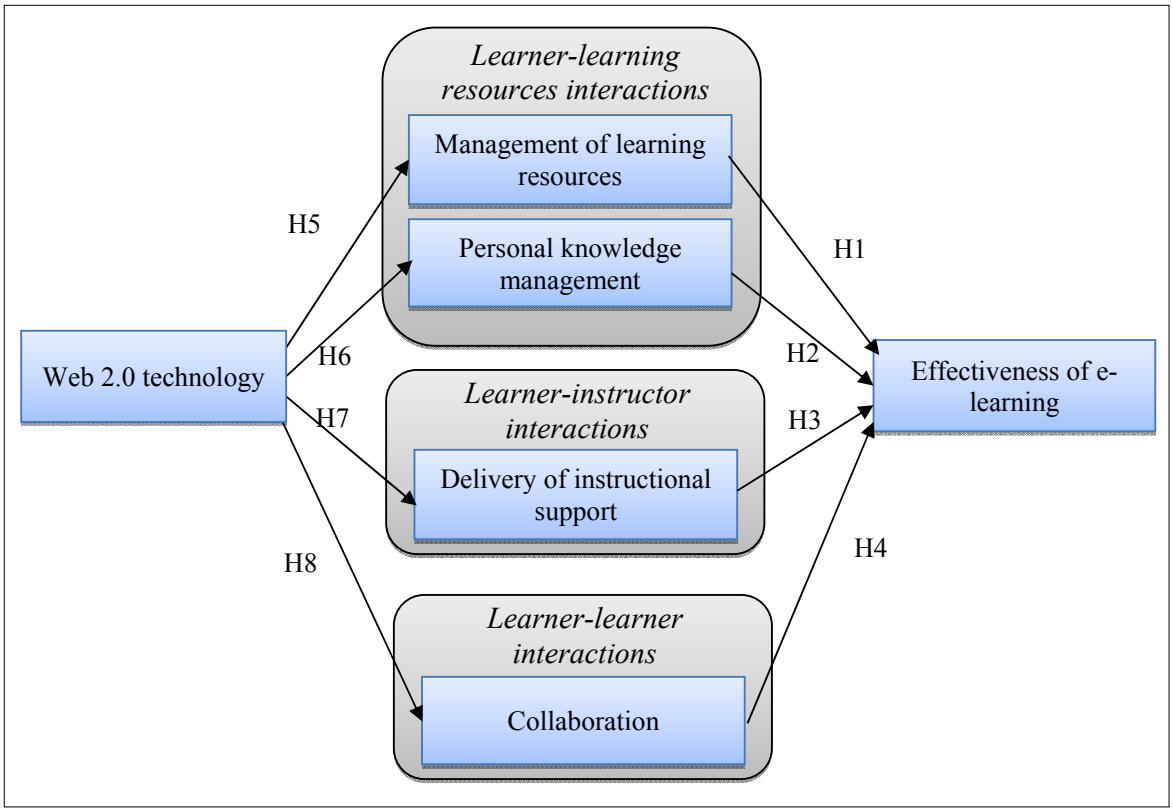

Figure 3.1: A conceptual framework

Effectiveness of e-learning

Effectiveness of e-learning refers to the extent to which teaching and learning delivered online enable learners to develop knowledge and skill required to successfully complete their courses (Webster & Hackley, 1997; Volery & Lord, 2000; Du & Wagner, 2007). Existing research identifies several indicators of effective e-learning. For example, Olson and Wisher (2002) state that meeting learning outcomes reflects the effectiveness of e-learning provided to students. Selim (2007) finds learner satisfaction as an indicator of the effectiveness of e-

learning. Sridharan et al. (2010) use obtaining good grades and employability as indicators of the effectiveness of e-learning. Hay, Peltier and Drago (2004) regard obtaining thinking skills as an indicator of the effectiveness of e-learning.

The 'effectiveness of e-learning' in the conceptual framework in Figure 3.1 is reflected by five indicator variables, namely, critical thinking ability, satisfaction, achievement of learning outcomes, academic performance and employability (Volery & Lord, 2000; Sridharan et al., 2008). Critical thinking ability refers to improving the critical thinking skills of learners following teaching and learning online (Hay et al., 2004; Du & Wagner, 2007). Satisfaction refers to the ability of teaching and learning online to improve the satisfaction of learners (Selim, 2007; Sridharan et al., 2008). Achievement of learning outcomes refers to enabling learners to better meet the learning outcomes of the online courses they follow (Olson & Wisher, 2002; Du & Wagner, 2007). Academic performance refers to obtaining better grades for online courses (Sridharan et al., 2008). Employability refers to improving the likelihood of finding a better career (Sridharan et al., 2008). Table 3.1 presents a summary of the indicator variables discussed above.

Table 3.1 : Indicators of the effectiveness of e-learning

Indicator	Description	Pertinent Literature
Critical thinking ability	Ability to improve critical thinking skills	Hay et al. (2004), Du and Wagner (2007),
Satisfaction	Ability to obtain sense of satisfaction	Piccoli, Ahmad and Ives (2001), Sridharan et al. (2008), Selim (2007)
Achievement of learning outcomes	Ability to meet learning outcomes	Olson and Wisher (2002), Selim (2007), Sridharan et al. (2008)
Academic performance	Ability to obtain good grades	Piccoli et al. (2001), Sridharan et al. (2008)
Employability	Increasing the likelihood of finding a better career	Sridharan et al. (2010)

Management of learning resources

Management of learning resources refers to maintaining electronic learning resources for delivering teaching and learning online in a usable and attractive manner (Sridharan et al., 2008). Effective management of learning resources in e-learning has several benefits. For example, the effective management of learning resources in e-learning positively increases the satisfaction of learners (Volery & Lord, 2000; Kuruback, 2007). In particular, presenting learning resources in a well-organized manner and providing learning resources of different types increase learners' satisfaction with e-learning (Volery & Lord, 2000; Munguatosha, Muyinda, & Lubega, 2011). Furthermore, the ability to search, share and reuse learning resources can significantly reduce the time that learners' have to spend in learning activities such as project-based learning (Govindasamy, 2001; Littlejohn & Shum, 2003; Sridharan et

al., 2011). Effective management of learning resources is, therefore, vital for e-learning (Dicheva, 2008; Sridharan et al., 2011).

Much existing research reveals how effective management of learning resources could influence the effectiveness of e-learning. For example, Marcus-Quinn and Geraghty (2010) state that self-directed learning in e-learning could be supported by increasing the availability of learning resources. Saeed and Yang (2008b) state that the availability of learning resources in multiple formats such as audio, video and text enables learners with different learning styles to learn the contents more effectively. Sridharan at al. (2008) show that the effectiveness of e-learning could be positively influenced by maintaining learning resources in a manner that they could be easily searched, shared and reused. Based on the above discussion the following hypothesis is formulated.

H1: Effective management of learning resources with the use of Web 2.0 technology positively influences the effectiveness of e-learning in Australian and Sri Lankan higher education.

There are several indicator variables that contribute to management of learning resources in the conceptual framework shown in Figure 3.1. They are presentation of resources, resources in multiple formats, search ability, accessibility and reusability (Selim, 2007; Sridharan et al., 2008). Presentation of resources refers to offering learning resources in a well-organized manner using consistent layouts and navigations styles (Swan, 2004; Selim, 2007). Resources in multiple formats refers to making learning resources available in various types such as audio, video, images and text (Saeed & Yang, 2008b). Search ability refers to facilitating learners to access learning resources available in the learning system in an efficient manner (Sridharan et al., 2008). Accessibility refers to facilitating learners to use any learning resource available in the learning system (Sridharan et al., 2008). Reusability refers to enabling learners to reuse the learning resources available in the learning system in different

contexts (Sridharan et al., 2008). A summary of the indicator variables discussed above is given in Table 3.2.

Table 3.2 : Indicators for management of learning resources

Indicator	Description	Pertinent Literature
Presentation of resources	Presenting learning resources in a well-organized manner	Selim (2007), Sridharan et al. (2008)
Resources in multiple formats	Providing learning resources of different formats preferred by learners with different learning styles.	Kafai and Resnik (1996), Karagiorgi and Symeou, (2005), Saeed and Yang (2008b)
Search ability	Facilities to access learning resources available in the learning system in an efficient manner	Sridharan et al. (2008), Minguillón, Sicilia and Lamb (2011)
Accessibility	Facilities to use any learning resources available in the learning system	Sridharan et al. (2008), Minguillón et al. (2011)
Reusability	Facilities to reuse any learning resources in the system (even the learning resources used by other courses) in different contexts.	Kahiigi, et al. (2008), Sridharan et al. (2008)

Personal Knowledge Management

Personal knowledge management refers to the process of maintaining information, resources and knowledge of one's interest using various technologies (Li & Liu, 2008; Cigognini et al., 2010; Cheong & Tsui, 2010). Such a process involves several activities such as creating content, and collecting, organizing, categorizing and integrating information and resources (Hsu et al., 2009). In e-learning, personal knowledge management is useful for learners to develop personal knowledge bases with information and resources they require to meet their learning outcomes (Liu, 2011).

Personal knowledge management in e-learning has several benefits. To quote Liu (2011) creating, categorizing, organizing and integrating information and resources enable learners to "update and improve personal knowledge system, increase competitive power, and adapt to the emerging knowledge economy era" (p. 113). Personal knowledge management, also, enables learners to improve their understandings of the subject content (Sridharan et al., 2011). Much attention is, therefore, paid to facilitating personal knowledge management in e-learning (Dabbagh & Kitsantas, 2012; McLoughlin & Lee, 2010b).

Existing research shows various ways in which personal knowledge management could improve the effectiveness of e-learning. Alexiou and Paraskeva (2010), for example, show that personal knowledge management is helpful for learners to regulate their learning as well as to acquire a set of professional skills including skills of problem solving, reflecting and analysing. Du and Wagner (2007) reveal that managing personal knowledge help learners to better meet their learning outcomes. The above study by Du and Wagner (2007), in particular, highlights that actively participating in managing personal knowledge by creating content, retrieving useful content from different sources and evaluating content, help learners to perform better in learning. Based on the above discussion the following hypothesis is formulated.

H2: Managing personal knowledge with Web 2.0 technology influences the effectiveness of e-learning in Australian and Sri Lankan higher education.

Five indicator variables namely, creation of information and resources, maintenance of resources, ability to classify, ability to organize and ability to integrate contribute to personal knowledge management in the conceptual framework in Figure 3.1 (Pettenati et al., 2007; Liu, 2011; Dabbagh & Kitsantas, 2012). Creation of information and resources refers to features enabling learners to create and record useful information and resources in the

learning system (Pettenati et al., 2007; Liu, 2011). Maintenance of resources refers to features that facilitate learners to make archives of useful information and resources in the learning system (Dabbagh & Kitsantas, 2012). Ability to classify refers to features for categorizing information and resources in a meaningful manner (Pettenati et al., 2007). Ability to organize refers to features in the e-learning system enabling learners to sort and sequence the information and resources (Pettenati et al., 2007). Ability to integrate refers to features assisting learners to combine content of different types such as videos, images and text to make more meaningful content (Liu, 2011; Dabbagh & Kitsantas, 2012). A summary of indicator variables contributing to personal knowledge management is given in Table 3.3.

Table 3.3 : Indicators for personal knowledge management

Indicator	Description	Pertinent Literature
Creation of information and resources	Features for creating and recording content learners consider as useful	Pettenati et al. (2007), Li and Lau(2008), Dabbagh and Kitsantas(2012)
Maintenance of resources	Features for archiving content for future use	Li and Liu(2008), Dabbagh and Kitsantas (2012)
Ability to classify	Features for categorizing information under different topics	Cigognini et al. (2007), Hsu et al. (2009)
Ability to organize	Features for sorting and sequencing information under different topics	Li and Lau (2008), Cheong and Tsui (2010)
Ability to integrate	Features for integrating information of different types (text, graphics, videos, web links) from different sources together to create more meaningful and rich collections of content	Hsu et al. (2009), Dabbagh and Kitsantas, (2012)

Delivery of Instructional Support

Delivery of instructional support in e-learning refers to provision of learning support through e-learning systems to assist learners to achieve learning objectives (Berge, 1998). E-learning instructors provide two types of instructional support to learners through the learning system. Firstly, direct instructional support such as delivering content and communicating feedback and encouragement is provided (Anderson, Rouke, Garrison, & Walter, 2001). Secondly, designing and organizing learning experience to support learners to develop knowledge and skills, and monitoring whether learning occurs as expected is done (Anderson et al., 2001).

Delivery of instructional support is critical for e-learning (Liaw, Chen, & Huang, 2007; Selim, 2007). In fact, it is considered the binding element in an e-learning environment with learners and learning resources (Anderson et al., 2001). Without adequate delivery of instructional support e-learning may fail (Gunawardena, 1991; Anderson et al., 2001; Bates, 2010). As a result, much attention is paid on how instructional support could be delivered in e-learning in an effective manner (Volery & Lord, 2000; Selim, 2007).

Existing research shows how effectiveness of e-learning could be increased by delivery of instructional support. For example, Selim (2007) shows that instructors' teaching styles and encouragement for collaboration positively influence learners' willingness to accept e-learning. Eom et al. (2006) find that instructors' interactive teaching styles, feedback and support assist learners to better meet their learning outcomes. Furthermore, Sun et al., (2008) reveal that instructors' support leads to the satisfaction of learners in e-learning. Based on the above discussion the following hypothesis is formed.

H3: Delivering instructional support with the adoption of Web 2.0 technology positively influences the effectiveness of e-learning in Australian and Sri Lankan higher education.

Six indicator variables, namely, teaching styles, design of learning activities, support for collaboration, provision of feedback, authentic assessment, and peer and self-feedback reflect the construct named 'delivery of instructional support' in the conceptual framework shown in Figure 3.1 (Volery & Lord, 2000; Eom et al., 2006; Selim, 2007). Teaching styles refer to features in the e-learning system enabling delivery of teaching in different forms (Volery & Lord, 2000). Design of learning activities refers to facilities in the learning system for instructors to create a wide range of innovative learning activities (Minocha et al., 2011). Support for collaboration refers to the availability of features in the learning system for facilitating learners to collaborate, and for monitoring the collaboration of learners (Volery & Lord, 2000). Provision of feedback refers to facilities for communicating personalized feedback to learners (Eom et al., 2006). Authentic assessment refers to features that enable learners to carry out authentic learning activities and assess such work of learners (Chang & Tseng, 2009). Peer and self- feedback refers to the availability of features that facilitate learners to evaluate their own work as well as the work of peer learners (Elliot, 2008). A summary of indicator variables described above are presented in Table 3.4.

Table 3.4 : Indicators for instructional support

Indicator	Description	Pertinent Literature
Teaching styles	Features enabling use of different teaching styles	Volery and Lord (2000), Selim (2007)
Design of learning activities	Features facilitating creation of different learning activities	Berge (1998), Minocha et al. (2011)
Support for collaboration	Features for facilitating and monitoring the collaboration of learners	Volery and Lord (2000), Selim (2007)
Provision of feedback	Features enabling provision of personalized feedback to learners	Berge (1998), Eom et al. (2006)
Authentic assessment	Features facilitating assessment of authentic work of learners	Elliot (2008), Chang and Tseng (2009)
Peer and self-feedback	Features enabling learners to assess their own work and work of other's	Elliot (2008), Koohang, Riley, Smith and Schreurs (2009)

Collaboration

Collaboration refers to a process where individuals build relationships to work together to achieve their learning goals (Alavi, 1994). It is an essential element in e-learning not only for developing knowledge and skills of learners, but also to develop a sense of belonging to the learning community (Kennedy & Duffy, 2004). Examples of collaborative activities in e-learning include sharing of information and resources, exchanging resources and participating in numerous tasks that require learners to work in groups (Alavi, 1994; Leidner & Jarvenpaa, 1995; Savery & Duffy, 1995; Johnson & Johnson, 1996; Murphy, 2004).

Facilitating collaboration is important for e-learning due to several reasons. Firstly, collaboration in e-learning enables learners to actively co-construct their knowledge (Jonassen et al., 1995; Garrison, Anderson & Archer, 2001; Laurillard, 2009). Secondly, collaboration

enables learners to develop numerous skills such as group reflection, social negotiation and teamwork (Alavi, 1994; Jonassen et al., 1995). Thirdly, collaboration in e-learning improves learners' retention of the knowledge they gain through collaboration (Alavi, 1994; LaPointe & Gunawardena, 2004). Due to above reasons, much attention is paid to facilitate collaboration in e-learning (Alavi, 1991).

Collaboration contributes to improving the effectiveness of e-learning in many ways (Selim, 2007; Shee & Wang, 2008). Fuller and Moreno (2004) and LaPointe and Gunawardena (2004), for example, find that collaboration positively influences learners' satisfaction in learning. Alavi (1994) shows that collaboration can support learners to better meet their learning outcomes and actively construct their knowledge. Based on the above discussion the following hypothesis is formulated.

H4: Facilitating collaboration between learners with the adoption of Web 2.0 technology positively influences the effectiveness of e-learning in Australian and Sri Lankan higher education

Five indicator variables, namely, group discussions, discussions with instructors, share resources, access shared resources and group tasks contribute to the construct named collaboration in the conceptual framework shown in Figure 3.1. Group discussions refer to features in the e-learning system enabling learners to discuss and share ideas and perspectives with peer learners (Shee & Wang, 2000). Discussions with instructors refers to facilities in the e-learning system enabling learners to have one to one or group discussions with instructors to clarify doubts and obtain content expertize (Shee & Wang, 2000). Share learning resources refers to availability of features in the e-learning system facilitating learners to share information and resources with the peer learners (Shee & Wang, 2000). Access shared resources refers to availability of features in the learning system enabling learners to access

resources found and used by peer learners (Shee & Wang, 2000). Group tasks refer to features in the e-learning systems facilitating learners to perform tasks with the involvement of multiple learners (Bernsteiner et al., 2008). A summary of indicators discussed above is given in Table 3.5.

Table 3.5 : Indicators for collaboration

Indicator	Description	Pertinent Literature
Group discussions	Features facilitating learners to discuss with peer learners to share ideas and evaluate ideas of peer learners	Shee and Wang (2000), Liaw et al. (2008)
Discussions with instructors	Features enabling learners to discuss with instructors to clarify doubts and to get content expertise	Shee and Wang (2000), Kennedy and Duffy (2004)
Share resources	Features facilitating learners to share resources with peer learners	Shee and Wang (2000), McLoughlin and Lee (2007)
Access shared resources	Features facilitating learners to access the learning resources found and used by the peer learners	Shee and Wang (2000), McLoughlin and Lee (2007)
Group tasks	Features facilitating learners to participate in group tasks such as collecting data and group documentation and etc.	McLoughlin and Lee (2007), Bernsteiner et al. (2008)

Web 2.0 technology

Web 2.0 technology refers to a series of web based tools such as blogs, wikis, social bookmarking and YouTube (Saeed & Yang, 2008a; Lee & Ge, 2010; McLoughlin & Lee, 2010b). Those tools share some common features among them such as facilitating users to create and share content, and network with each other. In e-learning, Web 2.0 tools are used for various purposes such as managing and sharing resources, communicating and forming networks (Dalsgaard, 2006).

Existing research shows that using Web 2.0 tools for e-learning could positively influence the effectiveness of e-learning. For example, Du and Wagner (2007) show that using blogs for learning activities improves learners' satisfaction and ability to meet learning outcomes. Hartshorne and Ajjan (2009) reveal that the use of Web 2.0 tools for e-learning improves learners' satisfaction, and ability to learn and write. Wheeler et al. (2008) find that using Web 2.0 tools for e-learning can enhance thinking skills of learners. Renner (2011) states that learners could gain several skills such as literacy skills and skills of reflection by using Web 2.0 tools in e-learning. Driven by the ability of Web 2.0 technology to deliver effective teaching and learning as above, it is widely adopted for e-learning in recent years (Bates, 2010).

Web 2.0 tools offer several features for creating and sharing content easily. Such features could be utilized in managing learning resources (Munguatosha et al., 2011; Stern & Willits, 2011). For example, Web 2.0 tools such as social bookmarking, Flicker and YouTube could be used for creating and uploading educational content (Saeed & Yang, 2008a; Luo, 2009). Special tags associated with the content uploaded with such tools enable efficient retrieval of uploaded content. Apart from the above tools which have not been specifically designed for educational purposes, more recent educational applications such as TeacherTube and MERLOT have been developed using Web 2.0 technology to manage learning content more effectively (Laurillard, 2010). Based on the above discussion, the following hypothesis is formulated.

H5: The adoption of Web 2.0 tools positively supports management of learning resources in Australian and Sri Lankan higher education

Web 2.0 tools such as blogs and social bookmarks are often used for managing personal information and resources effectively (Dalsgaard, 2006; Väljataga et al., 2010; Dabbagh &

Kitsantas, 2012). Learners are often encouraged to use these tools to maintain and organize information and resources useful to them for meeting their learning goals (Väljataga et al., 2010; Dabbagh & Kitsantas, 2012). Furthermore, learners are encouraged to use such tools for creating representations of knowledge to further improve their knowledge. In short, learners can use Web 2.0 tools to create their personal knowledgebase (Ching & Hsu, 2011; McLoughlin & Lee, 2010a). Based on this discussion the following hypothesis is formulated.

H6: The adoption of Web 2.0 tools positively supports personal knowledge management in Australian and Sri Lankan higher education

Instructors could use Web 2.0 tools to deliver learning support. Web 2.0 tools such as podcasts could be used to deliver lecture content (Saeed & Yang, 2008a). Web 2.0 tools such as YouTube, blogs and wikis on the other hand could be used to design innovative learning activities (Bates, 2010; Saeed & Yang, 2008a; Luo, 2010). Web 2.0 tools such as blogs are also useful for providing timely feedback, facilitating peer feedback and for assessing learners (Du & Wagner, 2007; Chang & Tseng, 2009; Ching & Hsu, 2011; Schneckenberg et al., 2011). Based on the above discussion, the following hypothesis is formulated.

H7: The adoption of Web 2.0 tools positively supports delivery of instructional support in Australian and Sri Lankan higher education

Web 2.0 tools such as wikis, blogs and social bookmarking could be effectively used for collaboration between learners (Wheeler et al., 2008; Hsu et al., 2009; Lee & Ge, 2010). Such tools could be used by learners for sharing information and resources, writing collaboratively, providing social feedback and building social networks (Dalsgaard, 2006; Kam, 2009; Hicks & Graber, 2010; Lee & Ge, 2010). Based on the above discussion, therefore, following hypothesis is formulated.

H8: The adoption of Web 2.0 tools positively supports collaboration in e-learning in Australian and Sri Lankan higher education

The theoretical construct named 'Web 2.0 Technology' in the conceptual framework is represented by ten indicator variables, namely, content creation tools, content sharing tools, subscription tools, content manipulation tools, content remixing tools, networking tools, communication tools, co-authoring tools, commenting and rating tools and tools supporting reusing. Content creation tools refer to Web 2.0 tools that enable learners to create content in the web with minimal technical knowledge (McLoughlin, & Lee, 2007). Content sharing tools refer to Web 2.0 tools that could be used to share information and resources among web users (McLoughlin, & Lee, 2007). Subscription tools refer to Web 2.0 tools that could be used by web users to subscribe to content and be notified of updates to the content (McLoughlin, & Lee, 2007). Content manipulation tools refer to Web 2.0 tools that could be used by web users to categorize and organize content (McLoughlin, & Lee, 2007).

Content remixing tools refers to Web 2.0 tools that could be used by web users to mix content of different type such as text, images, audio and video to create more meaningful content (McLoughlin, & Lee, 2007). Networking tools refer to Web 2.0 tools that could be used to create virtual networks of web users (McLoughlin, & Lee, 2007). Communication tools refer to Web 2.0 tools that could be used by web users to communicate synchronously (Bates, 2010). Co-authoring tools refer to Web 2.0 tools that could be used by web users to collaboratively create and manage content (McLoughlin, & Lee, 2007). Commenting and rating tools refer to Web 2.0 tools that enable web users to contribute to content by providing feedback as comments or ratings (Renner, 2007; Gray, 2012). Tools supporting reusing content refer to Web 2.0 tools that enable users to manage content in a manner they could be

reused (Guenter, 2008). A summary of indicator variables contributing to the construct Web 2.0 technology is given in Table 3.6.

Table 3.6 : Indicators for web 2.0 technology

Indicator	Description	Pertinent Literature
Content creation tools	Tools that support creation of content in the system without much technical knowledge.	O'Reilly (2005), McLoughlin, and Lee (2007)
Content sharing tools	Tools that support sharing of resources	McLoughlin and Lee (2007), Schneckenberg et al. (2011)
Subscription tools	Services that allow to subscribe to content to get notifications once they are updated	Duffy and Bruns (2006), Renner (2007)
Content manipulation tools	Tools that support to manipulation of content (sequence, classify) easily	McLoughlin and Lee(2007), Gray (2012)
Content remixing tools	Tools that support aggregation of content of different types together.	O'Reilly (2005), McLoughlin, and Lee (2007)
Networking tools	Tools that support creation of a network with the participation of multiple users	McLoughlin and Lee (2007), Schneckenberg et al. (2011)
Communication tools	Tools that support to synchronous communication with other users	Bakker et al., (2007), Bates (2010)
Co-authoring tools	Tools that support collaborative authoring and management of content	McLoughlin, and Lee (2007), McLoughlin and Lee (2010b)
Commenting and ratings tools	Tools that support contribution to dialogue and to resources by adding comments and ratings	Renner (2007), Gray (2012)
Tools supporting reusing	Tools that support to reuse resources created by others	Guenter (2008), Hung (2011)

3.4 Conclusion

This chapter presents a conceptual framework for Web 2.0 based e-learning to answer the primary research question of this research. The framework considers four theoretical

constructs that facilitate learner-learning resources, learner-instructor and learner-learner interactions, namely, management of learning resources, personal knowledge management, delivery of instructional support, and collaboration. The conceptual framework hypothesizes that Web 2.0 technology supports the aforementioned constructs. It further assumes that the management of learning resources, personal knowledge management, delivery of instructional support and collaboration with Web 2.0 technology positively influence the effectiveness of e-learning. Validating such a framework using data collected from learners studying in universities of Australia and Sri Lanka would be helpful to reveal the enabling role of Web 2.0 technology for interactive e-learning in higher education in Australia and Sri Lanka.

Chapter 4

RESEARCH METHODOLOGY

4.1 Introduction

A research methodology is a systematic approach to be followed in solving a specific research problem (Hussey & Hussey, 1997; Kothari & Gaurau, 2014). It describes the series of phases through which the research progresses to meet its objective such as data collection, data analysis and data interpretation (Hall & Howard, 2008; Creswell & Plano Clark, 2011). In addition, the research methodology explains various methods and techniques which could be used in each phase of the research and which methods are most suitable for the relevant research (Kumar, 2005).

The selection of a suitable research methodology in a research project depends on the nature of the research to be conducted (Srivastava & Thomson, 2009). There are two main types of research namely exploratory research and confirmatory research (Boudreau, Gefen, & Straub, 2001). A research project of the exploratory nature generates insights on a social phenomenon by analysing and understanding how individuals respond to the phenomenon (Jaeger & Halliday, 1998). Such research requires data to be collected from individuals and analysed, before insights are gained by interpreting the data. A research project of the confirmatory nature, in contrast, defines a priori hypotheses on a social phenomenon and investigates whether the defined hypotheses are valid (Jaeger & Halliday, 1998). Such research requires defining hypotheses on a topic of interest, collecting data from individuals and analysing data which will lead to either accepting or refuting the hypotheses (Jaeger & Halliday, 1998).

To meet the objective of this research a confirmatory approach is taken. With such an approach, a priori hypotheses on Web 2.0 based interactive e-learning in Australian and Sri Lankan higher education are formulated based on a comprehensive review of the related literature. The formulated hypotheses are then validated by analysing the data collected from learners studying in universities in Australia and Sri Lanka.

The purpose of this chapter is to describe the research methodology adopted in this research. The chapter explains the research strategy adopted in this research and the series of phases followed in this research to meet its objective with the adoption of such a strategy. In particular, this chapter explains how a survey research instrument is developed, data is collected and data is analysed with a detailed explanation of different methods and techniques used at each phase of the research.

The chapter is organized as follows. Firstly, section 4.2 discusses well-known research philosophies driving popular research strategies. Section 4.3 describes two popular research strategies used in business research which are influenced by the research philosophies explained in section 4.2. Section 4.4 presents how the research methodology followed in this research is implemented to meet its objective. Finally section 4.5 presents the conclusion of the chapter.

4.2 Research philosophies

The research of confirmatory or exploratory nature follows different research strategies to meet the intended objectives (Neuman, 2007). Three main research strategies, namely, the quantitative research strategy, the qualitative research strategy and the mixed method research strategy are commonly adopted in research (Creswell, 2009; Bryman & Bell, 2011). Those research strategies reflect different philosophical worldviews on how knowledge is

developed (Saunders, Lewis, & Thornhill, 2009). Positivism, realism and interpretivism are examples of the research philosophies underpinning these main research strategies (Creswell, 2009; Bryman & Bell, 2011).

A positivistic world view "assumes that a single and objective reality exists independently of what individuals perceive" (Hudson & Ozanne, 1988). Furthermore, it assumes that there are "priori fixed relationships" that describe the objective reality (Orlikowski & Baroudi, 2002, p. 7). Research strategies underpinned by the positivist world view are primarily used to test theories (Orlikowski & Baroudi, 2002; Bryman & Bell, 2011). To test theories, hypotheses are developed with references to specific relationships describing a social phenomenon (Hudson & Ozanne, 1988; Orlikowski & Baroudi, 2002). Precise numeric measures drawn from the population of interest are, then, used to see whether the hypotheses are verified or falsified (Orlikowski & Baroudi, 2002; Creswell, 2009). The above method used in positivism is known as the hypothetic-deductive method (Orlikowski & Baroudi, 2002).

Interpretivism is a research philosophy that recognizes the distinctiveness of individuals (Bryman & Bell, 2011). It assumes that "people create and associate their own subjective and inter-subjective meanings as they interact with the world around them" (Orlikowski & Baroudi, 2002, p. 8). It is, therefore, assumed possible for different individuals to perceive a social phenomenon in different ways (Hudson & Ozanne, 1988). Research strategies underpinned by the interpretivism attempt to understand the deeper structure of the social phenomenon being considered by understanding those different perceptions (Orlikowski & Baroudi, 2002). Based on such understanding, explanations are made as to why subjective meanings are created by individuals in the considered setting regarding the relevant phenomenon (Putnam, 1983).

Realism assumes that an objective reality exists "whether the observer or researcher is able to know them or not" (Scott, 2007, p. 34). Realism does not believe that the conceptualization of reality by researchers directly reflects the reality (Bryman & Bell, 2011). This is due to the fact that the events explaining reality may not be observed by the observer or may be interpreted by the observer in a different manner (Easton, 2009). Since the truth about the reality could not be judged definitively, "researcher may collect further data that helps to distinguish among alternative explanations and on the community of researchers to debate them thoroughly" (Easton, 2009, p. 123).

4.3 Research strategies

4.3.1 The qualitative research strategy

The qualitative research strategy follows the interpretivist approach for discovering and understanding how individuals or groups respond to a social phenomenon in detail (Neuman, 2007; Cresswell, 2009). With the adoption of such a strategy, data such as words and photos are collected by examining documents, observing and holding interviews (Neuman, 2007; Cresswell, 2009). The collected data is analysed to identify the patterns in them and to interpret those patterns (Neuman, 2007; Cresswell, 2009). The interpretations made in this manner lead to the generation of a theory (Bryman & Bell, 2011).

There are a number of advantages in using a qualitative strategy in research. Firstly, data collected using a qualitative research strategy can reveal the perceptions of individuals' or groups' regarding a phenomenon in depth (Steckler, McLeroy, Goodman, Bird, & McCormick, 1992; Carr, 1994; Neuman, 2007). Secondly, a clear understanding of a social phenomenon could be obtained based on how different individuals respond to the phenomenon being considered and why they respond to the phenomenon in certain ways

(Steckler et al., 1992; Carr, 1994; Neuman, 2007). Thirdly, a qualitative strategy enables the researcher to discover or identify issues and perspectives that he/she has not considered and has not been aware of at the beginning of the research (Carr, 1994).

A qualitative research strategy also has a few limitations. For example, qualitative research may be adversely affected by the biasness of the researcher in measuring the data and interpreting results (Duffy, 1985). The reliability of the research process might also be affected due to the absence of standardization of the techniques used such as instrumentation (Duffy, 1985; Carr, 1994; Nueman, 2007). In addition, the generalizability of the results of the qualitative research is limited due to limited sample sizes considered (Steckler et al., 1992).

4.3.2 The quantitative research strategy

A quantitative research strategy follows a positivist approach for confirming theories proposed by researchers on a certain phenomenon (Nueman, 2007; Bryman & Bell, 2011). The theories proposed in quantitative research are developed by researchers based on existing theories and domain knowledge. To confirm those theories, data are collected using research instruments such as surveys (Neuman, 2007). The collected data are, then, analysed to test the validity of the theories (Nueman, 2007).

There are a number of benefits of using a quantitative research strategy in research. For example, the results of a research following a quantitative research strategy could often be generalized to a large population (Steckler et al., 1992; Creswell, 2009). The research instruments developed in quantitative research are developed in a more systematic manner to reduce the bias of the instrument, and to improve its reliability and validity (Neuman 2007). For example, research instruments used in quantitative studies are often developed by

referring to instruments developed and tested in previous research to increase the reliability of the research instrument (Steckler et al., 1992; Neuman 2007). Numerous statistical tests are used to assess the reliability of research instruments developed in the above manner (Carr, 1994). Pilot studies or pre-tests are usually done to improve the validity of the instrument with the adoption of a quantitative research strategy. One disadvantage of a quantitative research strategy is that it does not explain individuals' different perceptions and feelings regarding a phenomenon in detail (Steckler et al., 1992; Nueman, 2007).

4.4 Implementation of the research methodology

A quantitative research strategy is adopted in this research to meet its objective. The research follows a confirmatory approach to validate a set of a priori hypotheses developed on Web 2.0 based interactive e-learning. A quantitative research strategy is considered suitable for this research due to four main reasons. Firstly, a quantitative strategy is useful for examining the validity of the proposed hypotheses on Web 2.0 based interactive e-learning by collecting and analysing numerical data. Secondly, a quantitative strategy is useful for systematically comparing the perceptions of learners on Web 2.0 based interactive e-learning in Australian and Sri Lankan higher education. Thirdly, a quantitative research strategy is useful for increasing the generalizability of the hypotheses being proposed on Web 2.0 based interactive e-learning in this research, since they are based on the perceptions of a larger population (Steckler et al., 1992; Creswell, 2009). Fourthly, there are a number of existing research instruments measuring the constructs such as collaboration, delivery of instructional support, management of learning resources and effectiveness of e-learning that could be used to improve the reliability of the research instrument used in this research.

How the research methodology for this research is implemented is shown in Figure 4.1. The research methodology is implemented in six phases, namely, formulation of research initiatives, reviewing related literature, developing a conceptual framework and hypotheses, developing a survey instrument and collecting data, conducting data analysis, and drawing conclusions and proposing recommendations. During the first phase, initial ideas of the research are developed leading to the development of research aims and research questions. A research strategy is selected in order to best meet the objectives of the research. For the purposes of this research, a quantitative research strategy is adopted.

During the second phase, a review of the relevant literature is conducted. A comprehensive review of the literature related to the theories and concepts relevant to the research is conducted, and the findings of previous research relevant to this research are reviewed. Such a review is useful to understand how Web 2.0 technology could support interactive e-learning.

In the third phase, a conceptual framework on Web 2.0 based interactive e-learning is developed based on the understanding developed from the review of literature conducted in phase two. Eight hypotheses are, then, developed based on the relationships in the conceptual framework. In addition, the indicator variables contributing to theoretical constructs in the conceptual framework are also identified from the review of literature.

In the fourth phase of the research methodology implementation, a survey instrument is developed. The survey instrument is developed by mapping each indicator variable selected to measure the theoretical constructs in to an item in the survey instrument. Several steps are also taken to improve the reliability and the validity of the developed survey instrument in this phase. In particular, consulting experts, conducting pilot tests and conducting statistical tests are done to improve the reliability and the validity of the survey instrument. The survey

instrument developed in the above manner is used to collect data from learners studying in Australian and Sri Lankan universities.

The data collected during the fourth phase is cleaned in the fifth phase to remove any issues with data. The cleaned data is then used to validate the conceptual framework developed in the third phase of the research using SEM techniques. Such a validation is useful to understand how well each hypothesis proposed in this research is supported. During the final phase of the research methodology implementation, the research questions for this research are answered based on the results of the data analysis. By answering the research questions, conclusions are drawn on how interactive e-learning in higher education in Australia and Sri Lanka could be facilitated using Web 2.0 technology.

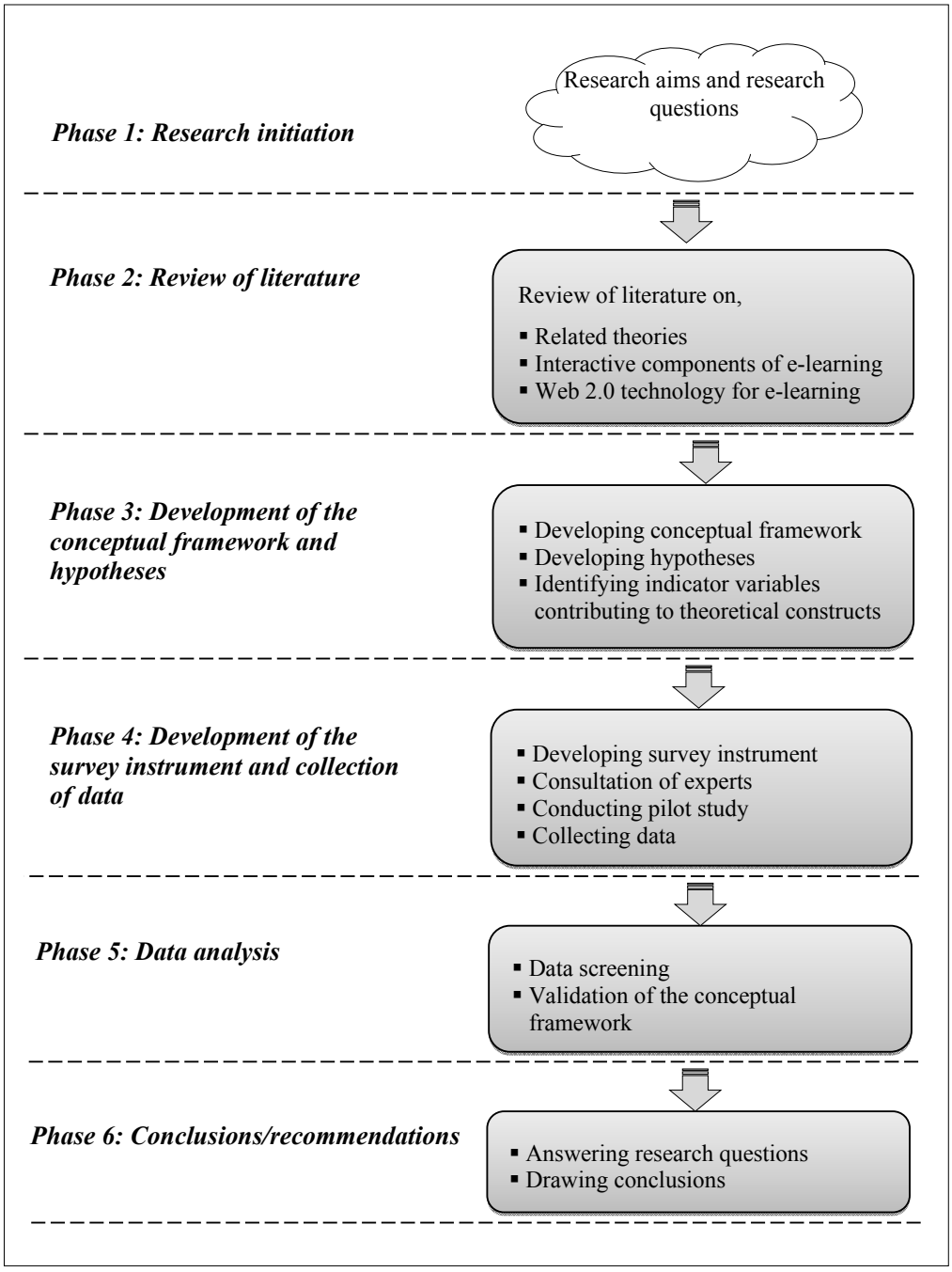

Figure 4.1: Implementation of the research methodology

4.4.1 Development of the research instrument

In the fourth phase of the research methodology implementation shown in Figure 4.1, a survey instrument is developed to collect data from learners studying in universities in

Australia and Sri Lanka. The survey instrument developed in this research contains 43 questions. The questions of the survey are close-ended questions. Close-ended questions are included in the survey for a number of reasons. Firstly, having close-ended questions and standardized answers in the survey provide much convenience in comparing, coding and analysing the responses (Bailey, 1994). Secondly, close-ended questions are helpful to minimize the possibility of receiving irrelevant responses from the respondents. Thirdly, such questions are convenient for the respondents to understand the questions by examining the answers rather than skipping questions when they do not understood them (Bailey, 1994).

The survey instrument used in this research is presented in Appendix A. The instrument comprises of two sections. The first section of the survey instrument contains questions on general information of learners such as age, gender, field of study and familiarity with Web 2.0 technology. The second section of the survey instrument contains questions developed for validating the hypotheses proposed in this research. Each question in section two corresponds to the indicator variables used for measuring the six theoretical constructs appearing in the conceptual framework shown in Figure 3.1. The answers to those questions are to be selected from a seven point Likert scale where the choices range from 'strongly disagree' to 'strongly agree'. Likert scales are widely used in survey instruments due to their simplicity and ease of use (Neuman, 2007).

The survey instrument is developed in English. English is the national language in Australia. Although Sinhala and Tamil are the official languages in Sri Lanka, English language is included in the curricula in Sri Lankan education from the primary school level. Before entering universities, all entrants are required to follow a general English course recommended by the University Grants Commission of Sri Lanka. Universities in Sri Lanka usually use English in delivering teaching and learning. The learners studying in universities

in Sri Lanka, therefore, are assumed to have an adequate level of proficiency in English to understand the content of the survey instrument.

Once the survey instrument is developed, it is presented to panels of ten experts in Australia and Sri Lanka to obtain feedback on the appropriateness of the questions. The panels of experts consisted of academics, educational consultants, and peer researchers. The feedback obtained from the experts is used to improve the survey instrument. The improved survey instrument is, then, used to conduct pilot studies. The purpose of conducting pilot studies is to obtain feedback from learners on the clarity of the questions in the survey instrument. Two pilot studies are conducted in Australia and Sri Lanka with the participation of 15 learners studying in universities of each country. Based on the feedback obtained from the pilot study, few changes such as changing the presentation of the survey instrument and rewording of questions are done. The modified survey is redistributed among the learners who participated in the initial pilot study. The feedback received from the learners on the modified survey instrument shows that the questions are understandable in the two countries in a similar manner. Learners in Sri Lanka have not indicated any problems with the survey questions presented in English language.

4.4.2 Data collection

The survey instrument developed as above is used to collect responses from appropriate individuals (Sekaran, 2003). The process of selecting an adequate number of appropriate individuals to respond to the survey is known as sampling. For the purpose of this research, random probability sampling method is used to select appropriate respondents (Nolan, Macfarlane, & Cartmel, 2013). In the random probability sampling method, each individual in the population has an equal chance of entering into the sample (Neuman, 2007; Van de

Vijver, 2011). It is considered suitable for research conducted across multiple cultures (Van de Vijver, 2011).

Data in Australia is collected from learners pursuing higher education in a leading university in Melbourne. Over 30000 learners study in a wide ranging fields of study in the above university. Learners from such a university are considered appropriate to represent the learners pursuing higher education in Australia. To collect data, 750 printed copies of the survey are distributed among learners at public places in the university. The completed surveys are collected on the spot. A total of 210 responses are collected in the above manner. The respondents include learners studying in different fields of study such as information technology, engineering and business studies.

In Sri Lanka, the responses to the survey are collected from five universities. Collecting data from five universities in Sri Lanka is done to make the sample more representative of learners studying in different fields of studies. Unlike the university in Australia considered in this research where learners study in a wide range of fields of study, certain fields of study are not available in all universities in Sri Lanka. For example, engineering and medical courses are offered in a limited number of universities in Sri Lanka. Under such circumstances collecting responses from five universities in Sri Lanka is useful to improve the representativeness of the sample.

Similar to Australia, 750 printed copies of the survey are distributed among the learners in Sri Lanka at public places in the universities such as cafeterias. The completed surveys are collected on the spot. Other participants are handed with self-addressed envelopes which they could use to post the completed survey back to the researcher later on. A total of 227 responses of respondents from numerous fields of study are collected in Sri Lanka.

4.4.3 Data analysis

The fifth phase of the research methodology implementation shown in Figure 4.1 is analysing the collected numerical data from Australia and Sri Lanka. As the first step of data analysis, issues with data that could adversely affect data analysis are investigated. For example, issues of data such as missing data values and extreme data values are identified among the sample data. Steps are, then, taken to reduce the adverse effect of such data on the data analysis. A detailed discussion of those steps is presented in Chapter 5.

As the second step of data analysis, SEM techniques are used to validate the proposed conceptual framework on Web 2.0 based interactive e-learning. SEM is a popular method used for quantitative data analysis (Byrne, 2010). It is capable of examining multiple relationships between theoretical constructs in conceptualized models simultaneously (Hair, Black, Babin, & Anderson, 2010). Such techniques are capable of validating the structural relationships in the proposed conceptual framework on Web 2.0 based interactive e-learning simultaneously. SEM also includes techniques for comparing the structural relationships in theoretical models across multiple groups (Byrne, 2010). Such techniques are useful for comparing how the learners perceive the structural relationships specified between the theoretical constructs in the conceptual framework developed in this research across Australia and Sri Lanka. To analyse the data in this research using SEM, AMOS 20.0 software is used. A detailed discussion of how data analysis using SEM is conducted in this research is given in Chapter 6 and Chapter 7.

4.4.4 Reliability and validity

Reliability and validity are two vital elements of research instruments. The reliability of the research instrument refers to the absence of errors in measurement. It enables the same

research instrument to be used to reproduce the same results again (Field, 2009; Hair et al., 2010). The validity of the research instrument refers to the degree to which the research instrument accurately measures what it is designed to measure (Field, 2009; Hair et al., 2010).

To improve the reliability of the research instrument used in this research, two steps are taken in selecting variables to measure the theoretical constructs in the conceptual framework. Firstly, multiple indicator variables are selected to measure the theoretical constructs in the conceptual framework in this research. Using multiple indicator variables to measure theoretical constructs is useful for improving the reliability of the measurement instruments (Neuman, 2007). Secondly, many of those selected indicator variables are chosen from research instruments used in previous research to measure similar constructs.

To evaluate the reliability of the developed research instrument, the internal consistency of the research instrument is assessed (Hair et al., 2010). Internal consistency determines the degree to which the indicator variables selected to measure the same construct are interrelated (Hair et al., 2010). It is commonly used to measure the reliability of measurement instruments (Hair et al., 2010). The internal consistency of the measurement instrument used in this research is assessed using Cronbach's alpha (Byrne, 2010; Hair et al., 2010). A detailed description of how the above reliability test is conducted is presented in Chapter 6.

The validity of the research is improved in terms of external validity, content validity, construct validity and the cross-cultural validity of the research (Vogt, 2007; Hair et al., 2010). External validity refers to the degree to which the results of the research could be generalized (Vogt, 2007). To improve the external validity in this research, steps are taken to improve the representativeness of the sample considered. For example, random probability sampling where each learner has an equal probability in being included in the sample is used to improve the representativeness of the sample. Furthermore, special attention is given in

obtaining responses from learners studying in different fields of study while collecting data in Sri Lanka.

The content validity determines whether the indicator variables of an instrument correspond to the conceptual definition of the relevant construct (Vogt, 2007; Hair et al., 2010). Two steps are used in this research to improve the content validity of the research instrument. Firstly, the selection of indicator variables in this research is done by referring to existing research instruments for measuring similar theoretical constructs. Secondly, the initial research instrument developed is provided to panels of experts consisting of academics, educational experts and peer researchers from whom feedback is obtained on the appropriateness of the indicator variables. Feedback obtained from the panel of experts is used to improve the content validity of the research instrument.

The construct validity determines the degree to which the indicator variables selected to measure theoretical constructs actually measure the construct being measured (Vogt, 2007; Hair et al., 2010). Two types of validities, namely, convergent validity and discriminant validity are used in this research to assess the construct validity of the theoretical constructs (Vogt, 2007; Hair et al., 2010). A detailed description of the tests used to assess the above types of validities is given in Chapter 6.

Special attention is also paid to the cross-cultural validity of this research. As the first step of improving the cross-cultural validity of the research, much attention is paid on developing a research instrument that behaves equivalently across the two cultures (Brislin, 1976; Matsumoto & Van de Vijver, 2011). To develop equivalent measurement instruments, this research has taken steps to improve the construct equivalence, measurement item equivalence and method equivalence of the research instruments. The construct equivalence refers to equivalence in measuring the same construct across multiple cultures. It does not require the

research instrument used to be identical across cultures. Different items may be used to measure constructs across multiple cultures. The measurement unit equivalence of a research instrument used across multiple cultures refers to having same units of measurement in the instruments even though with a different origin (Van de Vijver & Tanzer, 2004).

Several steps are taken in this research to improve the construct equivalence and the measurement item equivalence of the research instrument. To reduce the influence of bias resulting from the lack of equivalence in constructs, consultation with experts in local cultures, reviewing literature using similar constructs in local cultures and conducting pilot studies are done (Van de Vijver & Tanzer, 2004; Matsumoto & Van de Vijver, 2011). A review of the related literature conducted on e-learning in Sri Lanka and Australia confirms that similar constructs are considered in e-leaning research conducted in both countries. Furthermore, inquiries made from academics, experts and fellow research scholars in Australia and Sri Lanka regarding the construct equivalence reveal that there are no significance differences between the conceptualization of the constructs in the two countries. The review of literature and the consultations also reveal that the indicator variables used to measure the constructs are appropriate for both the cultures.

The method equivalence refers to the manner in which the survey is designed and administered. Two steps are taken to improve the method equivalence of the research instrument used in this research. Firstly, the research instruments used for collecting data in Australia and Sri Lanka has used the seven point Likert scale where the choices ranges from ‘strongly disagree’ to ‘strongly agree’. Secondly, both instruments are prepared in the English language. No translations are done for the research instrument used to collect the responses from the two countries. A summary of the steps discussed above to improve the reliability and validity of this research is given in Table 4.1.

Table 4.1 : Steps taken to improve the reliability and validity

Reliability/Validity	Techniques for improving reliability and validity
Reliability	a. Clear conceptualization of constructs b. Use of multiple indicator variables c. Tests for internal consistency of indicator variables (Cronbach's Alpha)
External validity	a. Use of random probability sampling b. Collection of data from learners studying in multiple fields of studies
Content validity	a. Use of indicator variables used to measure similar constructs in previous research b. Expert consultations on the appropriateness of the items in the measurement instrument
Construct validity	a. Tests for convergent validity b. Tests for discriminant validity
Cross-cultural validity	a. Construct equivalence and measurement item equivalence : Literature review and expert consultations revealing how constructs are defined and indicator variables are used in similar research in Australia and Sri Lanka b. Method equivalence : use of same presentation style for the survey and use of same language to design the survey

4.4.5 Ethical considerations

This research is categorized as a 'negligible or low risk' research by the Business College Human Ethics Advisory Network (BCHEAN). The procedures for collecting data and maintaining the collected data for this research is approved by the BCHEAN. Based on the guidelines provided by BCHEAN, an information sheet is developed to be provided to the participants of the survey. The information sheet explains the objective of the research, methods of data collection and contact information of the researcher. Participation in the

survey by learners is voluntary. There is no dependent relationship between the researchers and the respondents. No personal data is requested from the respondents, thus, the anonymity of the respondents is maintained. The data collected from the respondents is stored in digital form where only the researcher and the supervisor have the access to data.

4.5 Conclusion

This chapter explains how this research is designed to meet its objectives. In particular, the chapter explains the research strategy adopted in this research and the phases through which this research progressed to meet its objectives. A quantitative research strategy is followed in this research. The chapter highlights the appropriateness of such a strategy to improve the generalizability of the results of the research and to make systematic comparisons of learner perspectives on Web 2.0 based interactive e-learning across countries. The chapter further explains how the research instrument is designed, data is collected and data is analysed in this research. Furthermore, steps taken to improve the reliability and the validity of the research are also explained in detail.

Chapter 5

PRELIMINARY DATA ANALYSIS

5.1 Introduction

Data collected in quantitative research go through two phases, namely, data screening and preliminary data analysis before they are used to examine the validity of the proposed hypotheses. Data screening refers to a process where collected data are cleaned to address various issues with data such as missing data and extreme data values that might mislead the data analysis (Tabachnick & Fidell, 2007; Hair et al., 2010; Meyers, Gamst, & Guarino, 2013). Preliminary data analysis refers to a process where "additional descriptive observations are made about the data" (Buchner & Findley, 1990, p. 154). Such a process is important to obtain a "general 'feel' of the data" (Chatfield & Collins, 1980).

In this research, data screening and preliminary data analysis are done for a number of reasons. Firstly, data screening is conducted in this research to identify any missing data values among the collected data. Secondly, it is conducted in this research to find extreme data values which might adversely affect understanding the phenomenon attempted to be explained in this research (Tabachnick & Fidell, 2007; Meyers et al., 2013). Thirdly, data screening is conducted to examine whether the collected data meet the assumptions of SEM analysis techniques which are used for analysing data in this research. Finally, preliminary data analysis is conducted in this research to summarize the collected data to obtain a general understanding about the collected data and samples selected.

The purpose of this chapter is to explain how data screening and preliminary data analysis are done in the research concerned. The chapter explains how issues with data such as missing

data, outliers and non-normality are identified, and how steps are taken to reduce adverse effects of those data on data analysis and drawing conclusions. Furthermore, the chapter presents a summarised overview of the collected data for obtaining a general understanding of the selected sample and the collected data.

The organization of this chapter is as follows. Firstly, section 5.2 explains how this research identifies the issues with the collected data such as the missing data and outliers with a detailed description of the steps taken to handle those issues. Sections 5.3 and 5.4 then, present a summarised overview of the sample and the data collected respectively. Finally section 5.5 presents the conclusion of the chapter.

5.2 Data screening

5.2.1 Handling missing data

Data collected in quantitative research contain missing data values due to several reasons such as errors in entering data, errors in collecting data and omissions made by the respondents (Hair et al., 2010). Missing data values might adversely affect the validity and the reliability of the research findings depending on the amount of missing data values and their patterns (Tabachnick & Fidell, 2007). In particular, when the amount of missing data values is high or when the missing data values are not randomly distributed across the dataset it would be problematic (Kline, 2004; Tabachnick & Fidell, 2007).

In this research, a total of 227 and 202 responses are collected from Sri Lanka and Australia respectively. Among those responses there were few missing data. This is due to the questions for which the respondents have not provided answers. There is no observable pattern in the questions for which the respondents have not provided answers. Therefore, it is assumed that

the respondents have not answered those questions mistakenly. Missing data in this research does not exceed 10% for an individual response. When missing data values does not exceed 10% for individual responses and when there is no observable pattern in missing data values, imputing the missing data values is considered suitable to handle the missing data values (Tabachnick & Fidell, 2007; Kaplan, 2009; Hair et al., 2010).

Missing data values in data samples can be imputed using software such as SPSS (Statistical Package for Social Sciences) (Tabachnick & Fidell, 2007). For the purpose of this research, the missing data values have been imputed using SPSS 20.0. The maximum likelihood estimation technique is used to impute the missing data values (Kline, 2004; Hair et al., 2010). The above technique is a widely used technique for imputing missing values that appear at random (Kline, 2004; Tabachnick & Fidell, 2007; Hair et al., 2010).

5.2.2 Handling outliers

An outlier refers to "an observation that is substantially different from the other observations on one or more characteristics (variables)" (Hair et al., 2010). A univariate outlier is an extreme value that is observed for a single variable in a dataset (Kline, 2004; Tabachnick & Fidell, 2007). A multivariate outlier, on the other hand, has extreme data values for two or more variables (Kline, 2004). Outliers may exist in datasets due to several reasons such as errors in data entry and the presence of cases in the sample that do not belong to the intended population being considered (Tabachnick & Fidell, 2007; Hair et al., 2010). The presence of outliers can affect the normality of data distributions, which in turn can mislead data analysis done using SEM techniques (Cruz, 2007; Byrne, 2010).

Statistical software such as SPSS could be used to detect univariate outliers by visualizing the distribution of data for each variable using boxplots or histograms (Tabachnick & Fidell,

2007). The detected outliers could either be deleted or retained (Tabachnick & Fidell, 2007; Hair et al., 2010). In this research, univariate outliers are identified using box plots (Tabachnick & Fidell, 2007). The values of those outliers have been changed to the next most extreme value within three standard deviations of the mean to reduce the impact of the outliers on the univariate normality of the distributions (Kline, 2011). Multivariate outliers could be identified based on the Mahalanobis distance. The Mahalanobis distance "is the distance of a case from the centroid of the remaining cases where the centroid is the point created at the intersection of the means of all the variables" (Tabachnick & Fidell, 2007, p. 74). Statistical software such as AMOS (Analysis of Moment Structures) could be used to find multi-variate outliers using the Mahalanobis distance.

5.2.3 Handling non-normality

Data analysis in this research is done using SEM techniques (Byrne, 2010). A majority of SEM estimation techniques assume the multivariate normality of data distributions (Tabachnick & Fidell, 2007). The non-normality of data distributions would cause problems for SEM techniques in fitting the hypothesized framework with the given data (Byrne, 2010). It is, therefore, important to assess the normality of data distributions used in the research and take remedies for non-normality of data distributions.

The normality of data distributions in a dataset could be analysed using a graphical analysis and statistical tests. In this research, the normality of data is assessed using the Kolmogorov-Smimov test conducted using SPSS (George & Mallery, 2011). The Kolmogorov-Smimov test calculates the level of significance for the deviation of a distribution of data from the normal distribution (Hair et al., 2010; George & Mallery, 2011). A significance value approaching zero in the Kolmogorov-Smimov test indicates the non-normality of the data distribution (George & Mallery, 2011). The Kolmogorov-Smimov test results for the sample

data in this research indicate that the data distributions are non-normal. These results are shown in Appendix B. To handle the non-normality of the data distributions in this research, bootstrapping is used with AMOS 20.0. Bootstrapping is often used as a remedy for the non-normality of distributions of the collected data, when data is analysed using SEM (Kline, 2004; Byrne, 2010).

5.3 Characteristics of the samples

As the first step of preliminary data analysis of this research, the general information of respondents is summarized using tables and graphs. Such summaries are useful for understanding the characteristics of respondents in general. What follows next in this section presents the characteristics of the respondents of this research in terms of their age, gender, level of study, field of study and the familiarity with the Web 2.0 tools.

Table 5.1 shows the age distributions of the respondents of the survey. The majority of the respondents in both samples are aged between 20 to 29 years. Among a total of 202 respondents in Australia, 130 belong to the above group which is 64% of the total. In the sample from Sri Lanka, 160 respondents of a total of 227 belong to this group which is 71% of the total. The next highest number of respondents for both the groups belongs to the age group of 30 to 39 years. The aforementioned group counts 22% of the total respondents from Australia and 28% of the total respondents from Sri Lanka. The information above shows that there is no significant difference between the groups of respondents in term of age across the two countries. Figure 5.1 shows the information shown in Table 5.1 graphically for Australia and Sri Lanka.

Table 5.1 : Distributions of the respondents' age

Age group	Australia		Sri Lanka	
	Count	Percentage	Count	Percentage
Below 20	8	4.0%	2	1%
20-29	130	64.0%	160	71%
30-39	44	22.0%	64	28%
40-49	12	6.0%	1	0.0%
50-60	8	4.0%	0	0.0%

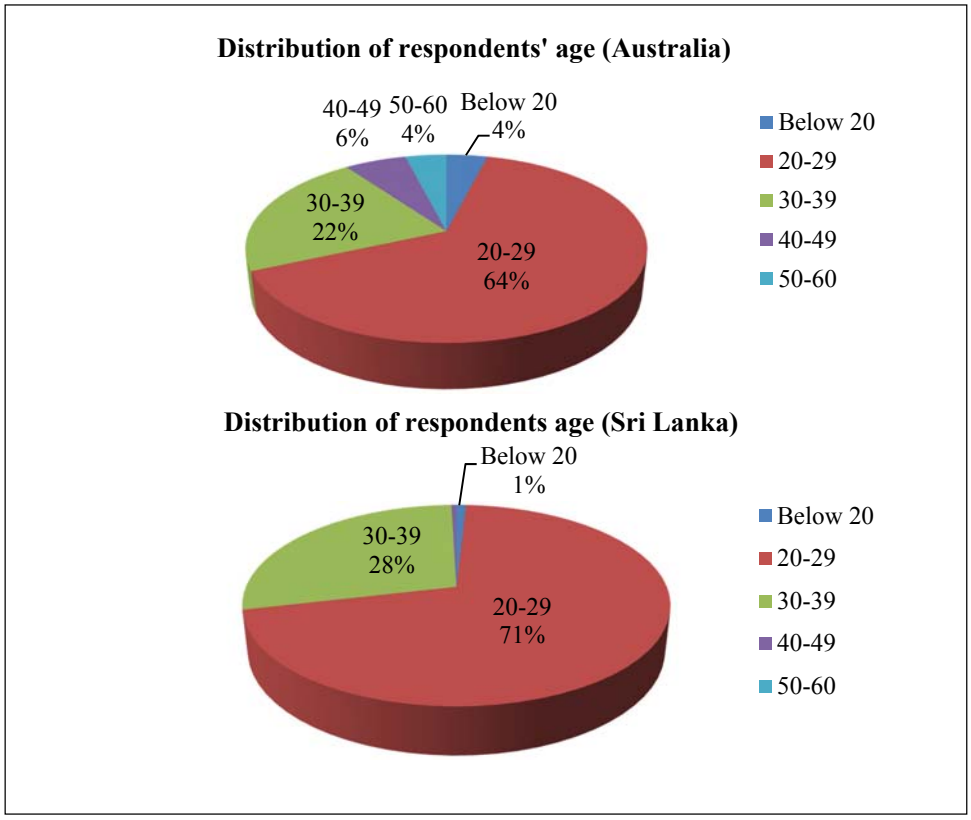

Figure 5.1: Distribution of the respondents' age

Table 5.2 shows the gender distributions of the respondents of the survey. From the total respondents in Australia and Sri Lanka, 73 and 97 respondents respectively are female which counts 36% and 43% from the total respondents. A total of 129 respondents and 130

respondents from the samples from Australia and Sri Lanka respectively are male which counts for 64% and 57% from total respondents. Figure 5.2 shows the information shown in Table 5.2 graphically for Australia and Sri Lanka.

Table 5.2 : Distribution of the respondents' gender

Age group	Australia		Sri Lanka	
	Count	Percentage	Count	Percentage
Female	73	36%	97	43%
Male	129	64%	130	57%

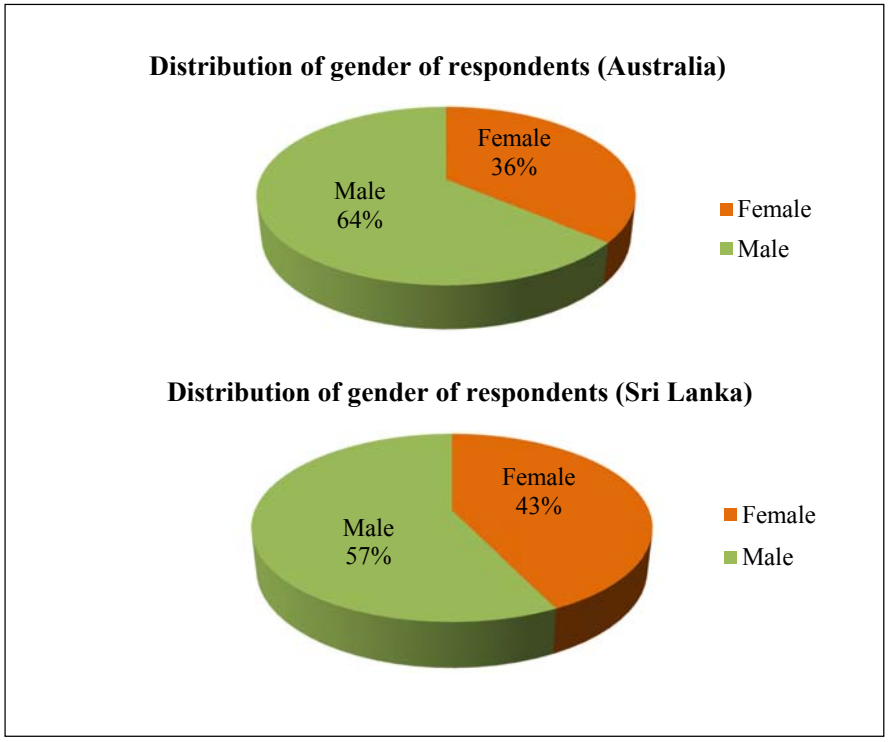

Figure 5.2: Distribution of the respondents' gender

Table 5.3 shows the distributions of the levels of study in which the respondents of the survey are at. The majority of respondents from both the samples are undergraduates. A total of 103 respondents and 142 respondents are undergraduates from Australian and Sri Lankan samples respectively. The above number of respondents accounts for 51% and 63% of the total

respondents. The remaining respondents are postgraduate learners which counts 49% and 37% of the total respondents from Australia and Sri Lanka respectively. Furthermore, 57% of the respondents who are postgraduate learners from Australia follow research degrees whereas, only 13% of the respondents who are postgraduate learners follow research courses in Sri Lanka. Figure 5.3 shows the information shown in Table 5.3 graphically for Australia and Sri Lanka.

Table 5.3 : Distribution of respondents' level of study

Level of study	Australia		Sri Lanka	
	Count	Percentage	Count	Percentage
Undergraduate	103	51%	142	63%
Postgraduate	99	49%	85	37%

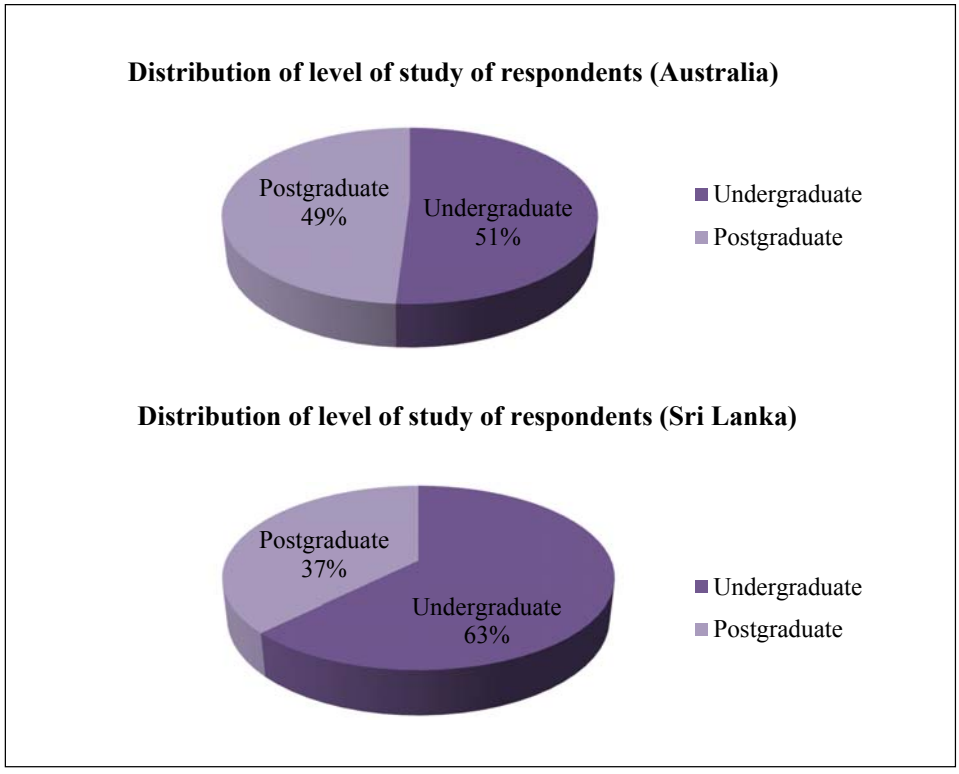

Figure 5.3: Distribution of the respondents' level of study

Table 5.4 shows the distributions related to the fields of studies the respondents of the survey are at. An examination of the fields of the studies of the respondents reveals that the respondents to the survey conducted in Australia and Sri Lanka belong to five fields of studies including Arts, Business, Engineering, Computer Science and Information Technology, and Science and Health. A majority of the respondents in Australia study business management. From the total respondents, 101 respondents study business management which is 50% from the total respondents. From the remaining respondents 61, 24, 8 and 8 respondents study computer science and information technology, engineering, arts, and science and health respectively.

Table 5.4 : Distribution of respondents' field of study

Field of study	Australia		Sri Lanka	
	Count	Percentage	Count	Percentage
Arts	8	4%	18	8%
Management	101	50%	53	23%
Engineering	24	12%	59	26%
Computer Science and Information Technology	61	30%	83	37%
Science and Health	8	4%	14	6%

A majority of respondents from Sri Lanka studies computer science and information technology. From the total respondents, 83 respondents study computer science and information technology which counts 37 % from the total respondents. From the remaining respondents 59, 53, 18 and 14 respondents study engineering, business management, arts, and science and health respectively. The above results show that the respondents of the survey in

both Australia and Sri Lanka represented a wide range of fields of studies. Figure 5.4 shows the information shown in Table 5.4 graphically for Australia and Sri Lanka.

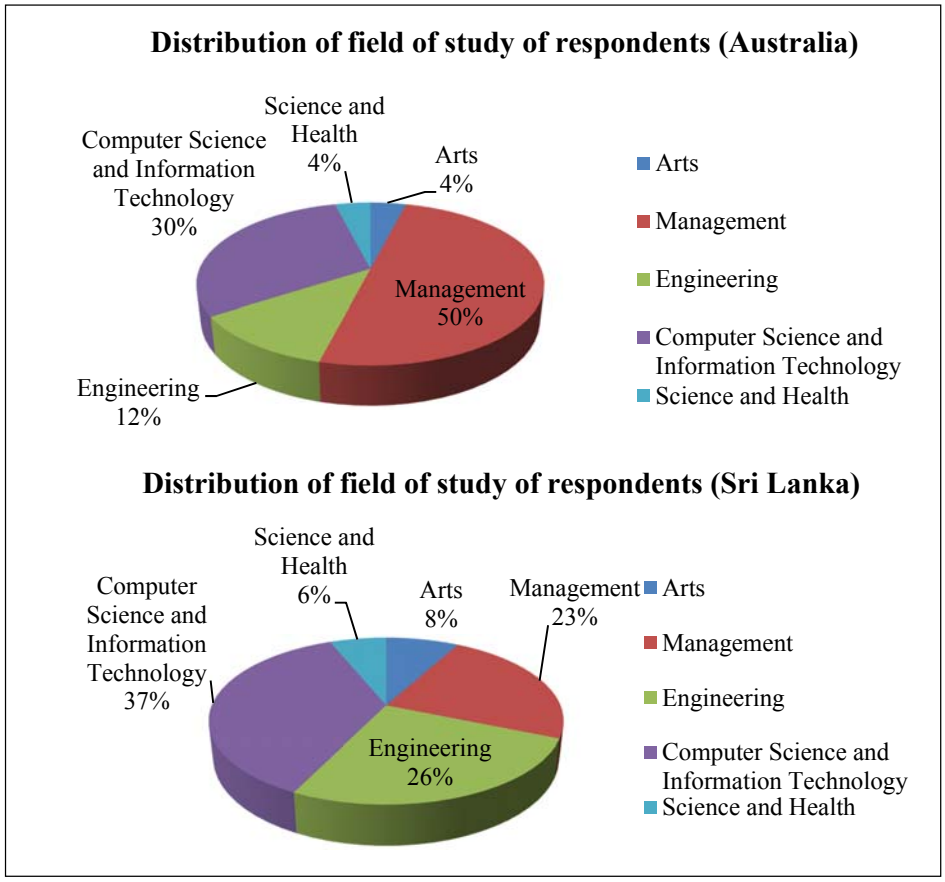

Figure 5.4: Distribution of the respondents' field of study

Understanding the level of familiarity of the respondents with Web 2.0 technology is important for this research. Questions are, therefore, included in the survey to capture familiarity of learners with popular Web 2.0 tools such as blogs, wikis, social bookmarks and YouTube. The results obtained are summarized as shown in Table 5.5.

Table 5.5 : Respondents' familiarity of web 2.0 tools

Web 2.0 tool	Australia		Sri Lanka	
	Count	Percentage	Count	Percentage
Blogs	121	60%	120	53%
Instant Messengers	155	77%	143	63%
Facebook	180	89%	210	92%
Social Bookmarking	18	9%	21	9%
RSS	44	22%	55	24%
TeacherTube	12	6%	18	7%
Wiki	143	71%	174	77%
YouTube	184	91%	188	83%

The results in Table 5.5 show that learners in both Australia and Sri Lanka are most familiar with Facebook and YouTube. While the majority of the respondents in Australia are familiar with YouTube with a rate of 91%, the Sri Lankan respondents are found more familiar with Facebook with a rate of 92%. A total of 184 respondents from a total of 202 respondents are familiar with YouTube in Australia whereas, 210 respondents from a total of 227 respondents are familiar with Facebook in Sri Lanka. Both groups of respondents are also familiar with blogs, instant messenger and wikis with a rate over 50%. Furthermore, the respondents in both Sri Lanka and Australia are familiar with RSS with a rate at around 20%. The respondents of both the groups are least familiar with TeacherTube. The number of respondents familiar with the application is found less than 20. Furthermore, social bookmarking is also found as a less familiarized application among respondents. Similar to TeacherTube, the number of respondents familiar with Social Bookmarking is found to be approximately around 20. Both the aforementioned applications are found familiar among

respondents with a rate less than 10%. The above results show that learners in both Australia and Sri Lanka are familiar with Web 2.0 tools in a similar manner. Figure 5.5 shows the information shown in Table 5.5 graphically for Australia and Sri Lanka.

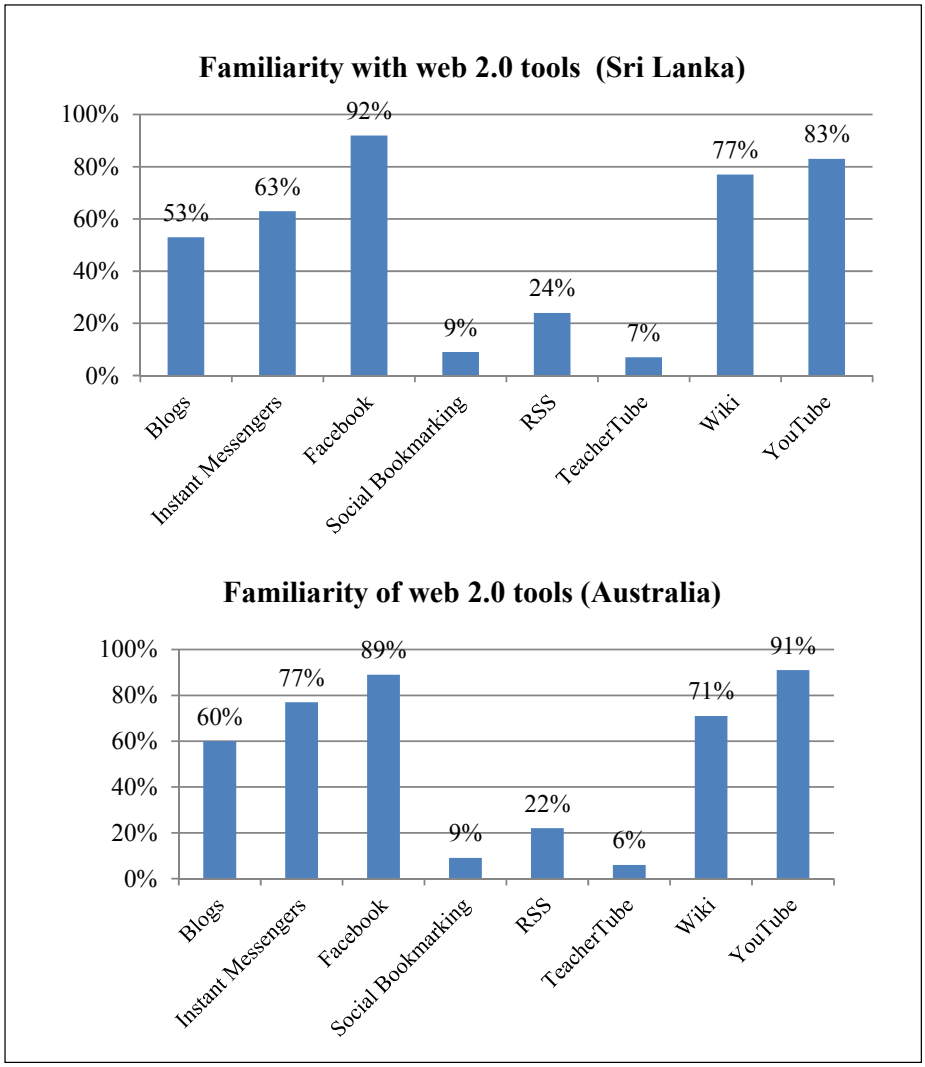

Figure 5.5: Respondents' familiarity of web 2.0 tools

Understanding the extent to which respondents in Australia and Sri Lanka are experienced in using Web 2.0 tools for e-learning is also important for this research. Table 5.6 shows how respondents in Australia and Sri Lanka have used popular Web 2.0 tools for e-learning.

Table 5.6 : Respondents'' familiarity of using Web 2.0 tools for e-learning

Web 2.0 tool	Australia		Sri Lanka	
	Count	Percentage	Count	Percentage
Blogs	49	24%	66	29%
Instant Messengers	47	23%	48	21%
Facebook	64	32%	29	13%
Social Bookmarking	6	3%	5	2%
RSS	9	4%	3	1%
TeacherTube	3	1%	0	0%
Wiki	100	50%	97	43%
YouTube	91	45%	112	49%

The results in Table 5.6 show that the respondents in both Australia and Sri Lanka are most familiar in using wikis and YouTube for e-learning. While the majority of the respondents in Australia are familiar with using wikis for e-learning with a rate of 50%, the Sri Lankan respondents are found more familiar in using YouTube for e-learning with a rate of 49%. A total of 100 respondents from a total of 202 respondents have used wikis for e-learning in Australia whereas, 112 respondents from a total of 227 respondents have used YouTube for e-learning in Sri Lanka. From the total respondents, 64 respondents in Australia have used Facebook for e-learning which counts 32% from the total respondents. In contrast, from the total respondents only 29 respondents in Sri Lanka have used Facebook for e-learning which counts 13% from the total respondents. Both groups of respondents have used blogs and instant messengers for e-learning over a rate of 20%. Both groups of respondents are least familiarized with using social bookmarks, RSS and TeacherTube for e-learning with rates less than 5%. Figure 5.6 shows the information shown in Table 5.6 graphically.

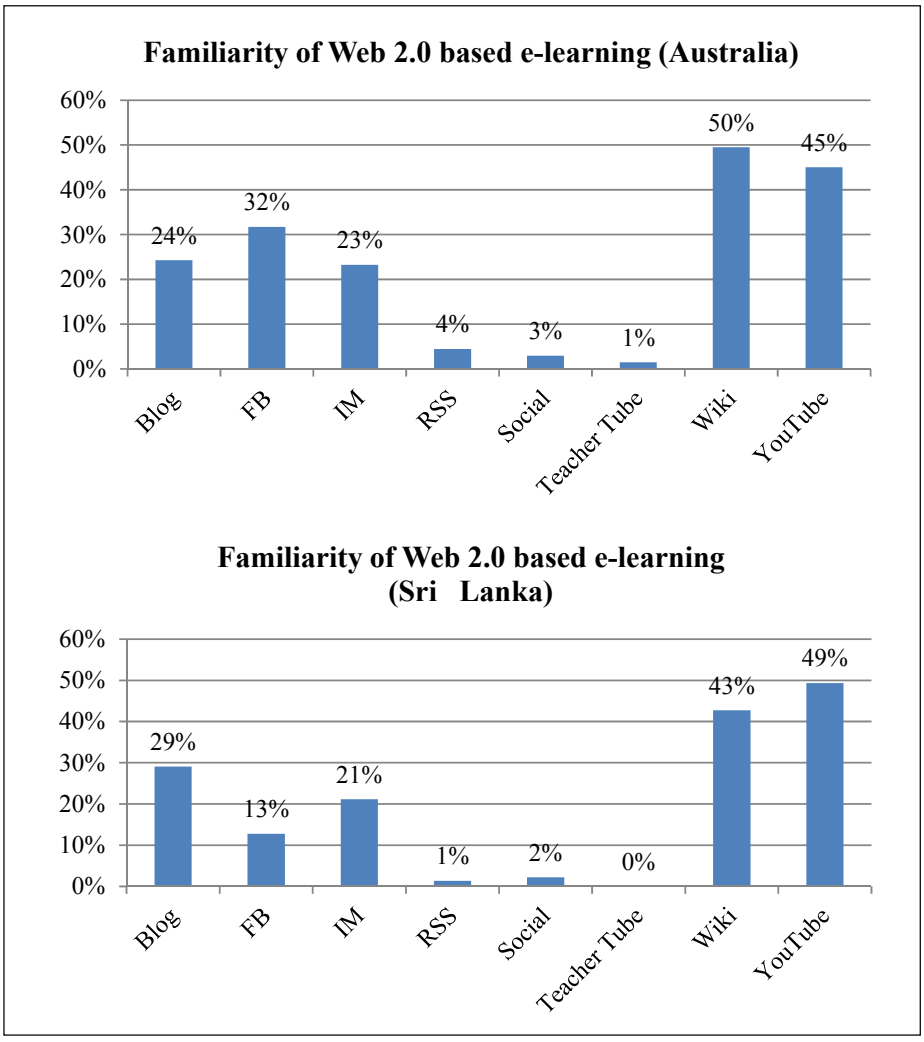

Figure 5.6: Respondents' familiarity of using Web 2.0 tools for e-learning

Australia provides higher education to a large number of local learners as well as international learners. Apart from the information such as age, gender, field of study, level of study and familiarity with Web 2.0 technology, therefore, information about the local and international respondents in Australia is also captured. From the total respondents of the survey in Australia, 64% are local learners whereas, 36 % are international learners. A majority of the international learners are from the Asian region. Other learners are from different regions of the world such as Africa, America, Europe and Middle East.

5.4 Descriptive statistics

Descriptive statistics describe the characteristics of data in a sample (Tabachnick & Fidell, 2007). They present data in a meaningful manner such that visualizing data in a sample is easier than when it is presented as raw data. Statistical software packages such as SPSS are capable of providing summaries of data by calculating descriptive statistics.

There are a total of 33 indicator variables measuring the six theoretical constructs in the conceptual framework of this research shown in Figure 3.1. Each respondent selects a preference from 1 to 7 based on the seven point Likert scale for each of the indicator variables above. To describe how the respondents have selected their preference for those indicator variables, descriptive statistics are used. In this research, five descriptive statistics namely, minimum, maximum, mean, mode and the standard deviation are considered. The above descriptive statistics are estimated for indicator variables representing the constructs in the conceptual framework. Such statistics are helpful for understanding the representative values and the amount of variation in the data values for each indicator variable.

The descriptive statistics for indicator variables representing personal knowledge management in the conceptual framework for data collected in Australia and Sri Lanka are given in Tables 5.7 and 5.8 respectively. These statistics are obtained using SPSS 20.0. The mean values obtained for all indicator variables in Table 5.7 and Table 5.8 are between 5.00 and 6.00. The median value for all items expect for PKM4 is 6.00. The descriptive statistics for the indicator variables representing the remaining constructs in the conceptual framework are given in Appendix C.

Table 5.7 : Descriptive statistics for personal knowledge management (Australia)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
PKM1	2	7	5.67	6.00	1.059
PKM2	3	7	5.65	6.00	1.056
PKM3	3	7	5.66	6.00	1.076
PKM4	2	7	5.45	5.00	1.006
PKM5	1	7	5.49	6.00	1.102

Table 5.8 : Descriptive statistics for personal knowledge management (Sri Lanka)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
PKM1	2	7	5.53	6.00	1.153
PKM2	2	7	5.56	6.00	1.164
PKM3	1	7	5.39	6.00	1.327
PKM4	2	7	5.46	6.00	1.187
PKM5	1	7	5.33	6.00	1.274

5.5 Test for common method bias

The common method variance is defined as the "variance that is attributable to the measurement method rather than to the constructs the measures represent"(Podsakoff, MacKenzie, Lee, & Podsakoff, 2003, p. 879). Such variances caused by the measurement method are problematic for research since they can cause measurement errors (Podsakoff et al., 2003). The common method bias “is the magnitude of the discrepancies between the observed and true relationships between constructs that result from the common method variance” (Podsakoff et al., 2003, p.879).

Existing research identifies a number of causes for the common method bias. For example, the method bias can occur when respondents may respond in a manner that their responses are acceptable in a society other than articulating their true feelings (Podsakoff et al., 2003). Furthermore, the method bias can occur when respondents try to maintain consistency in their answers. The method bias can also occur when the questions hint the respondents on how to respond it (Podsakoff et al., 2003).

In this research, several steps are taken to address potential concerns for common method bias. These include procedural and statistical remedies (Krishnan, Martin & Noorderhaven, 2006). To encourage the respondents to truly articulate their true feelings, and thus reduce the common method bias, anonymity of the respondents is maintained (Podsakoff et al., 2003; Krishnan et al., 2006). To discourage the respondents in maintaining the consistency of the answers, separating survey items and reducing ambiguity of items is done (Krishnan et al., 2006). The Harman's single-factor test is used to statistically examine whether the common method bias exists (Aulakh & Gencturk, 2000; Podsakoff et al., 2003; Krishnan et al., 2006). The test examines whether the majority of variances could be explained by a single variable. In the measurement model for Australia, the most variance that could be explained by a single factor is found to be 37.2%. In the measurement model for Sri Lanka, the most variance that could be explained by a single factor is found to be 42.8 %. Such results show that the common method bias is less likely (Li et al., 2010).

5.6 Conclusion

This chapter discusses two important steps followed in this research using collected data namely data screening and preliminary data analysis. During data screening in this research, missing data, extreme data values and normality of data distributions are investigated.

Imputing data is done to replace the missing data values. Extreme data values are changed to the next most extreme value within three standard deviations of the mean. Bootstrapping is recommended to be used for reducing the impact of non-normality of data distributions on the data analysis. During preliminary data analysis, calculating descriptive statistics and representing data graphically is done to obtain a general understanding of the data collected in the research. With remedies taken for issues of data and general understanding obtained of collected data, the data analysis could next proceed to SEM analysis.

Chapter 6

CONFIRMATORY FACTOR ANALYSIS

6.1 Introduction

This research use SEM techniques to investigate the enabling role of Web 2.0 technology for effective interactive e-learning in Australian and Sri Lankan higher education following a confirmatory approach (Jaeger & Halliday, 1998). SEM is a popular statistical technique used in the confirmatory research (Byrne, 2010). It is capable of validating a series of relationships among theoretical constructs in a hypothesized framework simultaneously (Byrne, 2010; Hair et al., 2010). Such a technique is suitable for validating relationships defined in the pre-conceptualized framework on Web 2.0 based interactive e-learning in this research.

The purpose of this chapter is to explain how a valid measurement model is developed in this research as the first step in SEM analysis. In particular, this chapter explains how the measurement model is developed and assessed using CFA, and how the developed measurement model is revised to improve its validity. Different tests conducted through the above process are explained and the results obtained in such tests are presented.

The organization of this chapter is as follows. Firstly, section 6.2 provides a brief overview of SEM, followed by section 6.3 which provides an overview of CFA. Section 6.4 describes how the measurement model is developed in this research. Section 6.5 then, presents a discussion on validating the measurement model developed in section 6.4 using CFA. Section 6.6 explains the steps taken to modify the measurement model to improve its validity followed by section 6.7 which presents the final measurement model resulted after applying the modifications discussed in section 6.6. Section 6.8 presents the tests performed to assess

whether the measurement model behaves in a similar manner for Australia and Sri Lanka. Finally, section 6.9 presents the conclusion of the chapter.

6.2 Structural equation modelling

SEM is a collection of statistical techniques that can be used to confirm a theory hypothesized on a phenomenon (Tabachnick & Fidell, 2007; Byrne, 2010; Hair et al., 2010). To confirm a theory, SEM develops and validates a set of models consisting interrelated structural relationships among theoretical constructs and indicator variables (Byrne, 2010; Hair et al., 2010; Kline, 2010). The theoretical constructs refer to unobservable factors that are used to describe the phenomenon explained by the proposed theory. Those theoretical constructs are represented by observable indicator variables (Byrne, 2010; Hair et al., 2010; Kline, 2010).

SEM is considered suitable for this research due to several reasons. Firstly, SEM allows theoretical frameworks with a number of structural relationships among theoretical constructs to be validated using collected data (Hair et al., 2010). Such a technique is suitable to validate the conceptual framework proposed in chapter 3 of this thesis which leads to answer the research questions for this research. Secondly, SEM allows developing complex theories with relevance to unobservable theoretical constructs as in this research and validate the relationships between such constructs with the use of observable indicator variables (Kline, 2010; Hair et al., 2010). Thirdly, SEM could be used to examine how relationships between theoretical constructs are perceived by different samples (Hair et al., 2010). Such capability of SEM is useful in this research to find the similarities and differences between learners' perceptions on using Web 2.0 technology for interactive e-learning in Australia and Sri Lanka. Fourthly, SEM analysis is considered suitable for this research due to the availability of user friendly tools supporting data analysis.

A number of steps are involved in the SEM analysis as shown in Figure 6.1 (Hair et al., 2010). The first step in the SEM analysis is to formulate a theory (Kaplan, 2009; Hair et al., 2010). For the purpose of this research, in this step, a series of priori hypothesized relationships among unobservable theoretical constructs with relevance to Web 2.0 based interactive e-learning are proposed based on a comprehensive review of the related literature. Furthermore, sets of observable indicator variables are also identified to measure those unobservable theoretical constructs. In the second step of the data analysis, the measurement model is developed (Kaplan, 2009; Hair et al., 2010). The measurement model shows how the unobservable theoretical constructs involved in a theory are represented by observable indicator variables (Hair et al., 2010). In the third step, a sample is selected and data is collected to validate the measurement model (Kaplan, 2009). In the fourth step, the developed measurement model is estimated using the collected data. The estimation provides empirical measures on the validity of the relationships specified in the measurement model between the indicator variables and the theoretical constructs (Hair et al., 2010).

In the fifth step of SEM analysis process, the empirical measures obtained by assessing the measurement model are used to examine the validity of the measurement model (Hair et al., 2010). For measurement models lacking validity, steps are taken to improve the validity by modifying the measurement model. If the measurement model is valid, a structural model could be developed as the sixth step (Hair et al., 2010). A structural model shows the hypothesized relationships among the unobservable constructs as specified in the pre-specified conceptual framework.

The developed structural model is assessed in the seventh step. The assessment of the structural model is done to understand how well the hypothesized relationships among the unobservable theoretical constructs are valid (Hair et al., 2010). If the structural model is

valid, conclusions are drawn on the validity of the hypotheses. If the structural model is not valid, steps have to be taken to improve the validity of the structural model.

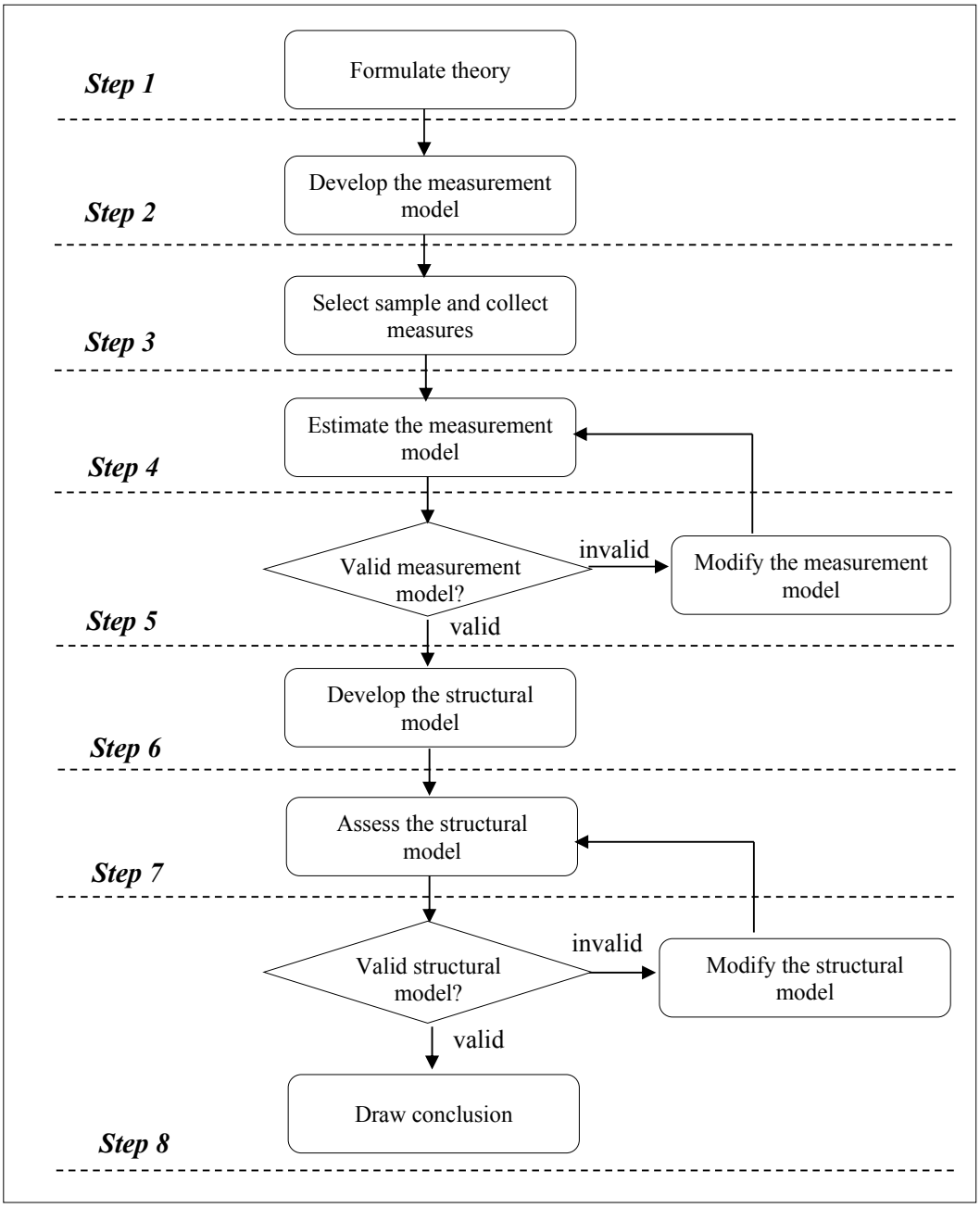

Figure 6.1: Steps in SEM analysis

6.3 Confirmatory factor analysis

CFA is a technique used to assess how well indicator variables used to represent theoretical constructs represent the theoretical constructs (Hair et al., 2010). In SEM, CFA is used to test and assess whether a specified measurement model is valid (Hair et al., 2010). Four steps are followed in SEM to perform CFA as follows (Hair et al., 2010).

a. Define theoretical constructs – The first step of the CFA with SEM is the conceptualization of the theoretical constructs and selection of appropriate indicator variables to represent the theoretical constructs (Hair et al., 2010). Special attention is paid in this step to the validity of the indicator variables selected to represent the constructs. To improve the validity of the indicator variables, several steps such as adopting previous research instruments, obtaining expert consultations and pre-testing the research instruments are taken (Hair et al., 2010).
b. Develop the full measurement model – In the second step, the full measurement model is developed. The measurement model shows the relationships between the theoretical constructs and the indicator variables representing those constructs (Hair et al., 2010).
c. Select the sample and collect data – In the third step, an appropriate sample is selected to collect data. Data is, then, collected from the selected sample to validate the measurement model.
d. Assess the validity of the measurement model – In the fourth step of CFA with SEM, estimating the specified measurement model is done (Hair et al., 2010). The estimation provides empirical measures on the validly of the measurement model (Hair et al., 2010).

6.4 Development of a full measurement model

As the first step of performing CFA with SEM in this research, defining theoretical constructs related to Web 2.0 based interactive e-learning and identifying indicator variables to measure those identified theoretical constructs is done. Those theoretical constructs and indicator variables are explained in detail in Chapter 3 of this thesis. As the second step of CFA with SEM, a measurement model is developed using the conceptualized theoretical constructs and identified indicator variables in this research as shown in Figure 6.2. The model contains six hypothesized unobserved theoretical constructs as effectiveness of e-learning (EFT), management of learning resources (LRS), personal knowledge management (PKM), delivery of instructional support (INS), collaboration (COL) and Web 2.0 technology (WEB). Those unobserved constructs are shown as ovals.

Each of the unobserved constructs is represented by several indicator variables which are shown in rectangles. For example, the theoretical construct EFT is represented by indicator variables EFT1 to EFT5. Indicator variables LRS1 to LRS5, PKM1 to PKM 5, INS1 to INS6 and COL1 to COL5 are used to represent the theoretical constructs LRS, PKM, INS and COL respectively. Indicator variables WEB1 to WEB10 represent theoretical construct WEB. Altogether 36 indicator variables represent the unobserved theoretical constructs in the measurement model and none of the indicator variables in the measurement model are cross-loaded on multiple theoretical constructs. A summary of unobserved theoretical constructs in the measurement model and variables representing them is given in Table 6.1. Each observed variable is associated with a measurement error which represents the degree to which the variable does not describe the construct (Kline 2011; Hair et al., 2010). The measurement errors are represented by circles pointing the observed variable.

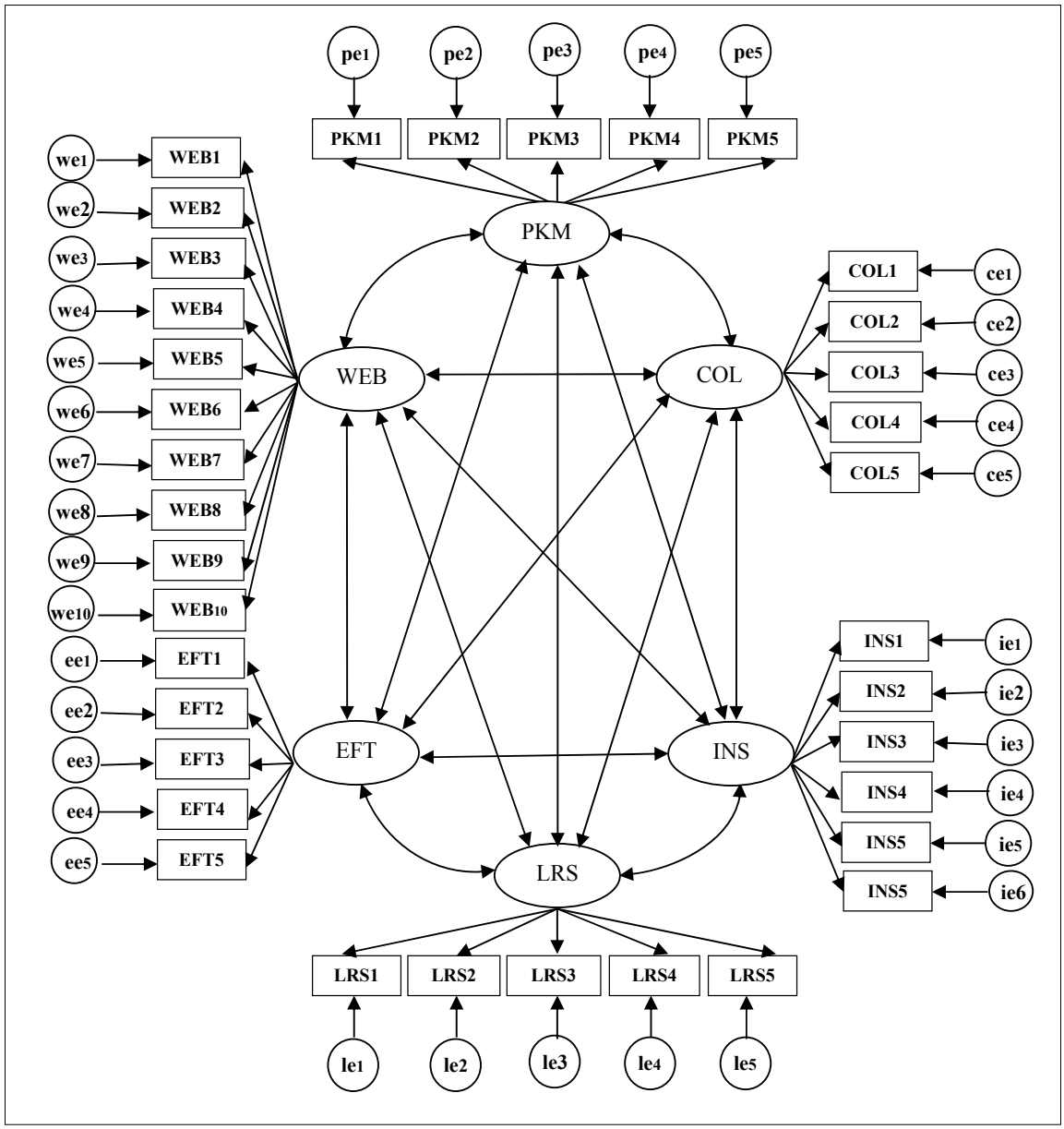

Figure 6.2: Initial full measurement model

Table 6.1 : Summary of constructs and indicators of the measurement model

Construct	Indicator	Description
E-learning effectiveness (EFT)	EFT1	Improvement of critical thinking skills
	EFT2	Obtaining sense of satisfaction
	EFT3	Meeting learning outcomes
	EFT4	Obtaining good grades
	EFT5	Increasing the likelihood of finding a better career
Management of Learning resources (LRS)	LRS1	Presentation style
	LRS2	Providing learning resources of different formats
	LRS3	Facilities to search
	LRS4	Facilities to share
	LRS5	Facilities to reuse
Personal Knowledge Management (PKM)	PKM1	Facilities to create and record content
	PKM2	Facilities to archive content for future use
	PKM3	Facilities to categorize information
	PKM4	Facilities to sort and sequence information
	PKM5	Facilities to integrate information of different types
Instructional Support (INS)	INS1	Facilities to use different teaching styles
	INS2	Facilities to use different learning activities
	INS3	Facilities to support collaboration
	INS4	Facilities to provide personalized feedback
	INS5	Facilities for authentic assessment
	INS6	Facilities to enable self and peer feedback
Collaboration (COL)	COL1	Facilities to discuss with peer learners
	COL2	Facilities to discuss with instructors
	COL3	Facilities to share learning resources
	COL4	Facilities to access shared resources
	COL5	Facilities to participate in group tasks
Web 2.0 technology (WEB)	WEB1	Content creation tools
	WEB2	Content sharing tools
	WEB3	Subscription tools
	WEB4	Content manipulation tools
	WEB5	Content remixing tools
	WEB6	Networking tools
	WEB7	Communication tools
	WEB8	Co-authoring tools
	WEB9	Commenting and ratings tools
	WEB10	Tools supporting reusing

6.5 Assessing the measurement model validity

Once the measurement model is developed, and the data is collected, the next step required in CFA with SEM is the estimation of the measurement model to examine the validity of the measurement model (Byrne, 2010; Hair et al., 2010). There are two main indicators for a valid measurement model. Firstly, the fitness of a measurement model indicates its validity (Hair et al., 2010). Secondly, the validity of the constructs in a measurement model indicates the validity of the measurement model (Hair et al., 2010).

The fitness of the measurement model is assessed by comparing the estimated covariance matrix for the relationships in the conceptual framework, with the covariance matrix generated for the observed relationships in collected sample data (Hair et al., 2010). If the two matrices are closer to each other, the measurement model has a better fitness (Hair et al., 2010). To assess the fitness of the measurement model, several empirical measures known as Goodness-of-fit (GoF) indices are used. There are three categories of GoF indices namely the (a) absolute fit indices, (b) incremental fit indices, and (c) parsimony fit indices (Byrne, 2010; Hair et al., 2010).

The absolute fit indices provide a direct measure on how well the covariance matrix of the sample data is explained by the model specified (Hair et al., 2010; Kline, 2011). In contrast to the absolute fit indices, the incremental fit indices compare how well the estimated model fits compared with some alternative baseline model (Hair et al., 2010; Kline, 2011). The parsimony fit indices "provide information about which model among a set of competing models is best, considering its fitness relative to its complexity" (Hair et al., 2010, p. 642). An adequate parsimony fit measures could be obtained for a model with better fitness or less complexity (Hair et al., 2010).

The Chi-square statistic ($\chi 2$), the normed $\chi 2$ value, the goodness-of-fit (GFI) index and the root mean square error of approximation (RMSEA) are examples of the absolute fit indices (Hair et al., 2010). $\chi 2$ is the basic GoF index that gives the difference between the estimated and the observed covariance matrices (Hair et al., 2010). A relatively small $\chi 2$ value with a probability (P) value greater than 0.05 indicates an adequate fitness of the measurement model (Byrne, 2010; Hair et al., 2010). A limitation of the $\chi 2$ statistic is that it is sensitive to the sample size (Hair et al., 2010). As an alternative to $\chi 2$, the ratio between the $\chi 2$ and the degree of freedom (df) is used as a measure of the GoF. $\chi 2/df$ is known as the Normed Chi-square value (Hair et al., 2010). A value lesser than 3 for $\chi 2/df$ indicates an adequate fitness of a measurement model (Hair et al., 2010). GFI and RMSEA are two measures developed to reduce the sensitivity of the GoF indices to the sample size (Hair et al., 2010). GFI value could vary between 0 and 1. A GFI value greater than 0.9 is an indication of the adequate fitness of the measurement model (Hair et al., 2010). On the other hand, lesser values are expected for RMSEA to demonstrate adequate fitness of the measurement model. In particular, a RMSEA value less than 0.08 is considered an acceptable fit (Browne & Cudeck, 1992; Byrne, 2010).

The Tucker Lewis Index (TLI) and the Comparative Fit Index (CFI) are incremental fitness indices used to measure the fitness of the measurement models (Hair et al., 2010). A TLI value approaching 1 and a CFI value greater than 0.9 are considered as indicators of a model that has adequate fitness (Hair et al., 2010). The adjusted goodness of fit (AGFI) index is a parsimony fit index used to measure the fitness of the measurement models (Hair et al., 2010). An AGFI value exceeding 0.9 is considered as an indicator of a model which is having adequate fitness (Byrne, 2010; Hair et al., 2010). A summary of the GoF indices discussed above are given in Table 6.2.

Table 6.2 : GoF indices and their recommended values

GoF index	Recommended values	Reference
χ^2	Relatively small χ^2 value with $P > 0.05$	Hair et al. (2010)
χ^2/df	$\chi^2/df < 3.00$	Hair et al. (2010)
GFI	GFI > 0.9	Hair et al. (2010)
RMSEA	RMSEA < 0.08	Browne and Cudeck (1992)
TLI	TLI value approaching 1	Hair et al. (2010)
CFI	CFI > 0.9	Hair et al. (2010)
AGFI	AGFI > 0.9	Byrne (2010), Hair et al. (2010)

The full measurement model for this research shown in Figure 6.2 is estimated using the data collected from Australia and Sri Lanka in AMOS 20.0, which is a commonly used software package for developing and estimating SEM models. The GoF results received by estimating the measurement model with the data collected from Australia and Sri Lanka are presented in Table 6.3 and Table 6.4 respectively.

Table 6.3 : Fit results of initial full measurement model for Australia

GoF index	Recommended values for index	Fit result
χ2	Relatively small *χ2* value	1080.4
P	$P > 0.05$	0.069
χ2/df	$\chi^2/df < 3.00$	1.866
GFI	GFI > 0.9	0.695
AGFI	AGFI > 0.9	0.649
RMSEA	RMSEA < 0.08	0.081
CFI	TLI value approaching 1	0.828
TLI	CFI > 0.9	0.813

Table 6.4 : Fit results of initial full measurement model for Sri Lanka

GoF index	Recommended values for index	Fit result
χ2	Relatively small *χ2* value	1302.6
P	$P > 0.05$	0.034
χ2/df	$\chi^2/df < 3.00$	1.951
GFI	GFI > 0.9	0.754
AGFI	AGFI > 0.9	0.717
RMSEA	RMSEA < 0.08	0.074
CFI	TLI value approaching 1	0.865
TLI	CFI > 0.9	0.876

The results in Table 6.3 and Table 6.4 show that both the measurement models for Australia and Sri Lanka lack fitness. The χ^2/df values for both measurement models are within the acceptable range. RMSEA value obtained for the measurement model for Sri Lanka is also in the acceptable range of values. The values for other fitness indices including GFI, AGFI, CFI and TLI for both the models, however, are well below the recommended values. For the measurement model for Australia the values obtained for GFI, AGFI, CFI and TLI are 0.695, 0.649, 0.828 and 0.813 respectively. For the measurement model for Sri Lanka, the values obtained for GFI, AGFI, CFI and TLI are 0.754, 0.717, 0.865 and 0.876 respectively. Overall, the fitness results indicate that the models do not have adequate validity to continue to the step of implementing and validating the structural model. Several steps are, therefore, taken to improve the validity of the measurement models.

6.6 Improving the fitness of the measurement model

Two steps are taken to improve the validity of the initial measurement model presented in Figure 6.2. Firstly, the full measurement model is decomposed into several one factor congeneric models and their fitness is examined separately using data collected from Australia and Sri Lanka. Steps are, then, taken to improve the fitness of those one factor congeneric models. Secondly, the validity of the constructs in the measurement model is examined and steps are taken to improve the validity of those constructs.

6.6.1 Congeneric measurement models

To improve the fitness of the full measurement model, six one factor congeneric models are developed for the effectiveness of e-learning, management of learning resources, personal knowledge management, delivery of instructional support, collaboration and Web 2.0 technology. Those one factor congeneric models are estimated using the sample data collected

from Australia and Sri Lanka. The fitness of the one factor congeneric models is assessed using the GoF results obtained from the estimations. These results are given in Appendix E. The results indicate that the congeneric measurement models lack fitness. Modifications are, therefore, done to the congeneric measurement models to improve their fitness.

The modifications to the congeneric models are done considering three measures. These measures and the guidelines to modify the measurement models are described as follows,

a. Standard factor loadings (SFLs) – Path estimates corresponding to the relationship between an observable indicator variable and an unobservable theoretical construct in a measurement model could be used to understand the nature of the relationship between the indicator variable and the theoretical construct (Hair et al., 2010). Indicator variables with SFLs greater than 0.5 show a strong relationship with its associated construct (Hair et al., 2010). Indicator variables with factor loadings lesser than 0.5 could be deleted to improve the fitness of the model (Hair et al., 2010).
b. Standardized Residuals – Residuals are considered as "individual differences between observed covariance terms and the fitted (estimated) covariance terms" (Hair et al., 2010). Standard residuals less than |2.5| are considered unproblematic, whereas standard residuals over |4.00| are considered unacceptable (Hair et al., 2010). In this research, indicator variables associated with standard residuals greater than |2.5| are considered as suitable to be deleted to improve the model fitness.
c. Modification indices – The modification indices with AMOS provide information on the fitness of the model by providing the evidence of misspecifications (Byrne, 2010). The modification indices having 4.00 or above indicated that the measurement model could be further improved (Hair et al., 2010).

Considering the above measures and guidelines, the congeneric measurement models for Australia and Sri Lanka are modified to improve their fitness. During the process, items PKM2 and PKM5 from personal knowledge management (PKM), items COL2 and COL5 from collaboration (COL), items INS3, INS4, INS5 and INS6 from delivery of instructional support (INS), items LRS4 and LRS5 from management of learning resources (LRS), WEB1, WEB2, WEB3, WEB5, WEB6 and WEB10 from Web 2.0 technology (WEB) and EFT1 and EFT5 from the e-learning effectiveness (EFT) are deleted from the congeneric measurement models for both Australia and Sri Lanka to improve their fitness.

The fitness of the modified congeneric measurement models is then re-estimated and the received GoF results are re-examined. GoF results received for the modified congeneric measurement models for Australia and Sri Lanka are shown in Table 6.5 and Table 6.6 respectively. The results in Table 6.5 and Table 6.6 show that the modified congeneric measurement models have adequate fitness. The initial full measurement models, therefore, are modified to reflect the changes done to the congeneric measurement models.

Table 6.5 : GoF results of the congeneric models for Australian sample

GoF index	Recommended values for index	LRS	PKM	INS	COL	WEB	EFT
$\chi 2$	Relatively small $\chi 2$ value	0.304	0.008	0.080	1.415	1.300	0.028
P	$P > 0.05$	0.581	0.928	0.778	0.234	0.522	0.868
$\chi 2/df$	$\chi^2/df < 3.00$	0.304	0.008	0.080	1.415	0.650	0.028
GFI	GFI > 0.9	0.998	1.000	0.999	0.993	0.995	1.000
AGFI	AGFI > 0.9	0.991	1.000	0.998	0.957	0.975	0.999
RMSEA	RMSEA < 0.08	0.000	0.000	0.000	0.056	0.000	0.000
TLI	TLI value approaching 1	1.013	1.033	1.013	0.986	1.009	1.020
CFI	CFI > 0.9	1.000	1.000	1.000	0.995	1.000	1.000

Table 6.6 : GoF results of the congeneric models for Sri Lankan sample

GoF index	Recommended values for index	LRS	PKM	INS	COL	WEB	EFT
$\chi 2$	Relatively small $\chi 2$ value	0.374	2.125	0.050	0.053	0.119	0.572
P	$P > 0.05$	0.541	0.077	0.478	0.818	0.942	0.450
$\chi 2/df$	$\chi 2/df < 3.00$	0.374	2.125	0.050	0.053	0.059	0.572
GFI	GFI > 0.9	0.999	0.991	0.998	1.000	1.000	0.998
AGFI	AGFI > 0.9	0.993	0.946	0.993	0.999	0.999	0.990
RMSEA	RMSEA < 0.08	0.000	0.064	0.000	0.000	0.000	0.000
TLI	TLI value approaching 1	1.007	0.971	1.004	1.012	1.015	1.009
CFI	CFI > 0.9	1.000	0.990	1.000	1.000	1.000	1.000

6.6.2 Construct validity

As the second step of improving the validity of the measurement models, the construct validity of the theoretical constructs is examined. The construct validity refers to the extent to which a set of indicator variables actually represent the theoretical constructs they are used to represent (Hair et al., 2010). It can be assessed by examining the convergent validity and the discriminant validity of constructs (Hair et al., 2010). The convergent validity refers to the "extent to which indicators of a specific construct converge or share a high proportion of variance in common." (Hair et al., 2010, p. 678). The discriminant validity of constructs refers to the extent to which the theoretical constructs of a measurement model are distinct from each other (Hair et al., 2010). It provides evidence for the uniqueness of the constructs in the model (Hair et al., 2010).

Three measures namely the factor loadings, the average variance extracted (AVE) and the construct reliability are considered to assess the convergent validity of theoretical constructs (Hair et al., 2010). These measures are described in the following.

a. Factor loadings – Factor loadings refers to the correlation between an indicator variable and the theoretical construct it represents (Hair et al., 2010). High factor loadings are considered as indicators of the convergent validity. In particular, SFLs greater than 0.5 are considered indicators of adequate convergent validity (Hair et al., 2010).
b. Average Variance Extracted – AVE is described as the "average percentage of variation explained (variance extracted) among the items of a construct" (Hair et al., 2010, pp. 661). It is calculated as the total of the squared SFLs divided by the number of indicator variables being considered (Hair et al., 2010). An AVE greater than 0.5 is considered an indicator for having an adequate convergent validity (Hair et al., 2010).

c. Construct reliability – The construct reliability is an indicator of the convergent validity (Hair et al., 2010). In this research, the Cronbach's Alpha is used to examine the reliability of constructs (Hair et al., 2010). A construct with Cronbach's alpha value exceeding 0.7 indicates adequate convergent validity (Hair et al., 2010).

The convergent validity of the constructs in the measurement models in this research is assessed, based on the above criteria. The SFLs of the indicator variables, AVEs and the reliability of the constructs obtained for measurement models for Australia and Sri Lanka are shown in Table 6.7 and Table 6.8 respectively. As shown in Table 6.7 and Table 6.8, the Cronbach's Alpha values obtained for constructs in both measurement models exceeded the cut-off value of 0.7. Furthermore, AVEs estimated for all the constructs in both measurement models except for COL in Australian model exceeded the cut-off value of 0.5. The AVE for COL in Australian sample also approaches the cut of mark of 0.5. All indicator variables measuring theoretical constructs have SFLs exceeding the cut off-value of 0.5. Such results indicate that the theoretical constructs in the measurement models have adequate convergent validity.

Table 6.7 : Convergent validity of the constructs for Australian sample

Construct	Reliability (α)	AVE	SFL	
			Item	SFL
PKM	0.752	0.504	PKM1	0.699
			PKM3	0.693
			PKM4	0.737
COL	0.746	0.492	COL1	0.724
			COL3	0.671
			COL4	0.708
INS	0.790	0.653	INS1	0.808
			INS2	0.808
LRS	0.846	0.649	LRS1	0.803
			LRS2	0.818
			LRS3	0.796
WEB	0.836	0.622	WEB4	0.663
			WEB7	0.743
			WEB8	0.928
			WEB9	0.798
EFT	0.812	0.616	EFT1	0.763
			EFT3	0.881
			EFT4	0.699

Table 6.8 : Convergent validity of the constructs for Sri Lankan sample

Construct	Reliability (α)	AVE	SFL	
			Item	SL
PKM	0.796	0.571	PKM1	0.623
			PKM3	0.788
			PKM4	0.840
COL	0.817	0.599	COL1	0.718
			COL3	0.834
			COL4	0.765
INS	0.868	0.767	INS1	0.876
			INS2	0.876
LRS	0.829	0.630	LRS1	0.923
			LRS2	0.736
			LRS3	0.705
WEB	0.849	0.592	WEB4	0.685
			WEB7	0.833
			WEB8	0.754
			WEB9	0.797
EFT	0.767	0.646	EFT1	0.844
			EFT3	0.763
			EFT4	0.803

Examining the discriminant validity of a construct could be done by comparing the square of correlation between two constructs with the AVE of the constructs (Hair et al., 2010). To have adequate discriminant validity, the AVEs of the constructs should be greater than the square of the correlation between them (Hair et al., 2010). The discriminant validity of constructs in

the measurement models for Australia and Sri Lanka are shown in Table 6.9 and Table 6.10 respectively. In both the tables, the AVEs of each constructs which are shown across the diagonal of the tables exceeded square of correlation between that construct and all the other constructs. Such results indicate that the constructs in the measurement model have adequate discriminant validity.

Table 6.9 : Discriminant validity for constructs for Australian sample

	PKM	COL	INS	LRS	WEB	EFT
PKM	**0.504**					
COL	0.307	**0.492**				
INS	0.254	0.340	**0.653**			
LRS	0.351	0.323	0.630	**0.649**		
WEB	0.175	0.349	0.380	0.354	**0.622**	
EFT	0.080	0.247	0.298	0.391	0.375	**0.616**

Table 6.10 : Discriminant validity for constructs for Sri Lankan sample

	PKM	COL	INS	LRS	WEB	EFT
PKM	**0.571**					
COL	0.308	**0.599**				
INS	0.254	0.339	**0.767**			
LRS	0.351	0.323	0.621	**0.630**		
WEB	0.176	0.351	0.381	0.354	**0.592**	
EFT	0.096	0.308	0.293	0.373	0.374	**0.646**

6.7 The Final full measurement model

Modifying the initial measurement model as described in section 6.6 results two measurement models which best fit for Australia and Sri Lanka respectively. The developed best fit measurement models for Australia and Sri Lanka are then combined to develop a single measurement model which is well-fitting across the groups (Byrne, 2010). The final measurement model which is developed by combining the best fit measurement models across groups is known as the 'configural model' (Byrne, 2010). Such a model enables comparing the validity of the measurement model across multiple samples (Byrne, 2010). The configural model developed in this research is shown in Figure 6.3.

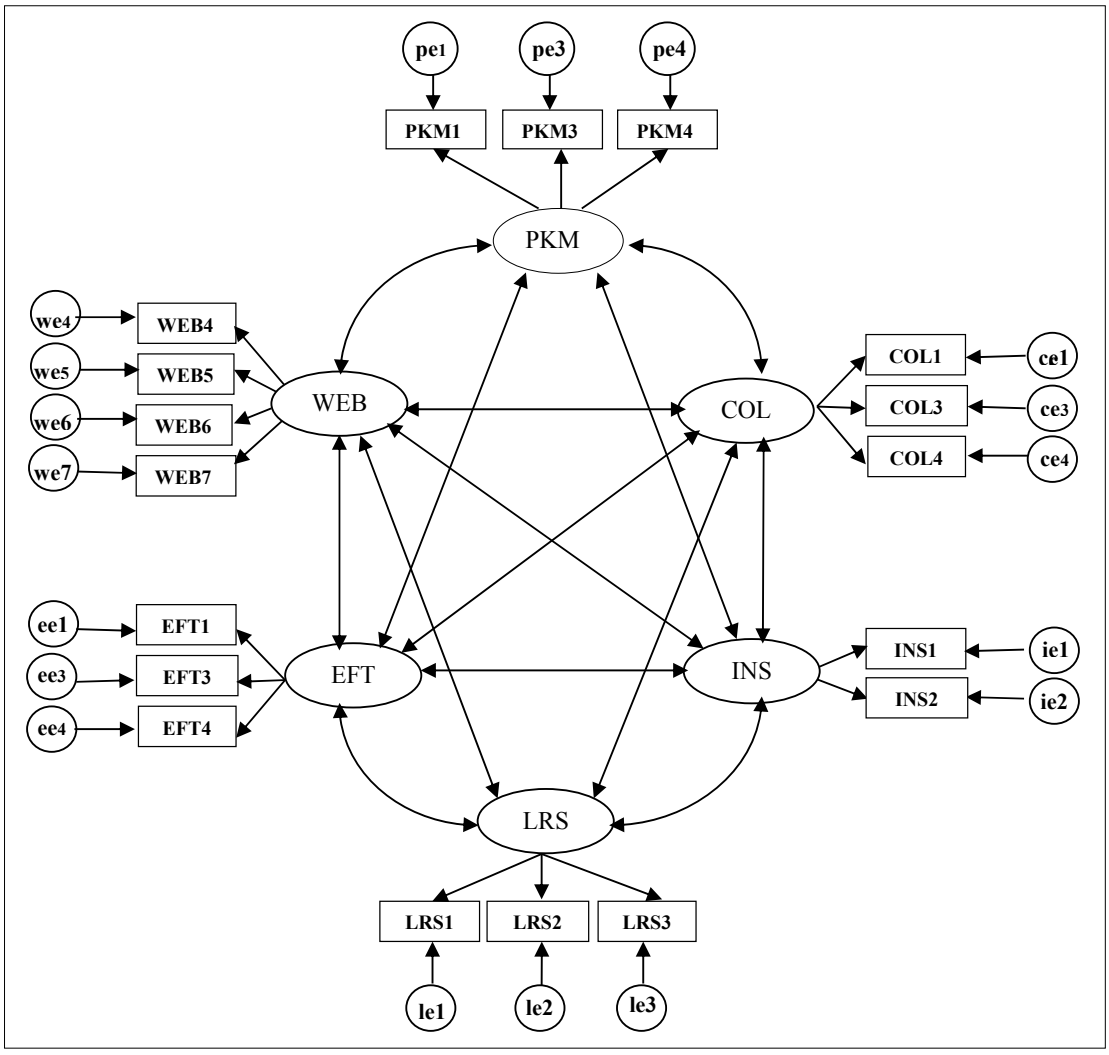

Figure 6.3: The configural model

The GoF results received by estimating the above model with data collected from Australia are given in Table 6.11. Estimation of the configural model with the data collected from Australia provided a $\chi 2$ value of 129.3 with a *df* of 120 and a *P* value of 0.264. For $\chi 2/df$ a value of 1.078 is obtained. The resulted GFI value and RMSEA value are 0.907 and 0.024 respectively. The fit results obtained for TLI and CFI are 0.989 and 0.992 respectively. The above fit results for $\chi 2/df$, GFI, RMSEA, TLI and CFI are in the recommended range of values for the indices and, therefore, indicating adequate fitness of the configural model for Australia. The AGFI value of 0.867 on the other hand is slightly below the recommended value of 0.9.

Table 6.11: GoF results of the configural model for Australian sample

GoF index	Recommended values for index	Fit result
$\chi 2$	Relatively small $\chi 2$ value	129.3
P	P > 0.05	0.264
$\chi 2/df$	$\chi^2/df < 3.00$	1.078
GFI	GFI > 0.9	0.907
AGFI	AGFI > 0.9	0.867
RMSEA	RMSEA < 0.08	0.024
TLI	TLI value approaching 1	0.989
CFI	CFI > 0.9	0.992

The GoF results received by estimating the configural model with the data collected from Sri Lanka are given in Table 6.12. Similar to the above results obtained for the Australian sample, the GoF results obtained by estimating the configural model using data collected from Sri

Lanka also show that the configural model has adequate fitness. The results obtained for *χ2/df*, GFI, AGFI, RMSEA, TLI and CFI are in the acceptable range for the indices. Compared to the GoF results obtained by estimating using the Australian sample, the fit results obtained by estimating the Sri Lankan sample are lower expect for GFI and AGFI.

Table 6.12 : GoF results of the configural model for Sri Lankan sample

GoF index	Recommended values for index	Fit result
χ2	Relatively small χ2 value	160.4
P	$P > 0.05$	0.212
χ2/df	$\chi^2/df < 3.00$	1.337
GFI	GFI > 0.9	0.928
AGFI	AGFI > 0.9	0.897
RMSEA	RMSEA < 0.08	0.039
TLI	TLI value approaching 1	0.977
CFI	CFI > 0.9	0.982

6.8 Test for the measurement invariance

Once the configuration model is developed, an additional step is required before developing the structural model. This step is to test the developed measurement model for measurement invariance (Byrne, 2008). Such a test is performed to see whether the indicator variables for unobservable theoretical constructs represent the unobservable theoretical constructs in the same manner across the groups (Bryne, 2008).

To assess whether the indicator variables in the configural model represent the theoretical constructs in a similar manner, factor loadings in the configural model are constrained to be equal across the Australian and Sri Lankan sample. The GoF results obtained for this constrained model are compared with the GoF results obtained for the unconstrained configural model (Bryne, 2010; Hair et al., 2010). If the fit results of the constrained model do not differ significantly from those of the unconstrained model, the equality constraints imposed could be accepted (Hair et al., 2010).

The $\chi 2$ different ($\Delta\chi 2$) test is used to test the invariance of the measurement model. The above test is widely used to examine the invariance between hypothesized models. It is performed by comparing the $\chi 2$ values of an unconstrained model and a constrained model where the equality constraints are applied (Byrne, 2010). If the difference of $\chi 2$ values is significant, the models are said to be non-invariance (Byrne, 2010; Hair et al., 2010).

The fit results obtained for the $\chi 2$ statistic for the unconstrained measurement model and the constrained measurement model are shown in Table 6.13. The complete fit results for the constrained measurement model are presented in Appendix F. As shown in Table 6.13, the $\chi 2$ value for the unconstrained model is at 289.8 with the *df* of 240. The $\chi 2$ value for the unconstrained model is at 310.3 with a *df* of 252.

Table 6.13 : GoF results for the constrained and unconstrained configural models

Model	Unconstrained model	Constrained model
$\chi 2$	289.8	310.3
Df	240	252

To examine the significance of the difference between the two models, the $\Delta\chi 2$ test is performed. The statistical significance for the resulted $\Delta\chi 2$ is not significant. Such results reveal that the difference between the unconstrained configural model and the constrained model with factor loadings made equal is non-significant. This provides evidence that the measurement model behaves in the same way across the two groups. Furthermore, this permits the analysis to progress to testing the structural model (Hair et al., 2010).

6.9 Conclusion

This research uses SEM to validate a proposed conceptual framework on Web 2.0 based interactive e-learning. The purpose of this chapter is to explain how a valid measurement model is developed in this research using CFA with SEM. The chapter discusses how the steps of CFA are followed in this research in detail. In particular, how the measurement model is developed, how tests are conducted to assess the validity of the measurement model and how the validity of the measurement model is improved is explained in detail. In addition, how the $\Delta\chi 2$ test is conducted to examine whether the measurement model behaves similarly across the two samples is also explained. The final measurement model developed in this chapter has shown to be valid. Furthermore, it is shown that this measurement model behaves in a similar manner across the two samples. With a valid measurement model developed, SEM analysis could proceed to the development of the structural model as the next step of data analysis.

Chapter 7

STRUCTURAL MODEL ANALYSIS

7.1 Introduction

A structural model is an important model developed in SEM analysis (Hair et al., 2010). Such a model shows hypothesized relationships between the unobservable theoretical constructs as shown in the pre-specified conceptual framework (Bryne, 2010; Hair et al., 2010). The validity of the structural model and its relationships are, then, tested (Hair et al., 2010). Based on the significance of the relationships in the structural model, the corresponding hypotheses are accepted or rejected leading to derive conclusions (Hair et al., 2010).

Based on a comprehensive review of literature, a conceptual framework for Web 2.0 based interactive e-learning for higher education is developed in Chapter 3 of this thesis. The developed framework hypothesize six theoretical constructs namely, (1) management of learning resources, (2) personal knowledge management, (3) delivery of instructional support, (4) collaboration, (5) effectiveness of e-learning , and (6) Web 2.0 technology. The aim of this chapter is to validate a structural model corresponding to the pre-conceptualized hypothesized framework above.

This chapter is organized as follows. Firstly, section 7.2 presents the structural model for this research and explains how the developed structural model is assessed using SEM techniques. Furthermore, the section discusses the tests performed in this research to analyse whether the structural model behaves similarly in Australian and Sri Lankan higher education. Section 7.3, then, discusses the findings of the structural model analysis by revisiting the hypotheses

developed in Chapter 3 of this thesis. Finally, section 7.4 presents the conclusion of the chapter.

7.2 Structural model analysis

A structural model shows the theoretical constructs and relationships in the pre-specified conceptual framework (Hair et al., 2010). Theoretical constructs are shown with ovals. Hypothesized relationships are shown by single-headed arrows. An arrow is drawn from one theoretical construct to another if there is a dependency relationship among the constructs (Hair et al., 2010). A structural model developed in above manner is estimated to examine its validity (Hair et al., 2010). Estimated parameters and the *P* value for the structural relationships in the estimated structural model provide empirical evidences on the significance of the structural relationships (Bryne, 2010; Hair et al., 2010).

The structural model developed for this research is shown in Figure 7.1. The model contains six unobservable theoretical constructs, namely, management of learning resources (LRS), personal knowledge management (PKM), delivery of instructional support (INS), collaboration (COL), Web 2.0 technology (WEB) and effectiveness of e-learning (EFT). The relationships drawn among the above constructs in the structural model represent eight hypothesis denoted by H1, H2, H3, H4, H5, H6, H7 and H8. The structural model above is estimated using data collected from Australia and Sri Lanka separately. GoF results received from the estimation using the data collected from Australia and Sri Lanka are shown in Table 7.1 and Table 7.2 respectively.

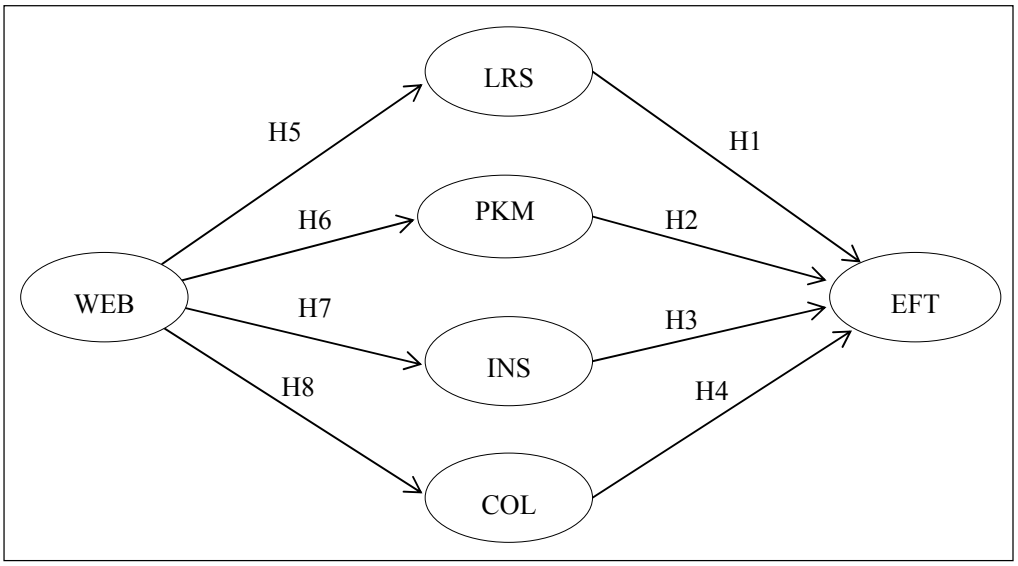

Figure 7.1: The structural model

Table 7.1 : GoF results of the baseline structural model for Australian sample

GoF index	Accepted range of values	Fit result
χ^2	Relatively small $\chi 2$ value	156.1
P	P > 0.05	0.612
χ^2/df	χ^2/df < 3.00	1.238
GFI	GFI > 0.9	0.893
RMSEA	RMSEA < 0.08	0.044
TLI	TLI value approaching 1	0.965
CFI	CFI > 0.9	0.971

Table 7.2 : GoF results of the baseline structural model for Sri Lankan sample

GoF index	Accepted range of values	Fit result
χ^2	Relatively small χ2 value	208.4
P	P > 0.05	0.075
χ^2/df	$\chi^2/df < 3.00$	1.654
GFI	GFI > 0.9	0.908
RMSEA	RMSEA < 0.08	0.054
TLI	TLI value approaching 1	0.954
CFI	CFI > 0.9	0.962

The estimation of the structural model using data collected from Australia provides a χ^2 value of 156.1 with a *df* of 126 and *P* value of 0.612. For χ^2/df a value of 1.238 is obtained. The above value obtained for χ^2/df is in the acceptable range for χ^2/df to demonstrate adequate fitness of the structural model (Hair et al., 2010). The structural model estimation using data collected from Sri Lanka provided a χ^2 value of 208.4 with a *df* of 126 and a *P* value of 0.075. For χ^2/df a value of 1.654 is obtained. The above value for χ^2/df is also in the acceptable range of values for χ^2/df. The RMSEA values of 0.044 and 0.054 obtained for structural models for Australia and Sri Lanka respectively are also in the acceptable range of values to demonstrate adequate fitness (Hair et al., 2010).

A GFI value of 0.893 is received by estimating the structural model using data collected from Australia. The GFI value obtained above is approaching the acceptable cut off mark of .900 (Hair et al., 2010). A GFI value of 0.908 is received by estimating the structural model using data collected from Sri Lanka. The above GFI value is in the acceptable range of values for

GFI to demonstrate adequate fitness of the structural model. TLI and CFI values of 0.965 and 0.971, and 0.954 and 0.962 respectively are obtained for structural models for Australia and Sri Lanka. Those TLI and CFI values are also in the acceptable range of values for the indices (Hair et al., 2010). Overall, the above results show that the structural models for Sri Lanka and Australia exhibit adequate fitness. Furthermore, it is evident that the structural model for Australia shows better fitness compared to structural model for Sri Lanka in GoF indices except for GFI.

The structural model estimated with data collected from Australia is shown in Figure 7.2 along with the path estimates. The structural model above shows a strong support for H1 (LRS→ EFT), H5 (WEB→ LRS), H6 (WEB→ PKM), H7 (WEB→ INS) and H8 (WEB→ COL) with path estimates of 0.338, 0.665, 0.491, 0.683 and 0.644 and *P* value less than 0.001. A weak support is shown for H4 (COL→ EFT) with a path estimates of 0.149. However, the *P* value less than 0.05 for the structural path indicates that the relationship is significant. The estimation reveals that the relationships indicated by H2 (PKM→ EFT) and H3 (INS→ EFT) in the structural model are not supported.

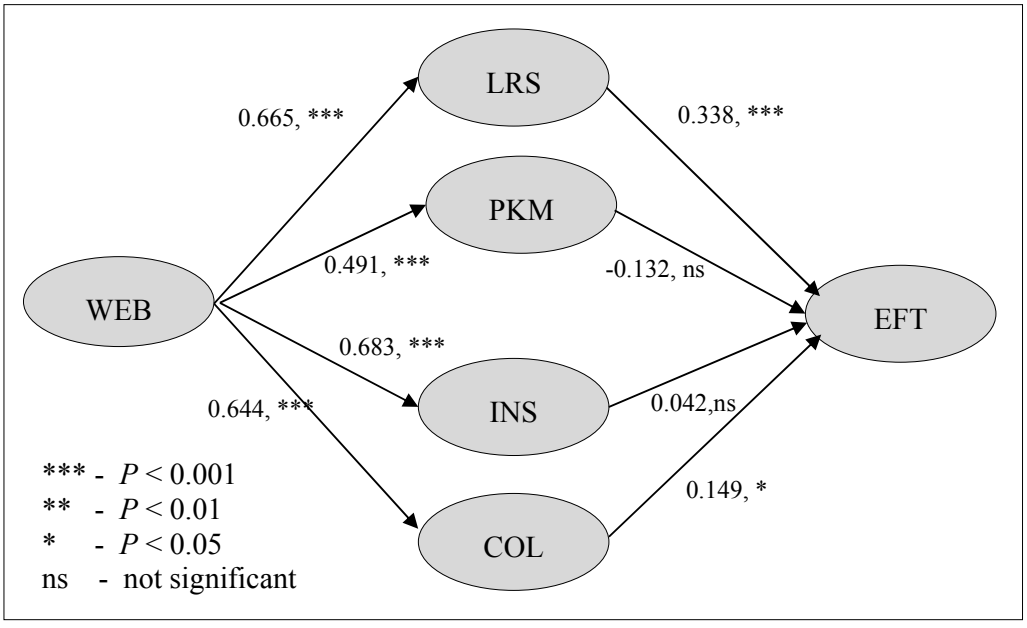

Figure 7.2: Estimated structural model for Australia

The structural model estimated with data collected from Sri Lanka is shown in Figure 7.3 along with the path estimates. The estimation of the model using data collected from Sri Lanka reveals that there is a strong support for H1 (LRS→ EFT), H5 (WEB→ LRS), H6 (WEB→ PKM), H7 (WEB→ INS) and H8 (WEB→ COL) with path estimates respectively of 0.511, 0.882, 0.763, 0.783 and 0.852, and a *P* value less than 0.001. Furthermore, a moderate support is shown for H2 (PKM→ EFT), H3 (INS→ EFT), H4 (COL→ EFT) with path estimates of 0.253, 0.323 and 0.277 respectively with significance at $P < 0.01$ and $P < 0.001$.

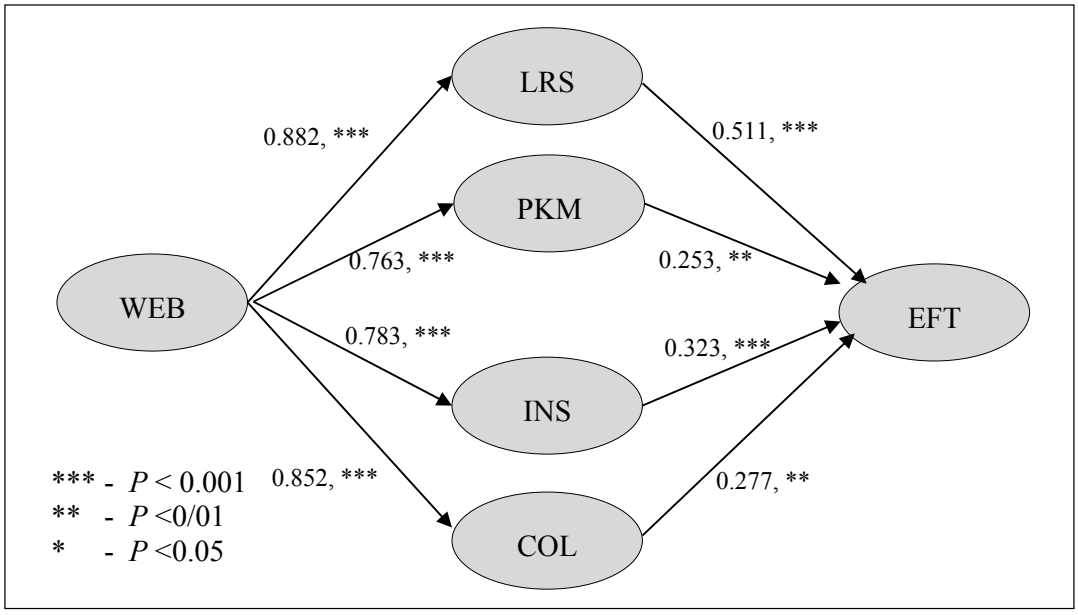

Figure 7.3: Estimated structural model for Sri Lanka

To examine whether the defined structural model behaves in a similar manner for Australia and Sri Lanka, a few tests for structural invariance are performed (Byrne, 2008; Hair et al., 2010). To assess the invariance of the structural model, first, all the paths in the structural model in Figure 7.1 are constrained as equal for both groups (Byrne, 2010). The fitness of the constrained model is estimated. The estimated results are compared with the GoF results obtained by estimating the unconstrained structural model (Byrne, 2008; Hair et al., 2010).

To examine the significance of the non-invariance of the two structural models above, the $\Delta \chi^2$ test is conducted. As shown in Table 7.3, the GoF results for the unconstrained model

have a χ^2 value of 364.6 and a *df* of 252. The GoF results for the constrained model show a χ^2 value of 417.8 and a *df* of 261. The $\Delta\chi^2$ test for comparing the constrained structural model and the unconstrained structural model provides a $\Delta\chi^2$ of 49.1 with a *P* value less than 0.01. This indicates that the two structural models for Australia and Sri Lanka are non-invariant. To identify which structural relationships in the structural model are perceived as non-invariant between the two groups, therefore, the invariance of each structural relationship in the structural model is evaluated (Byrne, 2010; Hair et al., 2010). Such an evaluation is useful to understand whether the individual hypotheses made by the researcher are generalizable between the two groups being considered (Byrne, 2010; Hair et al., 2010).

Table 7.3 : GoF results for the constrained and unconstrained structural models

Model	Unconstrained model	Fully constrained model
χ^2	364.6	417.8
df	252	261

To examine the invariance of each structural relationship in the structural model between the two groups, each relationship in the structural model is constrained as equal, one at a time. The GoF values for the constrained model and unconstrained model are obtained and the $\Delta\chi 2$ tests are, then, performed to assess the structural invariance of each structural relationship in the structural model. The $\Delta\chi 2$ test results obtained are given in Table 7.4. The results in Table 7.4 show that the structural relationships LRS → EFT, COL → EFT, WEB → LRS, WEB → PKM, WEB → INS and WEB → COL are structurally invariant with $P > 0.05$. Structural relationships PKM → EFT and INS → EFT, on the other hand, are found structurally non-invariant between the two groups.

Table 7.4 : Results of tests for invariance of the structural relationships

Model / Hypothesis	Goodness of Fit results		Model differences		Structurally invariance?
	χ^2	*df*	$\Delta\chi^2$	*P*	
Unconstrained model	364.6	252	-	-	
H1 : LRS → EFT	364.7	253	0.1	0.752	Invariant
H2: PKM → EFT	369.4	253	4.8	0.028	Non-invariant
H3 : INS → EFT	368.8	253	4.2	0.040	Non-invariant
H4 : COL → EFT	364.6	253	0.1	0.752	Invariant
H5 : WEB → LRS	368.1	253	3.5	0.061	Invariant
H6 : WEB → PKM	366.2	253	1.6	0.652	Invariant
H7 : WEB → INS	366.6	253	2.0	0.157	Invariant
H8 : WEB → COL	367.8	253	3.2	0.074	Invariant

7.3 Research findings

Web 2.0 Technology for learner-learning resources interaction

In both structural models shown in Figures 7.2 and 7.3 the path WEB → LRS is positive and significant. Furthermore, for the above path, a non-significant $\Delta\chi^2$ ($\Delta\chi$=3.5, P>0.05) is obtained across the groups in the $\Delta\chi^2$ test as shown in Table 7.4. The above results indicate that despite their cultural differences learners in both Australia and Sri Lanka think that Web 2.0 technology is useful for managing course learning resources in e-learning in higher education to a similar extent. The reason for this finding might be that learners in both Australia and Sri Lanka find Web 2.0 tools such as YouTube, TeacherTube and Merlot are

attractive and convenient for managing learning resources. The aforementioned Web 2.0 tools enable learning resources to be presented in a well-organized manner. According to Hofstede's (1986) cultural dimensions both Australia and Sri Lanka have high values for uncertainty avoidance which indicates that learners in both the countries prefer learning resources to be presented in a structured manner.

The path LRS → EFT in the conceptual framework shown in Figure 3.1 corresponds to the hypothesis that effective management of learning resources using Web 2.0 technology positively influences the effectiveness of e-learning in Australian and Sri Lankan higher education (H1). In both structural models shown in Figures 7.2 and 7.3 the path LRS → EFT is also positive and significant. Furthermore, for the above path, a non-significant $\Delta \chi^2$ ($\Delta \chi$=0.1, P>0.05) is obtained across the groups in the $\Delta \chi^2$ test as shown in Table 7.4. The above results indicate that learners in both Australia and Sri Lanka find Web 2.0 based management of learning resources positively influences the effectiveness of e-learning to a similar extent. The reason for the above finding might be that managing learning resources with Web 2.0 tools enables presenting learning resources to learners in a well organised manner. As discussed in the previous paragraph, learners in both Australia and Sri Lanka prefer leaning resources to be provided in a well-organized manner. Having learning resources presented in the preferred manner to learners would increase the effectiveness of e-learning, especially by improving the satisfaction of learners (Munguatosha et al., 2011).

Hypothesis denoted by H6 in the conceptual framework shown in Figure 3.1 hypothesizes that the adoption of Web 2.0 tools positively supports personal knowledge management in Australian and Sri Lankan higher education. The path WEB → PKM is positive and significant in structural models for both Australia and Sri Lanka. Furthermore, for the above path, a non-significant $\Delta \chi^2$ ($\Delta \chi$=1.6, P>0.05) is obtained across the groups in the $\Delta \chi^2$ test as

shown in Table 7.4. Such results indicate that despite cultural differences of learners in Australia and Sri Lanka Web 2.0 technology could be used for managing personal knowledge in e-learning in both Australian and Sri Lankan higher education in a similar manner. The reason for the above finding might be that learners in both Australia and Sri Lanka find Web 2.0 tools such as blogs and social bookmarks useful and convenient for managing their personal information and resources. This finding is in line with the findings of several existing research. Existing research has shown that Web 2.0 technology could support personal knowledge management in e-learning in higher education to a greater extent. For example, Lee and Ge (2010) and Liu (2011) show that Web 2.0 tools could be used for knowledge creation. Du and Wagner (2007) have shown that blogs could be used for managing personal reflections.

The path PKM → EFT in the conceptual framework developed in Chapter 3 refers to the hypothesis that managing personal knowledge with Web 2.0 technology influences the effectiveness of e-learning in Australian and Sri Lankan higher education (H2). The path PKM → EFT is not significant in the structural model for Australia. This indicates that Web 2.0 based personal knowledge management does not positively influence the effectiveness of e-learning in Australia. In contrast to the above finding, the path PKM → EFT is found positive and significant in the structural model for Sri Lanka indicating that Web 2.0 based personal knowledge management does influence the effectiveness of e-learning in Sri Lankan higher education. The difference between the above findings across the two countries could be explained with reference to the availability of learning resources in e-learning in higher education in the two countries. Universities in developed countries such as Australia have offered e-learning for many years and a large number of resources such as e-books and digital lecture materials are available for learners in those countries to meet their learning objectives (Taxler, 2007). In comparison, learning resources available to learners in developing countries

such as Sri Lanka are less (Traxler, 2007; Chen & Wei, 2012). Learners in developing countries such as Sri Lanka, therefore, are often required to find learning resources on their own and maintain their personal repositories of knowledge to make their learning more effective. Web 2.0 tools would be useful for such learners to maintaining personal knowledge repositories (Dabbagh & Kitsantas, 2012).

The above discussion shows that despite the cultural differences of learners in Australia and Sri Lanka, Web 2.0 tools are found useful by learners in both Australia and Sri Lanka for management of learning resources and personal knowledge management in a similar manner. In addition, using Web 2.0 tools for management of learning resources is found to positively influence effectiveness of e-learning in higher education in Australia. Furthermore, using Web 2.0 tools for personal knowledge management and management of learning resources is found to influence the effectiveness of e-learning in higher education in Sri Lanka. Based on the above, it could be concluded that Web 2.0 tools support effective learner-learning resources interactions in e-learning in higher education in Sri Lanka to a greater extent than in Australia. Web 2.0 tools also support learner-learning resources interactions in Australian higher education. However, the impact of Web 2.0 based learner-learning resources interactions on the effectiveness of e-learning is low.

Web 2.0 Technology for learner-instructor interaction

The path WEB → INS in the conceptual framework developed in Chapter 3 hypothesizes that the adoption of Web 2.0 tools positively supports the delivery of instructional support in Australian and Sri Lankan higher education (H7). The path WEB → INS is positive and significant in the structural models for both Australia and Sri Lanka. Furthermore, for the above path, a non-significant $\Delta\chi^2$ ($\Delta\chi$=2.0, P>0.05) is obtained across the groups in the $\Delta\chi^2$ test as shown in Table 7.4. The above results indicate that despite cultural differences of

learners in Australia and Sri Lanka Web 2.0 tools are useful for delivering instructional support in both Australia and Sri Lanka to a similar extent. Existing research has also shown that Web 2.0 tools could be used to deliver instructional support. For example, Saeed and Yang (2008a) have shown that blogs, social bookmarks and podcasting could be used to deliver instructional support. Väljataga et al. (2010) also show that Web 2.0 tools such as blogs and social bookmarks could be used to deliver instructional support.

The hypothesis denoted by H3 in the conceptual framework shown in Figure 3.1 in this thesis states that delivering instructional support using Web 2.0 technology positively influences the effectiveness of e-learning in Australian and Sri Lankan higher education. In the structural model for Australia the path INS → EFT is not significant. In contrast, in the structural model for Sri Lanka the path INS → EFT is positive and significant. The results as above reveal that the way Web 2.0 technology based delivery of instructional support influences effectiveness of e-learning is not similar across Australia and Sri Lanka. One possible reason for this finding could be that in Australia learners may find other technologies used for the delivery of instructional support such as BlackBoard more effective than Web 2.0 technology. Another reason for the above finding could be that irrespective of the choice of technology for instructional support, Australian learners are not much dependent on the learning support given by instructors, which lead to effective e-learning (Anderson & Hatakka, 2010). According to Hofstede's (1986) cultural dimensions Australia has a smaller estimate for power distance indicating that learners in Australia are most likely to be less dependent on instructors. In contrast, estimate for power distance in Sri Lanka is high indicating that learners in Sri Lanka are more likely to be dependent on instructors.

The above discussion shows that despite the cultural difference of learners in Australia and Sri Lanka, Web 2.0 technology supports learner-instructor interactions in both Australia and

Sri Lanka in a similar manner. However, it is found that how Web 2.0 technology based learner-instructor interaction influences the effectiveness of e-learning is dissimilar across the two countries. While learners in Australia do not believe that Web 2.0 based learner-instructor interactions would positively influence the effectiveness of e-learning, learners in Sri Lanka believe that Web 2.0 based learner-instructor interactions would positively influence the effectiveness of e-learning. The aforementioned difference is likely to be due to the differences in culture and technologies used in the two countries.

Web 2.0 technology for learner-learner interactions

The conceptual framework developed in Chapter 3 hypothesizes that the adoption of Web 2.0 tools positively supports collaboration in Australian and Sri Lankan higher education (H8). The path WEB → COL is positive and significant in the structural models for both Australia and Sri Lanka. Furthermore, for the above path, a non-significant $\Delta \chi^2$ ($\Delta \chi$=3.2, P>0.05) is obtained across the groups in the $\Delta \chi^2$ test as shown in Table 7.4. The above results show that despite cultural differences of learners in Australia and Sri Lanka, Web 2.0 tools support collaboration among learners in Australian and Sri Lankan higher education in a similar manner. Web 2.0 tools are found to positively support collaboration among learners in many existing research. For example, Du and Wagner (2007) and Wheeler et al. (2008) have found that blogs and wikis are useful for facilitating collaboration among learners. Saeed and Yang (2008a) have found that blogs and social bookmarks are useful for facilitating collaboration among learners.

Hypothesis denoted by H4 in the conceptual framework state that facilitating collaboration of learners with the adoption of Web 2.0 technology positively influences the effectiveness of e-learning in Australian and Sri Lankan higher education. The path COL → EFT is weakly supported in the structural model for Australia whereas it is strongly supported in the

structural model for Sri Lanka. However, for both structural models the path COL → EFT is positive and significant. Furthermore, for the above path, a non-significant $\Delta \chi^2$ ($\Delta \chi$=0.1, P>0.05) is obtained across the groups in the $\Delta \chi^2$ test as shown in Table 7.4. Such results show that Web 2.0 technology based collaboration among learners positively influences the effectiveness of e-learning in Australian and Sri Lankan higher education in a similar manner despite the cultural differences of learners in the two countries. The stronger support for COL → EFT in Sri Lanka than in Australia may be due to the collectivist nature of learners in Sri Lanka than the learners in Australia as revealed by analysis of Hofstede's (1986) cultural dimensions. Many existing research also have shown that Web 2.0 technology based collaboration among learners influences the effectiveness of e-learning. For example, Du and Wagner (2007) have shown that using Web 2.0 tools for collaboration could improve learners' ability to meet learning outcomes. Saeed and Yang (2008a) have shown that using Web 2.0 tools for collaboration could improve learners' satisfaction with e-learning.

The above discussion shows that Web 2.0 technology supports learner-learner interactions in both Australia and Sri Lanka in a similar manner despite the cultural differences of learners in Australia and Sri Lanka. Furthermore, it shows that Web 2.0 technology based learner-learner interactions influence the effectiveness of e-learning similarly across the two countries. The findings discussed above are summarized in Table 7.5.

Table 7.5 : Summary of findings of structural model analysis

Interaction	Factors	Support of Web 2.0 Technology		Improves the effectiveness of e-learning?	
		Australia	Sri Lanka	Australia	Sri Lanka
Learner-learning resources interaction	Management of learning resources	Yes	Yes	Yes	Yes
	Personal knowledge management	Yes	Yes	No	Yes
Learner-instructor interaction	Delivery of instructional support	Yes	Yes	No	Yes
Learner-learner interaction	Collaboration	Yes	Yes	Yes	Yes

7.4 Conclusion

This chapter discusses the steps followed in this research to examine the validity of the conceptual framework on Web 2.0 based interactive e-learning proposed in Chapter 3 and the hypotheses corresponding to the structural relationships in the conceptual framework. In particular, the chapter explains how a SEM structural model is developed, estimated and tested using data collected in this research to validate the proposed hypotheses. In the structural models for both Australia and Sri Lanka relationships between Web 2.0 technology and management of learning resources, personal knowledge management, delivery of instructional support and collaboration are supported in a similar manner. Such a results indicates that Web 2.0 technology supports learner-learning resources, learner-instructor and learner-learner interaction in e-learning in Australian and Sri Lankan higher education in a similar manner despite their cultural differences.

In the structural models for both Australia and Sri Lanka relationships between the management of learning resources and collaboration, and the effectiveness of e-learning are positive and significant. Such a result indicates that Web 2.0 based learner-learning resources and learner-learner interactions positively influence the effectiveness of e-learning in higher education in Australia and Sri Lanka. However, in the structural model, relationships between personal knowledge management and delivering of instructional support, and the effectiveness of e-learning are dissimilar. While the above relationships are found positive and significant in the structural model for Sri Lanka, they are not found significant in the structural model for Australia. The above differences are likely to be driven by the cultural differences of learners in Australia and Sri Lanka.

Chapter 8

CONCLUSION

8.1 Introduction

Interaction is the mutual communication between individuals or individuals and objects (Wagner, 1994, Swan, 2002). In e-learning, interaction is an essential, if not the most vital element (Sims, 1997). Interactions in e-learning enable learners to become active participants of learning who interact with learning resources and other individuals such as peers and instructors to develop their own knowledge and skills (Moore, 1989, Chou, 2003; McLoughlin & Lee, 2010a).

Selecting interactive technologies is essential for facilitating effective interactions in e-learning (Bates, 1991). Different technologies, however, may support interactions in e-learning to different extents (Hannafin & Land, 1997; Bates, 1991; Anderson, 2009). In designing interactive e-learning environments instructors, therefore, should be aware of how well different technologies support interactive e-learning (Bates, 1991; Anderson, 2009). The objective of this research is to investigate the enabling role of Web 2.0 technology for interactive e-learning in higher education in Australia and Sri Lanka.

The purpose of this chapter is to summarize the findings, implications, contributions and limitations of this research. This chapter is organized as follows. Firstly, section 8.2 revisits the research questions and explains the findings of this research. Section 8.3 discusses the implications of the research which is followed by section 8.4 which discusses the contribution that this research has made to the existing body of knowledge. Section 8.5 discusses the

limitations of this research. Finally, section 8.6 discusses how this research could be extended in future research work.

8.2 Revisit to research questions

The primary research question of this research is "How could Web 2.0 technology support developing interactive e-learning in Australian and Sri Lankan higher education?". To answer the primary research question as above, several subsidiary research questions are formulated. The first subsidiary research question is "to what extent does Web 2.0 technology support learner-learning resources interactions in e-learning in Australian and Sri Lankan higher education?". The second subsidiary research question of this research is "to what extent does Web 2.0 technology supports learner-instructor interactions in e-learning in Australian and Sri Lankan higher education?". The third subsidiary research question of this research is "to what extent does Web 2.0 technology support learner-learner interactions in e-learning in Australian and Sri Lankan higher education?". To answer the above research questions, a conceptual framework on Web 2.0 based interactive e-learning developed based on a comprehensive review of the literature is validated using numeric data collected from learners studying in universities in Australia and Sri Lanka.

To answer the first subsidiary research question, whether Web 2.0 technology supports two constructs of interactive e-learning, namely, management of learning resources and personal knowledge management are investigated. Furthermore, how Web 2.0 based management of learning resources and personal knowledge management influences effectiveness of e-learning are also investigated. The results of the data analysis indicate that Web 2.0 tools support management of learning resources and personal knowledge management in both Australian context and Sri Lankan context. The results further indicate that adoption of Web

2.0 technology for management of learning resources could improve the effectiveness of e-learning in both Australian and Sri Lankan context. The results also indicate that how adoption Web 2.0 technology for personal knowledge management improves the effectiveness of e-learning in Australian context is not similar across the two contexts. While adoption of Web 2.0 technology for personal knowledge management improves the effectiveness of e-learning in Sri Lankan context, adoption of Web 2.0 technology for personal knowledge management does not improves the effectiveness of e-learning in Australian context. Support of Web 2.0 technology for management of learning resources and personal knowledge management in a similar manner indicates that Web 2.0 technology supports learner-learning resources interactions in a similar manner across Australia and Sri Lanka.

To answer the second subsidiary research question, how Web 2.0 technology supports a construct of interactive e-learning, namely, delivery of instructional support is investigated. Furthermore, how Web 2.0 based delivery of instructional support influences effectiveness of e-learning is also investigated. The SEM analysis with data collected indicates that Web 2.0 technology supports delivery of instructional support across Australia and Sri Lanka in a similar manner. The SEM analysis further indicates that Web 2.0 technology based delivery of instructional support does not improve the effectiveness of e-learning across Australia and Sri Lanka in a similar manner. Support of Web 2.0 technology for delivery of instructional support in a similar manner indicates that Web 2.0 technology supports learner-instructor interactions in a similar manner across Australia and Sri Lanka.

To answer the third subsidiary research question, how Web 2.0 technology supports a construct of interactive e-learning, namely, collaboration is investigated. Furthermore, how Web 2.0 based collaboration supports effectiveness of e-learning is also investigated. The

SEM analysis with data collected indicates that Web 2.0 technology supports learner-learner interactions across Australia and Sri Lanka in a similar manner. The SEM analysis further indicates that Web 2.0 technology based collaboration influences the effectiveness of e-learning across Australia and Sri Lanka in a similar manner. Support of Web 2.0 technology for collaboration in a similar manner indicates that Web 2.0 technology supports learner-learner interactions in a similar manner across Australia and Sri Lanka.

Based on the above findings this research concludes that Web 2.0 technology could contribute significantly towards enabling interactive e-learning in Sri Lanka. This research also concludes that Web 2.0 tools are useful for enabling interactive e-learning in Australia. In addition, this research conclude that using Web 2.0 tools for interactive e-learning can improve the effectiveness of e-learning in Sri Lanka to a greater extent and effectiveness of e-learning in Australia to some extent.

8.3 Implications

The major implication of this research is that Web 2.0 technology could be used for facilitating effective interactive e-learning in Australia which is a developed country and Sri Lanka which is a developing country. This means that Web 2.0 tools such as blogs, wikis and social bookmarks could be used in both countries to facilitate effective learner-learning resources, learner-instructor and learner-learner interactions. This finding is especially important for Sri Lanka. As a developing country, adopting most tools which are popular in providing interactive e-learning such as virtual worlds is not possible in Sri Lanka due to their high cost and infrastructure requirements (Fernando, 2008; Andersson & Hatakka, 2010). With the use of Web 2.0 tools, however, interactivity of e-learning in Sri Lanka could be increased at less cost and infrastructure.

The second major implication of this research is that by using Web 2.0 tools for management of learning resources, personal knowledge management, delivery of instructional support and collaboration, learner-learning resources, learner-instructor and learner-learner interactions could be improved. How the aforementioned three types of interactions in e-learning could be improved by using Web 2.0 technology for management of learning resources, personal knowledge management, delivery of instructional support and collaboration is shown graphically in Figure 8.1. The figure shows that management of learning resources (LRS) and personal knowledge management (PKM) support learner-learning resources interactions, delivery of instructional support (INS) facilitates learner-instructor interactions and collaboration (COL) supports learner-learner interactions. The three aforementioned types of interactions together are also shown to improve the interactivity of e-learning.

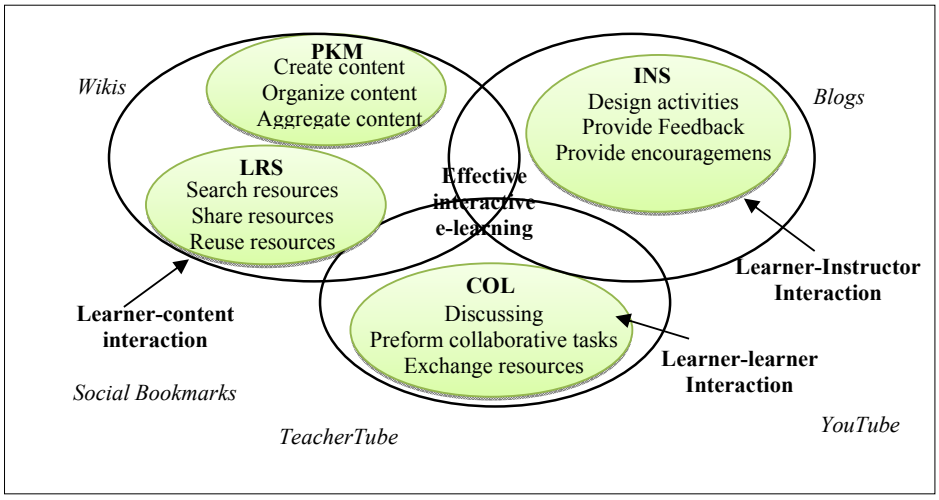

Figure 8.1: Enabling interactive e-learning in Australia and Sri Lanka using web 2.0

To enable learners to better interact with learning resources, Web 2.0 technology could be used to manage learning resources in a manner that the resources are easily searched, shared and reused. Furthermore, learners could be enabled to create, organize and aggregate personal information and resources using Web 2.0 technology. To support learners through learner-instructor interactions, provision of feedback, design of learning activities and providing encouragements could be done with the adoption of Web 2.0 technology. To facilitate

learners to better interact with peer learners, Web 2.0 technology could be used to facilitate discussions, collaborative tasks and exchange of resources.

The above implication is useful for instructors and e-learning system developers to understand how interactivity of e-learning could be enhanced using Web 2.0 tools. Instructors could use such knowledge to design more interactive e-learning environments and e-leaning activities. E-learning system developers, on the other hand, are able to develop more interactive e-learning systems by using knowledge shared in this research.

8.4 Contributions

This research makes a number of contributions to the existing body of knowledge from a both a practical perspective and a theoretical perspective. From a practical perspective, this research shows that Web 2.0 technology could improve the interactivity of e-learning in Australia and Sri Lanka to a great extent. Furthermore, how Web 2.0 technology could be used to improve the interactivity in e-learning is also shown. Such an understanding is useful especially for e-learning developers and educators in designing teaching and learning.

This research also make three major contributions from a theoretical perspective. Firstly, this research reveals that Web 2.0 technology supports interactive e-learning to a great extent by investigating how Web 2.0 technology supports the three major types of interactions in e-learning, namely, learner-learning resources interactions, learner-instructor interactions and learner-learner interactions. Much of the existing research on Web 2.0 based interactive e-learning investigate how Web 2.0 technology supports only one or two of the aforementioned types of interactions. This research also reveals that Web 2.0 technology supports interactive e-learning by investigating how multiple Web 2.0 tools support interactions in e-learning.

Much of the existing research, however, only investigates how one particular Web 2.0 tool such as blogs, wikis or social bookmarks supports interactive e-learning.

Secondly, this research contributes for existing body of knowledge by finding that Web 2.0 technology supports interactive e-learning in higher education in Sri Lanka to a great extent. Since Web 2.0 technology has gained momentum in e-learning, attempts are made in developing countries such as Sri Lanka to incorporate Web 2.0 tools for e-learning. However, there is a critical scarcity of research on how Web 2.0 technology could be used for e-learning in higher education in Sri Lanka. In particular, there is a scarcity of research on how Web 2.0 technology supports interactive e-learning in Sri Lanka.

Thirdly, this research contributes to the existing body of knowledge by revealing that Web 2.0 technology could be used for improving interactivity of e-learning in both a developed and a developing country in a similar manner despite their cultural differences. Although much research has investigated whether Web 2.0 technology could be used for interactive e-learning in a single country, whether Web 2.0 technology supports interactive e-learning across multiple countries is not much investigated in existing research. In particular, whether Web 2.0 technology supports interactive e-learning both in developed countries and developing countries in a similar manner is not considered in the existing research.

8.5 Limitations

There are several limitations in this research. These limitations are related to the generalizability, sampling and selection of the research method. Several steps are taken in this research to improve the representativeness of the samples as to improve the generalizability of the research findings. Those steps include, collecting data from a large number of learners and collecting data representing learners from various fields of study. The sample sizes considered

in this research are 202 and 227 in Australia and Sri Lanka respectively. Such sample sizes are considered appropriate for the data analysis techniques used in this research. However, this sample size may still not be adequate to represent the population of higher educational learners in Australia and Sri Lanka. In addition, data for this research are collected from a single university in Australia due to practical limitations in obtaining ethics approval for collecting data from multiple universities. Due to the above fact also the representativeness of the sample could be affected.

During the course of this research, learners indicated how Web 2.0 tools are useful for interactive e-learning based on their experience. Although learners who participated in this research are found to be familiar with Web 2.0 tools to a great extent, different learners may have different experiences with Web 2.0 tools. Therefore, the true potential of the Web 2.0 tools for interactive e-learning may not have been revealed by the results of this research. In addition, this research only considers the perceptions of learners in drawing conclusions on Web 2.0 based interactive e-learning. The perceptions of other stakeholders of e-learning such as instructors are not examined in investigating the enabling role of Web 2.0 technology for interactive e-learning. Perceptions of such stakeholders could also be important for revealing the enabling role of Web 2.0 technology in interactive e-learning.

Finally, this research follows a quantitative research strategy to answer the research questions. Quantitative research strategy is useful for obtaining results in research that could be generalized for a larger population. However, quantitative research does not hear the individuals' perceptions on a certain phenomenon in detail. Thus, individuals' perceptions on the enabling role of Web 2.0 technology for interactive e-learning are not heard in detail in this research.

8.6 Future work

This research followed a quantitative research approach to answer the research questions of this research. Quantitative research strategy is useful for generalizing results of the research to a larger population of learners. However, the ability to hear individuals' perceptions on Web 2.0 based interactive e-learning in detail is limited in the above strategy. To discover the learners' perceptions on Web 2.0 based interactive e-learning in detail, future research could collect qualitative data on how Web 2.0 tools could support interactive e-learning and analyse those data. For example, interviews could be conducted with learners who participated in this study where the learners can express their opinions on using Web 2.0 technology for interactive e-learning in detail. In addition, future research could collect data from other stakeholders of e-learning whose perceptions are important to understand how Web 2.0 technology could be used for interactive e-learning. For example, instructors and university management could be interviewed to understand their views on using Web 2.0 technology for interactive e-learning.

Similar to many developing countries Web 2.0 technology is being used to facilitate e-learning in Sri Lanka. Review of the literature on this topic has revealed, however, that there is a critical scarcity of research on Web 2.0 based e-learning. Thus, there is ample space for future research to develop on Web 2.0 based e-learning in Sri Lanka. For example, challenges and opportunities in facilitating Web 2.0 based e-learning, and learners and instructors current knowledge, experience and perceptions on Web 2.0 based e-learning could be investigated.

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APPENDICES

Appendix A: Survey Instrument

Part A – Survey instrument for Australia

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Fax +61 3 9925 5850
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INVITATION TO PARTICIPATE IN A RESEARCH PROJECT

Dear Participant,

I am Anuradha Karunasena, a PhD student at the School of Business Information Technology, RMIT University, Australia. I hereby kindly invite you to participate in my research project aiming to investigate the applicability of web 2.0 technology for e-learning in higher education. My research is supervised by Professor Hepu Deng and Assoc. Prof. Booi Kam.

Your participation will involve in a survey which will not take more than 15 minutes. During the survey you will be given a set of questions where you have to provide your perceptions on using web 2.0 technology for e-learning. You will be able to answer the questions with your experience of your Learning Management System (Ex: BlackBoard, Moodle) and your experience with web 2.0 applications such as YouTube or Facebook. You will not be asked to provide any personal information and personal records. There are no apparent or hidden risks in participating in this research as it only involves a set of questions about your opinion on integrating web 2.0 technology for e-learning. You may choose not to answer any particular question and participation in this research is voluntary. You may withdraw from participation at any time.

The data collected through the survey will be analysed for my thesis and the results may appear in publications. The results will be reported in a manner which does not enable you to be identified. Thus the reporting will protect your anonymity.

Research findings will be helpful to develop and validate a framework on how web 2.0 technology

can benefit e-learning. Your contribution is so important since you are the major stakeholder of e-learning. Participating in the surveys or, and interview is a valuable opportunity for you to express how e-learning systems can be improved using web 2.0 technologies in your opinion.

If you have any queries regarding this project please contact my supervisors Professor Hepu Deng (phone +61 03 9925 5823, email: Hepu.Deng@rmit.edu.au). Further, if you have any complaints regarding this project please contact the Chair, RMIT Business College Human Ethics Advisory Network, GPO Box 2476V, Melbourne, 3001.(phone +61 3 9925 5596, email : bchean@rmit.edu.au)

I highly appreciate your support on this.

Yours Sincerely,

Anuradha Karunasena

SECTION 1: DEMOGRAPHIC DATA

1. What is your age?

   ☐ Below 20

   ☐ 20-29

   ☐ 30-39

   ☐ 40-49

   ☐ 50- 60

2. What is your gender?

   ☐ Male

   ☐ Female

3. Are you a local student or an international student?

   ☐ International student

   ☐ Local student

4. If you are an international student, what region are you from?

- ☐ Africa
- ☐ Asia
- ☐ America
- ☐ Europe
- ☐ Middle East
- ☐ Any other

5. What is the level of program you are following?

- ☐ Undergraduate Degree
- ☐ Postgraduate Degree

6. If you are a postgraduate student what is the program you are enrolled in?

- ☐ Postgraduate coursework
- ☐ Postgraduate Research

7. What is your field of study?

- ☐ Arts
- ☐ Management, Accountancy, Finance, Marketing, Economics
- ☐ Engineering
- ☐ Information Technology and Computer Science
- ☐ Science and Health
- ☐ Any other

8. Which of the following web 2.0 applications /services are you familiar with?

- ☐ Blogs
- ☐ Instant Messengers (Ex: MSN Messenger, Yahoo Messenger, Skype, Gtalk)
- ☐ Facebook
- ☐ Social Bookmarking (Diigo, Del.icio.us)

☐ RSS

☐ Teacher Tube (www.teachertube.com)

☐ Wikis (Ex: Wikipedia)

☐ YouTube

9. Have you used any web 2.0 applications (ex: blogs, wikis, Instant messenger, YouTube and etc.) as a requirement of any course you are following?

☐ Yes

☐ No

10. If yes, please select the applications you have been using.

☐ Blogs

☐ Instant Messengers (Ex: MSN Messenger, Yahoo Messenger, Skype, Gtalk)

☐ Facebook

☐ Social Bookmarking (Diigo, Del.icio.us)

☐ RSS

☐ Teacher Tube (www.teachertube.com)

☐ Wikis (Ex: Wikipedia)

☐ YouTube

SECTION 2: FACTORS OF INTERACTIVE E-LEARNING

Part A: Managing personal knowledge

During each course you are following you might need to refer to numerous web based articles, images, videos and etc. in addition to the learning content provided by the instructor. You might also develop new knowledge and make new findings. It would be important for you to manage these knowledge and resources. How would you rate the following techniques to be enabled in e-learning to manage your findings, thoughts, resources and etc. to improve the effectiveness of e-learning? (You might picture this as how you manage content in your Facebook page or a blog)

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
1.	Facilities to create information and resources (Ex: writing notes, uploading and maintaining graphics, videos, project reports, assignments & etc)	☐	☐	☐	☐	☐	☐	☐
2.	Facilities to achieve and maintain resources you find for future use (Ex: keeping track of important web pages, YouTube tutorials)	☐	☐	☐	☐	☐	☐	☐
3.	Facilities to classify learning content (Ex: Classifying downloaded documents, relevant web links, videos, graphics, project reports meaningfully by topic names)reports) meaningfully by topic names.	☐	☐	☐	☐	☐	☐	☐
4.	Facilities to effectively sequence and organize learning content (text, graphic, videos, web links) collected under each topic	☐	☐	☐	☐	☐	☐	☐
5.	Facilities to integrate learning content of different types (text, graphics, videos, web links) easily to create more meaningful and rich collections of content (Ex: Portfolios)	☐	☐	☐	☐	☐	☐	☐

Part B: Collaboration

During each course you follow you might have to work with your peer learners cooperatively to gain knowledge. How would you rate the importance of the following regarding the collaboration facilities enabled in your e-learning system to improve the effectiveness of e-learning? (You might consider how you interact through Facebook or internet messengers such as google talk and skype)

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
6.	Facilities to discuss with the peer learners	☐	☐	☐	☐	☐	☐	☐
7.	Facilities to discuss with the instructors	☐	☐	☐	☐	☐	☐	☐
8.	Facilities to share your learning resources (Notes you have created, web links, graphics and videos you have	☐	☐	☐	☐	☐	☐	☐

found or created)

9. Facilities to access learning resources (Notes created by peers, web links, graphics and videos found or created by peers) created by peer learners. ☐ ☐ ☐ ☐ ☐ ☐ ☐

10. Facilitating the environment for actively participating group activities ☐ ☐ ☐ ☐ ☐ ☐ ☐

Part C: Instructional support

During each course your instructor might be using different teaching techniques and might be following different teaching practices. How would you rate the following teaching techniques and practices using technology in improving the effectiveness of e-learning?

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

	7	6	5	4	3	2	1
11. Use of different teaching styles (ex: delivering content directly, teaching through discussions, brainstorming and etc.)	☐	☐	☐	☐	☐	☐	☐
12. Introducing different learning activities (ex: group projects, individual assignments, presentations)	☐	☐	☐	☐	☐	☐	☐
13. Encouraging, facilitating and monitoring the collaboration of students	☐	☐	☐	☐	☐	☐	☐
14. Providing personalized feedback on your work	☐	☐	☐	☐	☐	☐	☐
15. Assessing your work not only looking at the content but also looking at your creativity and gathering of knowledge	☐	☐	☐	☐	☐	☐	☐
16. Facilitating self and peer assessment such that you can assess your work or let your peers to assess your work.	☐	☐	☐	☐	☐	☐	☐

Part D: Management and Presentation of Learning Content

During your course your instructors must have shared various learning resources to you (Ex: slides, audio files, videos, web links). Apart from these resources your e-learning system is a rich repository of learning resources containing learning resources used by different courses. How would you rate the importance of the following techniques to manage and present learning resources in the system using technology to improve e-learning effectiveness? (You might have to consider how content are shared using Facebook, SlideShare, YouTube and TeacherTube)

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
17.	Presenting learning resources in a well-organized (sequenced and categorized) manner	☐	☐	☐	☐	☐	☐	☐
18.	Providing learning resources of different formats (Ex: text, graphical, audio, video) preferred by learners with different learning styles.	☐	☐	☐	☐	☐	☐	☐
19.	Ability to search and access any learning resources in the system (learning resources used by other courses)	☐	☐	☐	☐	☐	☐	☐
20.	Ability to share any learning resources in the system (even the learning resources used by other courses)	☐	☐	☐	☐	☐	☐	☐
21.	Ability to reuse any learning resources in the system (even the learning resources used by other courses) in different contexts.	☐	☐	☐	☐	☐	☐	☐

Part E: Web 2.0 technology

Web 2.0 applications are increasingly being used in e-learning at present. How would you rate the following features to best describe web 2.0 applications/services such as blogs, wikis, social bookmarking, YouTube and RSS supporting to manage personal knowledge, collaborate, deliver instruction and manage learning resources?

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
22.	Ability to create your content in the system without much technical knowledge. (Ex:blogs)	☐	☐	☐	☐	☐	☐	☐
23.	Ability to share your resources	☐	☐	☐	☐	☐	☐	☐
24.	Ability to subscribe to content to get notifications once they are updated (ex: RSS)	☐	☐	☐	☐	☐	☐	☐

25.	Ability to manipulate content (sequence, classify) easily (ex: social bookmarking)	☐	☐	☐	☐	☐	☐	☐
26.	Ability to aggregate content of different types together.	☐	☐	☐	☐	☐	☐	☐
27.	Ability to network with the other users	☐	☐	☐	☐	☐	☐	☐
28.	Ability to synchronously communicate with other users (Ex: skype, MSN Messenger)	☐	☐	☐	☐	☐	☐	☐
29.	Ability to collaboratively author and manage content with other users	☐	☐	☐	☐	☐	☐	☐
30.	Ability to contribute to dialogue and collaboratively contribute to resources (Ex: adding comments, ratings)	☐	☐	☐	☐	☐	☐	☐
31.	Ability to reuse resources created by others	☐	☐	☐	☐	☐	☐	☐

Part F : e-Learning effectiveness

How would you rate the following as your expectations in e-learning by having features of personal knowledge management, collaboration, support of instructor, management of learning resources enabled through web 2.0 technology in your e-learning system?

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
32.	Improving critical thinking skills	☐	☐	☐	☐	☐	☐	☐
33.	Obtaining sense of satisfaction	☐	☐	☐	☐	☐	☐	☐
34.	Meeting learning outcomes	☐	☐	☐	☐	☐	☐	☐
35.	Obtaining good grades	☐	☐	☐	☐	☐	☐	☐
36.	Increasing the likelihood of finding a better career	☐	☐	☐	☐	☐	☐	☐

Part B – Survey instrument for Sri Lanka

RMIT University

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Fax +61 3 9925 5850
www.rmit.edu.au

INVITATION TO PARTICIPATE IN A RESEARCH PROJECT

Dear Participant,

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The data collected through the survey will be analysed for my thesis and the results may appear in publications. The results will be reported in a manner which does not enable you to be identified. Thus the reporting will protect your anonymity.

Research findings will be helpful to develop and validate a framework on how web 2.0 technology can benefit e-learning. Your contribution is so important since you are the major stakeholder of e-learning. Participating in the surveys or, and interview is a valuable opportunity for you to express how e-learning systems can be improved using web 2.0 technologies in your opinion.

If you have any queries regarding this project please contact my supervisors Professor Hepu Deng (phone +61 03 9925 5823, email: Hepu.Deng@rmit.edu.au). Further, if you have any complaints regarding this project please contact the Chair, RMIT Business College Human Ethics Advisory

Network, GPO Box 2476V, Melbourne, 3001.(phone +61 3 9925 5596, email : bchean@rmit.edu.au)

I highly appreciate your support on this.

Yours Sincerely,

Anuradha Karunasena

SECTION 1: DEMOGRAPHIC DATA

1. What is your age?

   ☐ Below 20

   ☐ 20-29

   ☐ 30-39

   ☐ 40-49

   ☐ 50- 60

2. What is your gender?

   ☐ Male

   ☐ Female

3. What is the university you are studying at?

   ☐ SLIIT

   ☐ University of Colombo

   ☐ University of Kelaniya

   ☐ University of Moratuwa

   ☐ University of Peradeniya

   ☐ University of Sri Jayawardenapura

   ☐ Open University

   ☐ Any other

4. What is the level of program you are following?

   ☐ Undergraduate Degree

   ☐ Postgraduate Degree

5. If you are a postgraduate student what is the program you are enrolled in?

   ☐ Postgraduate coursework

   ☐ Postgraduate Research

6. What is your field of study?

   ☐ Arts

   ☐ Management, Accountancy, Finance, Marketing, Economics

   ☐ Engineering

   ☐ Information Technology and Computer Science

   ☐ Science and Health

   ☐ Any other

7. Which of the following web 2.0 applications /services are you familiar with?

   ☐ Blogs

   ☐ Instant Messengers (Ex: MSN Messenger, Yahoo Messenger, Skype, Gtalk)

   ☐ Facebook

   ☐ Social Bookmarking (Diigo, Del.icio.us)

   ☐ RSS

   ☐ Teacher Tube (www.teachertube.com)

   ☐ Wikis (Ex: Wikipedia)

   ☐ YouTube

8. Have you used any web 2.0 applications (ex: blogs, wikis, Instant messenger, YouTube and etc.) as a requirement of any course you are following?

☐ Yes

☐ No

9. If yes, please select the applications you have been using.

☐ Blogs

☐ Instant Messengers (Ex: MSN Messenger, Yahoo Messenger, Skype, Gtalk)

☐ Facebook

☐ Social Bookmarking (Diigo, Del.icio.us)

☐ RSS

☐ Teacher Tube (www.teachertube.com)

☐ Wikis (Ex: Wikipedia)

☐ YouTube

SECTION 2: FACTORS OF INTERACTIVE E-LEARNING

Part A: Managing personal knowledge

During each course you are following you might need to refer to numerous web based articles, images, videos and etc. in addition to the learning content provided by the instructor. You might also develop new knowledge and make new findings. It would be important for you to manage these knowledge and resources. How would you rate the following techniques to be enabled in e-learning to manage your findings, thoughts, resources and etc. to improve the effectiveness of e-learning? (You might picture this as how you manage content in your Facebook page or a blog)

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

	7	6	5	4	3	2	1
1. Facilities to create information and resources (Ex: writing notes, uploading and maintaining graphics, videos, project	☐	☐	☐	☐	☐	☐	☐

reports, assignments & etc)

2.	Facilities to archieve and maintain resources you find for future use (Ex: keeping track of important web pages, YouTube tutorials)	☐	☐	☐	☐	☐	☐	☐
3.	Facilities to classify learning content (Ex: Classifying downloaded documents, relevant web links, videos, graphics, project reports meaningfully by topic names)reports) meaningfully by topic names.	☐	☐	☐	☐	☐	☐	☐
4.	Facilities to effectively sequence and organize learning content (text, graphic, videos, web links) collected under each topic	☐	☐	☐	☐	☐	☐	☐
5.	Facilities to integrate learning content of different types (text, graphics, videos, web links) easily to create more meaningful and rich collections of content (Ex: Portfolios)	☐	☐	☐	☐	☐	☐	☐

Part B: Collaboration

During each course you follow you might have to work with your peer learners cooperatively to gain knowledge. How would you rate the importance of the following regarding the collaboration facilities enabled in your e-learning system to improve the effectiveness of e-learning? (You might consider how you interact through Facebook or internet messengers such as google talk and skype)

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
6.	Facilities to discuss with the peer learners	☐	☐	☐	☐	☐	☐	☐
7.	Facilities to discuss with the instructors	☐	☐	☐	☐	☐	☐	☐
8.	Facilities to share your learning resources (Notes you have created, web links, graphics and videos you have found or created)	☐	☐	☐	☐	☐	☐	☐
9.	Facilities to access learning resources (Notes created by peers, web links, graphics and videos found or created by peers) created by peer learners.	☐	☐	☐	☐	☐	☐	☐
10.	Facilitating the environment for actively participating group activities	☐	☐	☐	☐	☐	☐	☐

Part C: Instructional support

During each course your instructor might be using different teaching techniques and might be following different teaching practices. How would you rate the following teaching techniques and practices using technology in improving the effectiveness of e-learning?

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
11.	Use of different teaching styles (ex: delivering content directly, teaching through discussions, brainstorming and etc.)	☐	☐	☐	☐	☐	☐	☐
12.	Introducing different learning activities (ex: group projects, individual assignments, presentations)	☐	☐	☐	☐	☐	☐	☐
13.	Encouraging, facilitating and monitoring the collaboration of students	☐	☐	☐	☐	☐	☐	☐
14.	Providing personalized feedback on your work	☐	☐	☐	☐	☐	☐	☐
15.	Assessing your work not only looking at the content but also looking at your creativity and gathering of knowledge	☐	☐	☐	☐	☐	☐	☐
16.	Facilitating self and peer assessment such that you can assess your work or let your peers to assess your work.	☐	☐	☐	☐	☐	☐	☐

Part D: Management and Presentation of Learning Content

During your course your instructors must have shared various learning resources to you (Ex: slides, audio files, videos, web links). Apart from these resources your e-learning system is a rich repository of learning resources containing learning resources used by different courses. How would you rate the importance of the following techniques to manage and present learning resources in the system using technology to improve e-learning effectiveness? (You might have to consider how content is shared using Facebook, SlideShare, YouTube and TeacherTube)

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
17.	Presenting learning resources in a well-organized (sequenced and categorized) manner	☐	☐	☐	☐	☐	☐	☐
18.	Providing learning resources of different formats (Ex:	☐	☐	☐	☐	☐	☐	☐

text, graphical, audio, video) preferred by learners with different learning styles.

19.	Ability to search and access any learning resources in the system (even the learning resources used by other courses)	☐	☐	☐	☐	☐	☐	☐
20.	Ability to share any learning resources in the system (even the learning resources used by other courses)	☐	☐	☐	☐	☐	☐	☐
21.	Ability to reuse any learning resources in the system (even the learning resources used by other courses) in different contexts.	☐	☐	☐	☐	☐	☐	☐

Part E: Web 2.0 technology

Web 2.0 applications are increasingly being used in e-learning at present. How would you rate the following features to best describe web 2.0 applications/services such as blogs, wikis, social bookmarking, YouTube and RSS supporting to manage personal knowledge, collaborate, deliver instruction and manage learning resources?

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
22.	Ability to create your content in the system without much technical knowledge. (Ex:blogs)	☐	☐	☐	☐	☐	☐	☐
23.	Ability to share your resources	☐	☐	☐	☐	☐	☐	☐
24.	Ability to subscribe to content to get notifications once they are updated (ex: RSS)	☐	☐	☐	☐	☐	☐	☐
25.	Ability to manipulate content (sequence, classify) easily (ex: social bookmarking)	☐	☐	☐	☐	☐	☐	☐
26.	Ability to aggregate content of different types together.	☐	☐	☐	☐	☐	☐	☐
27.	Ability to network with the other users	☐	☐	☐	☐	☐	☐	☐
28.	Ability to synchronously communicate with other users (Ex: skype, MSN Messenger)	☐	☐	☐	☐	☐	☐	☐

29.	Ability to collaboratively author and manage content with other users	☐	☐	☐	☐	☐	☐	☐
30.	Ability to contribute to dialogue and collaboratively contribute to resources (Ex: adding comments, ratings)	☐	☐	☐	☐	☐	☐	☐
31.	Ability to reuse resources created by others	☐	☐	☐	☐	☐	☐	☐

Part F : e-Learning effectiveness

How would you rate the following as your expectations in e-learning by having features of personal knowledge management, collaboration, support of instructor, management of learning resources enabled through web 2.0 technology in your e-learning system?

Please rate your responses according to the following scale.

[7= highly important……..1= Not important at all]

		7	6	5	4	3	2	1
32.	Improving critical thinking skills	☐	☐	☐	☐	☐	☐	☐
33.	Obtaining sense of satisfaction	☐	☐	☐	☐	☐	☐	☐
34.	Meeting learning outcomes	☐	☐	☐	☐	☐	☐	☐
35.	Obtaining good grades	☐	☐	☐	☐	☐	☐	☐
36.	Increasing the likelihood of finding a better career	☐	☐	☐	☐	☐	☐	☐

Appendix B: Kolmogorov-Smimov test results

Part A- Kolmogorov-Smimov test results for Australian sample

Variable	Statistic	Significance
PKM1	.219	.000
PKM2	.228	.000
PKM3	.200	.000
PKM4	.194	.000
PKM5	.208	.000
COL1	.232	.000
COL2	.228	.000
COL3	.192	.000
COL4	.267	.000
COL5	.232	.000
INS1	.222	.000
INS2	.223	.000
INS3	.230	.000
INS4	.220	.000
INS5	.231	.000
INS6	.178	.000
LRS1	.228	.000
LRS2	.204	.000
LRS3	.203	.000
LRS4	.204	.000
LRS5	.215	.000

WEB1	.259	.000
WEB2	.194	.000
WEB3	.184	.000
WEB4	.194	.000
WEB5	.207	.000
WEB6	.207	.000
WEB7	.238	.000
WEB8	.198	.000
WEB9	.214	.000
WEB10	.235	.000
EFT1	.260	.000
EFT2	.195	.000
EFT3	.240	.000
EFT4	.214	.000
EFT5	.211	.000

Part B- Kolmogorov-Smimov test results for Sri Lankan sample

Variable	Statistic	Significance
PKM1	.195	.000
PKM2	.222	.000
PKM3	.206	.000
PKM4	.222	.000
PKM5	.224	.000
COL1	.222	.000
COL2	.211	.000
COL3	.262	.000
COL4	.252	.000
COL5	.207	.000
INS1	.216	.000
INS2	.250	.000
INS3	.232	.000
INS4	.215	.000
INS5	.249	.000
INS6	.198	.000
LRS1	.191	.000
LRS2	.242	.000
LRS3	.212	.000
LRS4	.201	.000
LRS5	.219	.000
WEB1	.197	.000
WEB2	.249	.000

WEB3	.227	.000
WEB4	.226	.000
WEB5	.221	.000
WEB6	.187	.000
WEB7	.209	.000
WEB8	.223	.000
WEB9	.229	.000
WEB10	.213	.000
EFT1	.188	.000
EFT2	.208	.000
EFT3	.210	.000
EFT4	.232	.000
EFT5	.195	.000

Appendix C: Descriptive statistics

Part A- Descriptive statistics for survey items Australian sample

Descriptive statistics for collaboration (Australia)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
COL1	2	7	5.73	6.00	1.090
COL2	3	7	5.84	6.00	1.025
COL3	2	7	5.60	6.00	1.125
COL4	2	7	5.88	6.00	1.012
COL5	3	7	5.61	6.00	1.090

Descriptive statistics for instructional support (Australia)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
INS1	3	7	5.73	6.00	1.064
INS2	3	7	5.75	6.00	1.044
INS3	3	7	5.65	6.00	1.034
INS4	2	7	5.87	6.00	1.201
INS5	2	7	5.73	6.00	1.140
INS6	2	7	5.30	5.00	1.335

Descriptive statistics for management of learning resources (Australia)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
LRS1	3	7	5.94	6.00	1.017
LRS2	3	7	5.75	6.00	1.007
LRS3	2	7	5.83	6.00	1.106
LRS4	2	7	5.55	6.00	1.058
LRS5	2	7	5.67	6.00	1.053

Descriptive statistics for web 2.0 technology (Australia)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
WEB1	3	7	5.64	6.00	1.071
WEB2	3	7	5.66	6.00	1.138
WEB3	2	7	5.47	5.00	1.108
WEB4	2	7	5.51	6.00	0.985
WEB5	2	7	5.43	5.50	1.120
WEB6	2	7	5.73	6.00	1.033
WEB7	3	7	5.68	6.00	0.894
WEB8	3	7	5.55	6.00	0.999
WEB9	2	7	5.64	6.00	1.086
WEB10	2	7	5.57	6.00	1.050

Descriptive statistics for e-learning effectiveness (Australia)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
EFT1	2	7	5.83	6.00	1.102
EFT2	1	7	5.68	6.00	1.051
EFT3	2	7	5.86	6.00	1.068
EFT4	2	7	5.70	6.00	1.164
EFT5	1	7	5.59	6.00	1.336

Part B- Descriptive statistics for survey items Sri Lankan sample

Descriptive statistics for collaboration (Sri Lanka)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
COL1	1	7	5.61	6.00	1.337
COL2	1	7	5.38	6.00	1.372
COL3	2	7	5.74	6.00	1.087
COL4	2	7	5.68	6.00	1.099
COL5	1	7	5.45	6.00	1.317

Descriptive statistics for instructional support (Sri Lanka)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
INS1	2	7	5.53	6.00	1.273
INS2	2	7	5.68	6.00	1.079
INS3	2	7	5.61	6.00	1.117
INS4	1	7	5.68	6.00	1.356
INS5	2	7	5.64	6.00	1.227
INS6	1	7	5.33	6.00	1.337

Descriptive statistics for management of learning resources (Sri Lanka)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
LRS1	2	7	5.71	6.00	1.253
LRS2	2	7	5.68	6.00	1.166
LRS3	2	7	5.48	6.00	1.249
LRS4	1	7	5.47	6.00	1.263
LRS5	1	7	5.62	6.00	1.243

Descriptive statistics for web 2.0 technology (Sri Lanka)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
WEB1	2	7	5.30	5.00	1.289
WEB2	2	7	5.59	6.00	1.147
WEB3	1	7	5.46	6.00	1.354
WEB4	1	7	5.41	6.00	1.210
WEB5	1	7	5.35	6.00	1.330
WEB6	1	7	5.37	6.00	1.312
WEB7	2	7	5.59	6.00	1.126
WEB8	2	7	5.45	6.00	1.190
WEB9	2	7	5.48	6.00	1.134
WEB10	2	7	5.49	6.00	1.213

Descriptive statistics for e-learning effectiveness (Sri Lanka)

Survey Item	Minimum	Maximum	Mean	Median	Standard deviation
EFT1	2	7	5.70	6.00	1.018
EFT2	1	7	5.19	5.00	1.074
EFT3	2	7	5.34	5.00	1.079
EFT4	2	7	5.48	6.00	1.082
EFT5	2	7	5.22	5.00	1.112

Appendix D: GoF results of the initial full measurement model

Part A : GoF results for initial full measurement model (Australian sample)

GOF Index	Australian Sample
Chi-Square (χ^2)	1080.4
χ^2/df	1.866
GFI	0.695
RMSEA	0.081
TLI	0.813
CFI	0.828

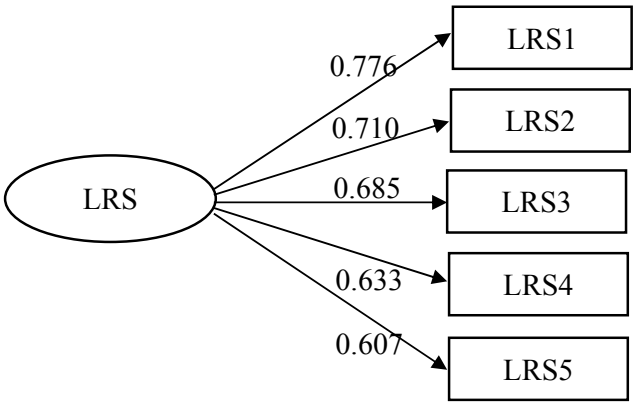
Part B : GoF results for initial full measurement model (Sri Lankan sample)

GOF Index	Sri Lankan Sample
Chi-Square (χ^2)	1302.6
χ^2/df	1.951
GFI	0.754
RMSEA	0.074
TLI	0.865
CFI	0.876

Appendix E: Congeneric measurement models

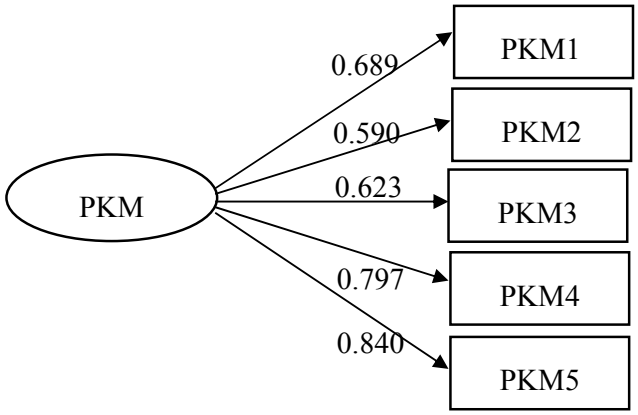
Part A – Congeneric measurement model for Australia

1. LRS



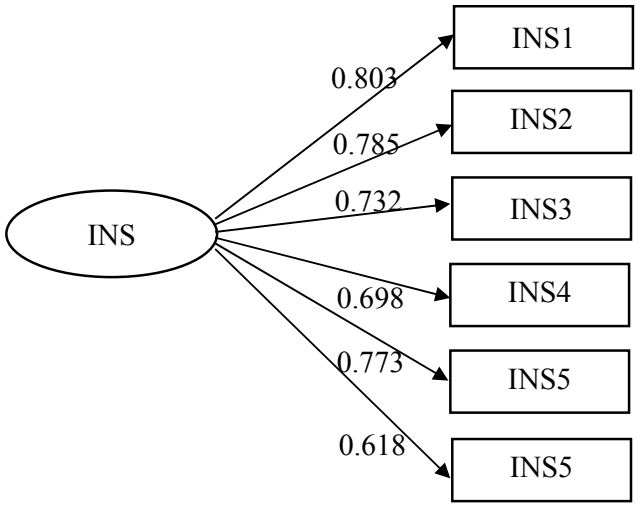
GOF Index	Result
Chi-Square (χ2)	22.691(Bollen-stine P value= 0.034)
χ^2/df	4.538
GFI	0.933
RMSEA	0.164
TLI	0.899
CFI	0.95

2. PKM



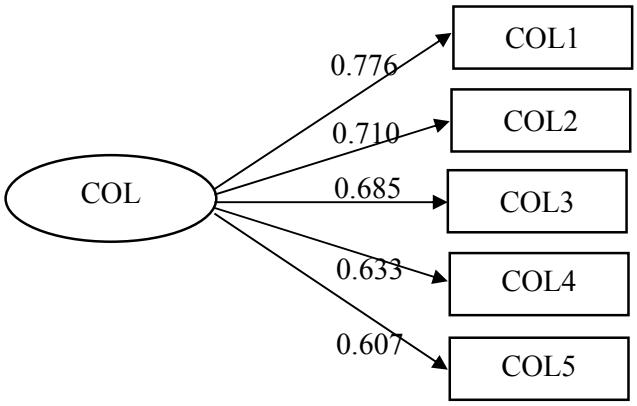
GOF Index	Result
Chi-Square (χ2)	10.974
χ^2/df	2.195
GFI	0.966
RMSEA	0.095
TLI	0.948
CFI	0.978

3. INS



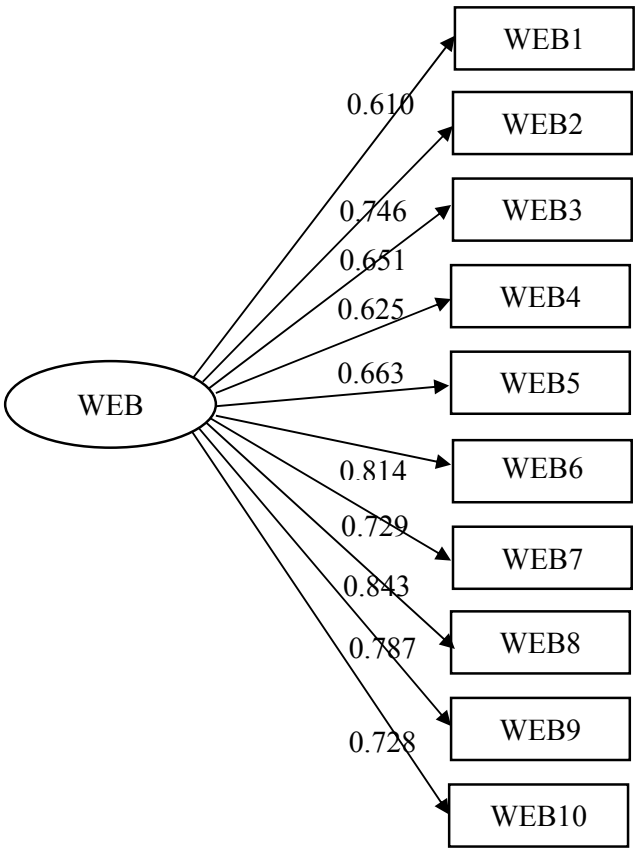
GOF Index	Result
Chi-Square (χ2)	36.702
χ^2/df	4.078
GFI	0.917
RMSEA	0.153
TLI	0.875
CFI	0.925

4. COL



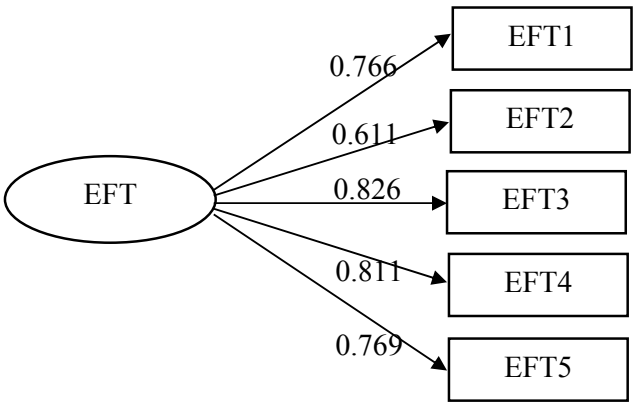
GOF Index	Result
Chi-Square (χ2)	8.265
χ^2/df	1.653
GFI	0.975
RMSEA	0.071
TLI	0.966
CFI	0.983

5. WEB



GOF Index	Result
Chi-Square ($\chi 2$)	139.545
χ^2/df	3.987
GFI	0.812
RMSEA	0.151
TLI	0.824
CFI	0.863

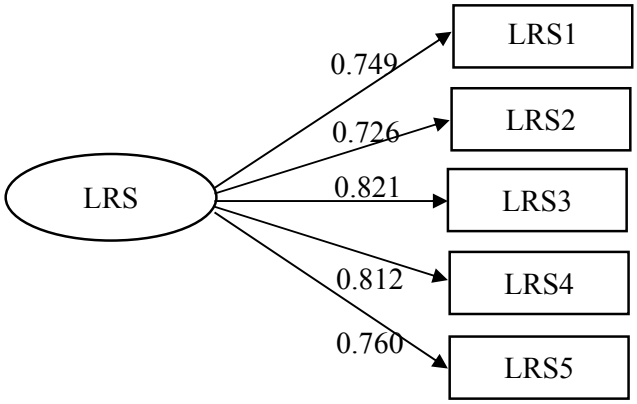
6. EFT



GOF Index	Result
Chi-Square (χ2)	16.548
χ^2/df	3.31
GFI	0.949
RMSEA	0.133
TLI	0.926
CFI	0.963

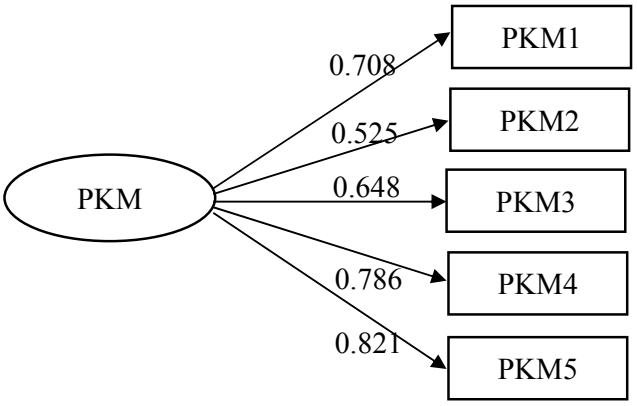
Part B – Congeneric measurement model for Sri Lanka

1. LRS



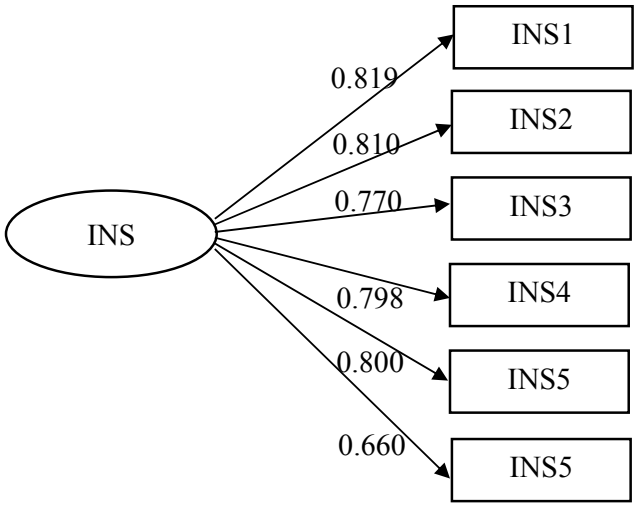
GOF Index	Result
Chi-Square (χ2)	47.202
χ^2/df	9.44
GFI	0.921
RMSEA	0.193
TLI	0.858
CFI	0.929

2. PKM



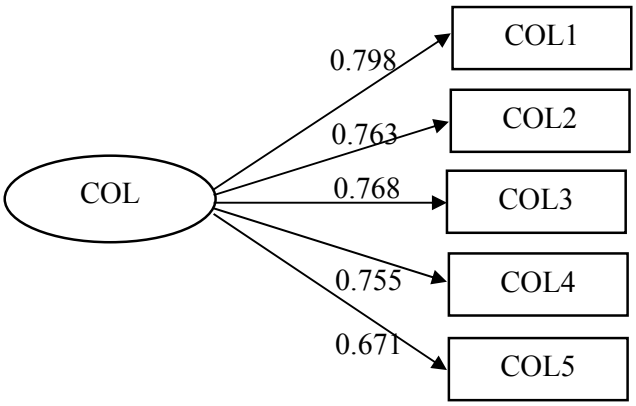
GOF Index	Result
Chi-Square (χ2)	21.211
χ^2/df	4.242
GFI	0.962
RMSEA	0.12
TLI	0.943
CFI	0.973

3. INS



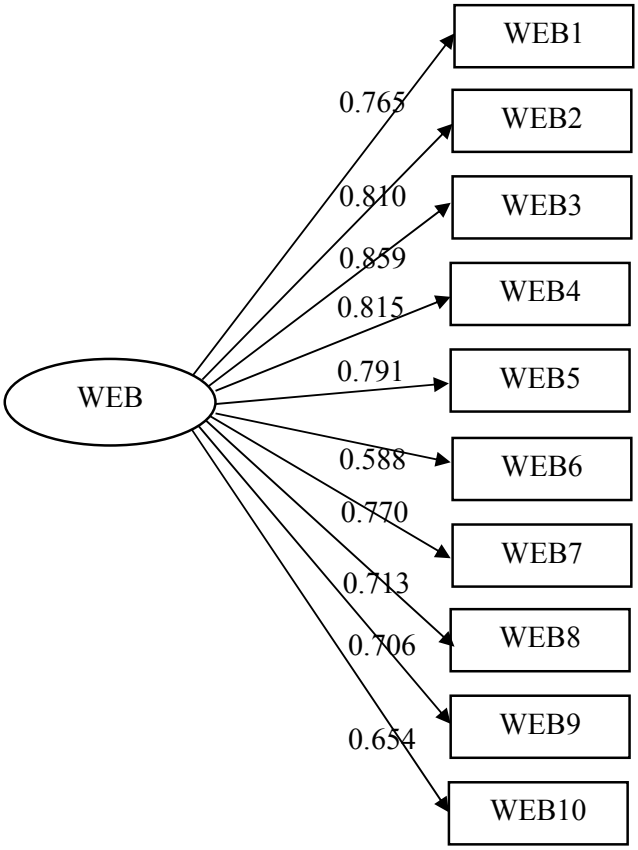
GOF Index	Result
Chi-Square (χ2)	103.21
χ^2/df	11.469
GFI	0.859
RMSEA	0.215
TLI	0.818
CFI	0.891

4. COL



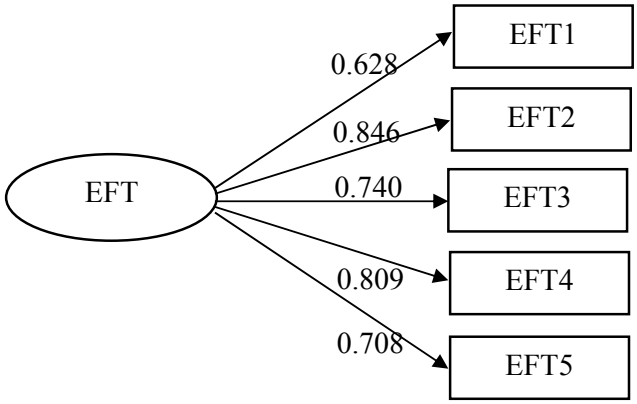
GOF Index	Result
Chi-Square (χ2)	16.454
χ^2/df	3.291
GFI	0.974
RMSEA	0.101
TLI	0.954
CFI	0.977

5. WEB



GOF Index	Result
Chi-Square (χ2)	195.673
χ^2/df	5.591
GFI	0.827
RMSEA	0.143
TLI	0.861
CFI	0.892

6. EFT



GOF Index	Result
Chi-Square (χ2)	6.969
χ^2/df	1.394
GFI	0.988
RMSEA	0.042
TLI	0.992
CFI	0.996

Appendix F: Fitness of constrained and unconstrained measurement models

GOF Index	Constrained measurement model	Unconstrained measurement model
Chi-Square (χ2)	310.3	289.8
χ^2/df	1.231	1.207
GFI	0.913	0.919
RMSEA	0.024	0.026
TLI	0.971	0.981
CFI	0.981	0.985