PRE-SERVICE TEACHERS' TPACK AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS IN MALAYSIA AND NEW ZEALAND

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Table of Contents

List of Figures

List of Tables

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Abstract

Information and communication technologies (ICT) are common in schools worldwide in the 21st century, in both developed and developing countries. A number of initiatives have been made in the development of ICT related training in Initial Teacher Education (ITE) programmes. These initiatives aim to develop future teachers' ability to teach and deliver the school curriculum, including using ICT in the classroom. Sufficient field experience is essential since the process of undergoing such placements would prepare them in creating new ideas and implementing strategic ways as to how they can effectively incorporate the use of ICT in their lesson plan, class management, and in teaching.

The key research question in this study is "Do pre-service teachers in a New Zealand and a Malaysian ITE programme use their field experience to develop their potential to integrate ICT in schools and, what are the similarities and differences between these case studies?" Effective use of ICT in teaching and learning requires the teacher to understand how ICT weaves with pedagogy and content. The Technological, Pedagogical Content Knowledge (TPACK) theoretical framework introduced by Mishra and Koehler (2006) clarifies the need to understand and develop TPACK to inform integration of ICT in teaching.

This research provides two case studies of ICT in ITE in the Asia Pacific region, one in a developed country, New Zealand, and the other in a developing country, namely Malaysia. Both case studies are of ICT in an ITE programme with a particular focus on field experience in secondary schools, within which there are embedded cases of ITE students. This study illustrates how pre-service teachers' experience and development of ICT knowledge and skill and their understanding of TPACK can support an increase in their teaching competencies. This research provides evidence that field experience is important to support pre-service teachers to develop their teaching competencies with ICT and understanding of TPACK in

ways that are transferable into their own practice. This study has also contributed to increased reliability and validity of TPACK instrumentation. The comparative findings of the New Zealand and Malaysian case studies indicate the importance of a range of contextual factors, which suggest that the Initial Teacher Education programme, school curriculum and ICT availability as well as student maturity contribute to the development of TPACK.

CHAPTER 1: INTRODUCTION

1.1 Overview

Information Communication Technology (ICT) has become an increasingly important issue in the field of initial teacher education since ICT was first introduced in the UK about 1980s (Davis, 1992). How to adequately prepare pre-service teachers to effectively use ICT in teaching remains a challenging issue for initial teacher education (Law, 2010; Kirschner & Selinger, 2003; UNESCO, 2002; UNESCO Bangkok 2014; McDougall, 2008). Davis' entry in the most recent edition of the International Encyclopedia of Education summarised the terminology and the field at that time, noting that ICT in initial teacher education (ITE) was better known as technology in preservice teacher education in North America whereas ICT initial teacher training (ITT) was the terminology that had evolved in the UK. In Malaysia Information Technology (IT) in ITT is mainly the term adopted when English is used. The terminology in New Zealand is ICT in ITE and that will be adopted for this thesis. These differences in terminology provide an indication of the influence of culture and context on education, including ICT in ITE. Research into ICT in ITE is presented in this thesis through the comparison of a case study of ICT in ITE programme that prepares teachers for secondary schools in New Zealand and a case study of ICT in ITE programme that prepares teachers for secondary schools in Malaysia.

There are five major strategies that have been commonly implemented in order to integrate ICT in the teaching and learning process during ITE programmes: 1) stand-alone technology course; 2) workshops; 3) integrating ICT in method and foundation courses; 4) modeling how to use ICT; 5) early field experience and a later practicum in schools that include ICT (Davis, 2010).

Cultural diversity and languages of a nation and region provide interesting perspectives in cross-cultural studies (Wubbels, 2010). Cultural differences and

languages influence how student teachers use and think about learning with ICT (Chin, Chang & Bauer, 2000; Bing & Ai-Ping, 2008).

New Zealand and Malaysia are both modern countries that have well-developed information technology infrastructure and wide application of ICT in most sectors, as well as society in general (Brown, Chamberlain & Shouler, 2003; Hashim, 2003). New Zealand may be seen as an example of a developed country with a high GDP, whereas Malaysia with a lower GDP may be recognised as a developing country. Additonal contrasts include the cultural diversity within both countries particularly language, beliefs, and practices, which influence wide differences in school practice and policy. For example, while English is a languge common to both countries, the English language dominates other languages in New Zealand; where as in Malaysia English language becomes as a second language as Malay language is predominantly used among Malaysians. The use of ICT in teaching continues to increase in New Zealand (Johnson, Hedditch & Yin, 2011) and in most Malaysian schools (Alazam, Bakar, Hamzah & Asmiran, 2012).

Reviews of research into ICT in education, including those in ITE, tend to provide a dominant view, most often North American or European with little critique of the relevance of the research for other contexts, languages and cultures. Even Davis' review of ICT in USA ITE that took an international perspective to identify factors sustaining good practice did not consider implications for developing countries (Davis, 2003). This then is the problem that this research addresses through two separate case studies of ICT in ITE followed by comparative analysis: one programme in New Zeland and one programme in Malaysia with a particular focus on the influence of the student teachers' experiences in secondary schools in the same country as the programme.

1.2   My Professional Journey

The focus on this topic was stimulated by my professional journey. Teaching courses on Educational Technology in university department providing teacher education was very challenging when I started teaching in Malaysia as a teacher

educator in 2003. I taught teachers, both in-service and student teachers, four stand-alone technology courses: Development of Graphics and Animation in Education; Development of Audio Video in Education; Development of Courseware; and Developing Web-based Instruction. For the first semester of teaching in 2003, I delivered the course the same way that I had been taught. I was from an Information Technology background and I had learnt ICT skills and knowledge from stand-alone courses offered by the Information Technology Department, so I assumed that this was the way to teach similar ICT knowledge and skills to student teachers. I was not alone in that assumption. Lim, Chai and Churchill (2011), who are ICT teacher educators in Hong Kong, noted that most ITE programmes offer ICT as standalone courses and they also recognised that this does not train teachers in how to teach in a technologically mediated class. I had learned ICT knowledge and skills without having a model of ICT integration in the classroom. In additon, I did not have experience of teaching in schools and that added to my difficulties in planning how best to offer ICT in the ITE courses that I led.

I also supervised 10 students for their first field experience in schools in Malaysia (a course described as 'school orientation plan'). This first field experience provided student teachers with experience by observing in the classroom context in a school. I also supervised student teachers on their second field experience in a Malaysian school, duing which each student must become responsible for a class to show that they are ready to become a teacher after they graduate. For example, in May 2008, I supervised four pre-service teachers at two different schools as each did their second and final field experience in a secondary school. One pre-service teacher had been placed in a school without adequate ICT resources. The other three pre-service teachers had support and ICT resources to help and assist them during their field experience. Experiences observing and supervising students such as these led me to question how pre-service teachers would be able to develop their knowledge and skills in teaching, particularly in relation to ICT. Later, I found that even when, or after, they had been equipped with the ICT knowledge and skills, they rarely developed the confidence to integrate ICT into their future classroom.

In 2007, I along with a senior colleague conducted some preliminary research on the topic of this thesis, before I began my PhD studies (Nordin & Awang Hashim, 2008). The 30-item questionnaire was distributed to the 196 final year students of Bachelor of Education at a university in Malaysia. The participants were asked to rate their knowledge in using multimedia technologies, perceived ease of use and perceived usefulness of using multimedia in classroom instruction. The questionnaire was adapted from Karim et al., (2004) and F.Davis (1989) respectively. The findings from that study conducted to investigate ITE student teachers' readiness to use ICT, particularly multimedia technology, in their classroom instruction revealed that these students had the intention to integrate ICT, but whether they did use ICT in their future teaching remained questionable.

Coming from this background, I identified that there is an issue in preparing pre-service teachers with necessary knowledge and skills in order for them to effectively integrate ICT into classrooms. Throughout the duration of the ITE programme pre-service teachers have learned about their subject matter/content knowledge, and were introduced to several strategies for delivering that content. In addition, pre-service teachers have been exposed to ICT that can assist them in their teaching and learning. Therefore, pre-service teachers have been exposed to ICT, pedagogy and content knowledge to enable them to deliver their instruction in a meaningful way. However, I recognised that directly teaching ICT during ITE does not ensure the effectiveness of ICT integration in classrooms.

Looking from my present perspective in 2014 I realise that, as an academic, my doctoral studies have allowed me to study more about this issue. One of the reasons for pursuing a PhD is to gain knowledge where I can study more about my passion and interest to learn new things when doing research. Planning for a PhD was a major shift in my mindset and a drive that brought me to this stage in this academic area. PhD journey has contributed more valuable experience in solving problems, finding relevant information, working independently and sometimes as a member of a team, communicating, working collaboratively with supervisors and managing time effectively. I chose New Zealand for a few reasons. The expertise that I was

looking for was in New Zealand and a scholarship available for academicians to further study in New Zealand. Furthermore, a good reputation of New Zealand educational setting contributes to the selection of research context. This is continuing and can be recognised by the New Zealand Ministry of Education's intention to pilot postgraduate ITE, which was preceded by two white papers (Aitken, Sinnema & Meyer, 2013; Timperley, 2013).

In 2009 at the start of my PhD I knew little of New Zealand ITE and eagerly embraced the opportunity to increase my expertise and experience of ICT in ITE by beginning my research with observations of teaching on campus and in New Zealand secondary schools. These experiences were disrupted by an earthquake occured in 2010 and 2011 and the following recovery. Abei-Arthur and Davis (2014 In Press) briefly describe ways in which e-learning has supported the College's resilience in the series of earthquakes that disrupted education in the region for three years. However, it should be noted that the secondary programme researched here did not include a flexible learning option and has continued to be a campus based programme, as has the Malaysian ITE programme. Therefore, teaching through ICT is not an aspect that is researched or reported here.

1.3   The Problem to be investigated in this Study

Most countries, both developed and developing, are facing the challenging issue of producing quality teachers in the 21st century (Townsend & Bates, 2007; Timperley 2012). the development of quality teachers is the key to quality education since the effectiveness of the teachers is related to the quality of students graduating from primary and secondary schools (Harris & Sass, 2011). Governments invest in ICT resources for schools and formulate policies that regulate ITE with the expectation that teachers will be prepared for current modern learning environments (Davis 2014; UNESCO 2002, UNESCO Bangkok, 2013). As schools are increasingly provided with ICT, teachers need to be prepared for their teaching to effectively integrate ICT in schools (Al-Weher & Abu-Jaber, 2007). In light of the increasing availability of ICT, preparing future teachers to effectively integrate ICT into classroom instruction is a continuing issue (Doering, Hughes, & Huffman, 2003)

which requires resources, expertise and planning (UNESCO, 2002) to assist and guide pre-service teachers to accommodate themselves in schools. Use of ICT in ITE plays an important role in the integration of ICT in their teaching (Davis, 2010).

However, it appears that student teachers are not ready to use ICT in education and to effectively integrate ICT into classroom instruction (Kay, 2006; Yildirim, 2000). This could be due to lack of exposure to ICT integration in ITE programmes (Brown & Warschauer, 2006), lack of acess to ICT in schools and the fear that they are not adequately prepared (Doering, et al., 2003).

Effective use of ICT in teaching and learning requires the teacher to understand how ICT connects with pedagogy and content. Mishra and Koehler (2006) proposed a framework of Technological (ICT), Pedagogical Content Knowledge (TPACK) that clarifies the need to develop the ICT, pedagogy and content knowledge separately and together to effectively integrate ICT in teaching. TPACK was chosen for theroetical framework within this case study research. TPACK has three basic types of knowledge: that is Technological Knowledge (TK), Content Knowledge (CK) and Pedagogical Knowledge (PK). The TPACK model shown in Figure 1.1 clarifies the connection of the three domains for teaching and learning; they are not isolated. This will be expanded in detail in chapter 2.
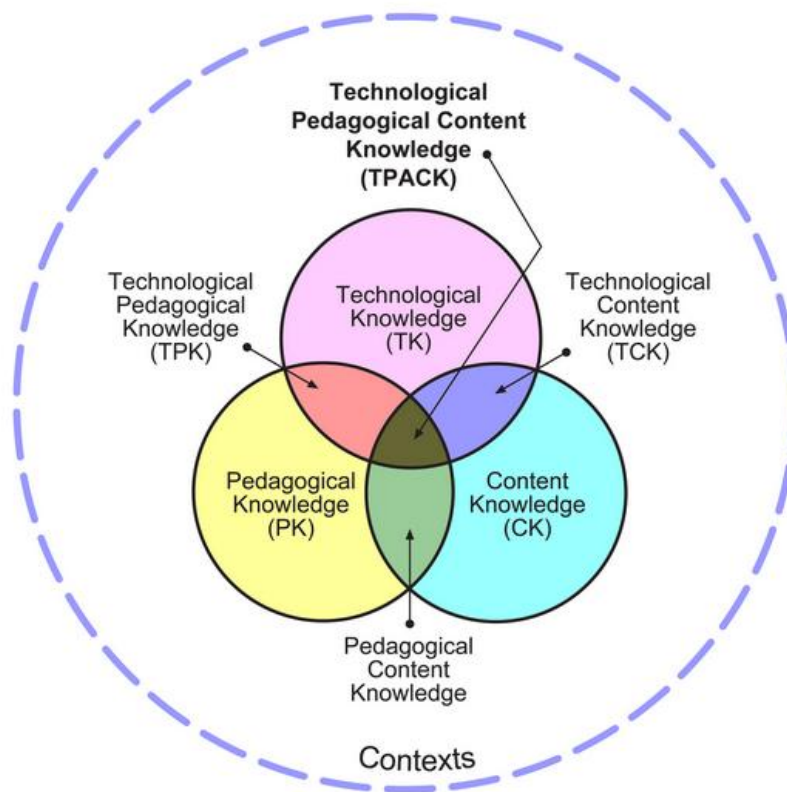
Figure 1.1: Technological Pedagogical Content Knowledge. (Retrieved from www.tpack.org)

A range of research has identified the usefulness of the TPACK framework to inform the provision of in-service teacher education (Grandgenett, 2008; Lee, 2008; Archambault & Crippen, 2009) as well as in ITE (Neiss, 2005; Thompson & Mishra, 2007; Schmidt, et al., 2009; Albion, Jamieson-Proctor & Finger, 2010). Schmidt, et al. (2009) examined pre-service teachers' self-assessment of all the TPACK domains. Although the sample size was small, the survey used was reported as a reliable measure to assess elementary pre-service teachers' TPACK. Albion, Jamieson-Proctor and Finger (2010) developed a different TPACK instrument to measure pre-service teachers' TPACK competence and confidence. They state that their Teaching With ICT Audit Survey (TWictAS) also provides a reliable instrument to measure teachers' TPACK. Therefore it appears that there is some methodological research to be done in relation to the measurement of TPACK.

As described earlier ITE programmes include experience in an ITE institution and in schools. Field experience in ITE programmes is one of the major strategies that can help pre-service teachers to integrate ICT into classroom instruction (Tryon & Schwartz, 2012; Davis, 2010; Pellegrino, Goldman, Bertenthal, & Lawless, 2007). Field experience can help pre-service teachers to increase their level of confidence before starting their teaching career. More importantly, field experience can provide pre-service teachers with the opportunity to transfer the knowledge and skills gained during university studies to the school classroom. It also creates an opportunity for the student teacher to learn how to integrate ICT in their teaching activities, thus helping them to develop professionally (Hixon & So, 2009). The pre-service teachers may be better prepared for using ICT in teaching where they are provided with a 'positive transfer' context (see Perkins & Salomon, 1996). For instance, providing pre-service teachers with good access to ICT during their field experience could enhance their integration of ICT into their future teaching. However, Davis (2010) also acknowledged the challenge to adequately prepare pre-service teachers for teaching with ICT and the difficulty of placing them in a technology-rich classroom.

This study seeks to investigate the experience and development of pre-service teachers' potential to integrate ICT during field experience, as well as the development of their TPACK in order to understand the acquisition and development of ICT, pedagogical and content knowledge.

This research aims to contribute to the field of ICT and teacher education. The objective is to uncover and contrast the phenomenon, with a focus on the transfer of knowledge and skills gained in ITE programmes into schools and also contrasting contexts and cultures. As an ITE teacher educator who teaches courses specifically related to ICT integration (as described in section 1.2), it will also better inform my own practices. Furthermore, this study may also be useful for pre-service teachers to reflect their own experiences with the knowledge they have and to think about suitable and creative ways to integrate ICT into their teaching by

understanding how field experience and development of TPACK could enhance the integration of ICT in teaching.

To date, many studies have been conducted on ICT use in education and on TPACK. However, there have been few studies taking into consideration the differences between countries, and none have been in relation to field experience with ICT in ITE. Even the quick scan study to identify international benchmarks for ICT in ITE led by Kirschner had very little contrast of practices between countries and it was limited to Europe and North America (Kirschner & Selinger, 2003; Kirschner & Davis, 2003). This study investigates commonalities and differences regarding pre-service teachers' experience and development of ICT knowledge and skill, and their understanding of TPACK. The quantitative analysis conducted through the distribution of TPACK questionnaires is complemented with a qualitative approach to gain a better understanding of pre-service teachers' perceptions of their TPACK and ICT knowledge and skill during field experience. The qualitative approach helps to uncover the phenomenon under study with rich data gathered from interviews, classroom observations and documents, supported with statistical tests of significance in the changes with field experience.

1.4   Objectives of the Study

The aim of this study is gain a better understanding of the impact of field experience by comparing the development of TPACK by future teachers situated in two contrasting programmes of initial teacher education with field experience in secondary schools. The contrasts include languages, cultures, educational practices and ICT policies, while similarities include the digital technologies and some aspects of the ITE programmes including field experience in secondary schools and a course on teaching methods.

The main research question in this study is *Do pre-service teachers in a New Zealand and a Malaysian ITE programme use their field experience to develop their potential to integrate ICT in schools and, what are the similarities and*

differences when they are compared? Research sub-questions were also generated to assist the study.

The research sub-questions for the ITE programme in New Zealand and Malaysia were:

1) Does the theoretical TPACK measurement model fit the data collected in each of the two ITE programmes in New Zealand and Malaysia?

2) What are pre-service teachers' perceptions of their own TPACK levels before and after field experience in a school?

3) Are there any significant differences in pre-service teachers' perceptions of all seven domains of TPACK level (TK, CK, PK, PCK, TPK, TCK, and TPACK) before and after completing field experience in a school?

4) What concerns do pre-service teachers have about integration of ICT in schools and do they change with field experience?

5) How do these pre-service teachers develop their TPACK levels and their practice with ICT in schools?

In addition,

6) What are the similarities and contrasts between the students in these two programmes in New Zealand and Malaysia, the structure of the programmes, and the students' field experiences?

1.5 Key Terminologies

Definitions of key terminology used in this study is provided below

- ICT - This study defines ICT as the diverse set of technological tools (hardware) and resources (applications, software) used to communicate, to create, disseminate, store, and manage information. The new digital ICTs are not single technologies but combinations of hardware, software, media, and delivery systems, such as desktop, notebook, and handheld computers; digital cameras; local area networking; the Internet and the World Wide Web; CD-ROMs and DVDs; and applications such as word processors, spreadsheets, tutorials, simulations, electronic mail (email), digital libraries, computer-mediated conferencing, videoconferencing, and virtual reality (Blurton, 1999). According

to Davis (2010), there are four purposes in preparing pre-service teachers to use ICT: 1) Using ICT in the classroom; 2) Using ICT to teach ICT-related content; 3) Using ICT in teacher education programmes; and 4) Teaching and Learning through ICT. ICT is used interchangeably with technology in some countries as well as in this study.

- *ICT Integration*- This research is focussed specifically on how the ICT can be integrated into the processes of teaching and learning. Therefore, within this research, ICT integration refers to the implementation of ICT in teaching and learning. Integration is not only defined by the amount or type of technology used, but by how and why it is used.

- *ITE* – Initial Teacher Education programme that leads to provisional registration as a teacher.

- *Pre-Service Teachers* - In this context of study, pre-service teachers are student teachers who are studying to prepare to become secondary school teachers. In Case Study 1, the context is the Graduate Diploma in Teaching and Learning (Secondary School) at University of Canterbury, New Zealand and in Case Study 2, the Bachelor of Education at Universiti Utara Malaysia, Malaysia.

- *Field Experience* - Field experience is the school-based requirement of the education programmes which provides the opportunity for students to develop skills and gain teaching experience in the school context. Other terms used are teaching practice, in New Zealand, and teaching practicum, in Malaysia.

- *Associate Teacher* - Generally, the role of associate teachers is subject competence so as to provide significant guidance and support to pre-service teachers and partnership for pre-service teachers during their field experience (Haigh & Ward, 2004). In Malaysia, an associate teacher is commonly known as a cooperating teacher. Thus, the terms associate and cooperating teacher are

used interchangeably throughout this thesis to reflect the situation being discussed.

- *Visiting Lecturer* - A visiting lecturer is a university lecturer who is responsible for observing and assessing pre-service teachers during field experience. This term is commonly used in New Zealand and supervising lecturer is the term commonly used in Malaysia.

1.6   Organisation of the thesis

The thesis is largely presented as two separate case studies followed by their comparison: the New Zealand case is always persented first followed by the Malaysian case. One case study of a New Zealand ITE programme with embedded cases of three student teachers' field experiences in New Zealand schools is then contrasted with a case study of a Malaysian ITE programme with seven embedded cases of student teachers' field experiences in Malaysian schools. The case study findings are preceded by a literature review, methodology and findings on the TPACK models.

The remainder of the thesis is organised as follows:

Chapter 2 reviews the relevant literature including a brief overview of research into ICT in schools, previous studies and the TPACK framework relevant to this study. The final section reviews relevant literature on the context for the two case studies, starting with New Zealand. Relevant documents including national policies are reviewed to provide the context for the two case studies starting with a brief overview of the education system, an overview of ICT in education and ITE and ending with the particular ITE programme.

Chapter 3 presents the methodology. The research methods and data collection procedures are described. The chapter also considers issues of research ethics. This is followed by a description of the process of data collection and the procedures used in analysing the data.

Chapter 4 focuses on research question 1: Does the theoretical measurement model in this study fit the data collected in New Zealand and Malaysia? The findings to research question 1 are presented separately, first for New Zealand. The chapter begins with a summary of the TPACK instruments used in previous studies to measure teachers' TPACK. The design and distribution of the TPACK survey in New Zealand is described followed by description of the reliability and validity of that TPACK survey. Further design processes of the TPACK survey for measuring pre-service teachers' TPACK mastery level in Malaysia are then introduced, followed by Malaysian findings for research queston 1. Comparisons between the survey instruments are withheld for discussion until chapter 7 (details in 7.2.8) with further discussion in chapter 8 (details in 8.2.1).

Chapter 5 presents the two sets of findings that answer the research question 2: What are pre-service teachers' perceptions of their own TPACK levels before and after field experience in a school? and question 3: Are there any significant differences in pre-service teachers' perceptions of all seven domains of TPACK level (TK, CK, PK, PCK, TPK, TCK, and TPACK) before and after completing field experience in a school? The New Zealand findings are presented first and followed by the Malaysian findings. This chapter focusses on pre-service teachers' perceptions of their own TPACK levels and differences in pre-service teachers' perceptions of TPACK in their pre- and post- surveys. The cross-case findings of these two research questions are presented and discussed in chapter 7 (details in 7.2.8) and chapter 8 (details in 8.2.1).

Chapter 6 presents a rich description of embedded case studies of selected student teachers. The findings are presented separately, first on student teachers in New Zealand. These embedded case studies centre on the ICT knowledge and skills that the students developed during field experience and the changes in their TPACK within the contexts provided by description of individual backgrounds and the conditions that the student teacher experienced in the schools. The chapter describes the respondents in the context of the three secondary schools. This

chapter discusses the concerns of pre-service teachers about the development of TPACK and the integration of ICT in schools from a qualitative point of view. Comparisons between these in-depth case stories are discussed in chapter 7 (details in 7.3) and chapter 8 (details in 8.2.2).

Chapter 7 presents the rationale for conducting the cross-case analysis by looking at the similarities and differences between the New Zealand and Malaysian ITEs and their national contexts. The similarities and differences of the contextual aspects include educational systems, school curriculum, cultural diversity, ICT policy and practice in education, programmes of Initial Teacher Education (ITE) and ITE curriculum. These similarities and contrasts are then used to provide a frame of reference for interpreting and presenting the comparative findings of the two contexts in a detailed account structured around the research questions.

Chapter 8, the concluding chapter, aims to clarify the originality of the findings of this doctoral thesis along with recommendations that arise, while also identifying limitations. It presents an overview of the current study by describing the purpose, the research design and the original contributions of the study. This chapter provides recommendations for ITE programmes, Ministries of Education, schools and future researchers who are interested in undertaking further studies in this field, including the author who has returned to Malaysia.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter provides a review of literature relevant to the research in this thesis. It begins with key literature on initial teacher education and field experience before a section on ICT in ITE which covers the importance of field experience and support to successfully integrate ICT in teaching. This chapter further discusses the concerns and barriers that can impede successful ICT integration in teaching. Technological Pedagogical Content Knowledge (TPACK) framework in analyzing the link between content, pedagogy, and technology is tackled in detail, starting with its theoretical background, followed by discussion of the importance of the TPACK framework, and ways to accurately and reliably measure pre-service teachers' TPACK. The chapter ends with a review of literature and documenting that sets the scene for the two case studies of ICT in ITE in New Zealand and Malaysia.

2.2 ITE

Preparing pre-service teachers to use ICT in teaching is the best solution to making teaching policies and future plans effective such as those involved with ICT. The development of quality teachers begins with the effectiveness of ITE programmes (Darling-Hammond & Baratz-Snowden, 2005). There is a wide range in the structure of teacher education programmes. Generally, the ITE programmes consist of two main components, namely, university-based courses and field-based components with the aims of developing pre-service teachers (Boz & Boz, 2006) (see section 7.2.7 for details of ITE programmes in New Zealand and Malaysia).

Teacher education programmes should not only focus on what student teachers need to learn, but also on how pre-service teachers learn (Darling-Hammond & Baratz-Snowden, 2005). For example, a study by Darling-Hammond (2006) examining seven exemplary teacher education programmes which included public and private, undergraduate and graduate, large and small programmes found seven common features of exemplary ITE programmes in the United States including:

- A common, clear vision of good teaching that permeates all coursework and clinical experiences, creating a coherent set of learning experiences;
- Well-defined standards of professional practice and performance that are used to guide and evaluate coursework and clinical work;
- A strong core curriculum taught in the context of practice and grounded in knowledge of child and adolescent development and learning, an understanding of social and cultural contexts, curriculum, assessment, and subject matter pedagogy;
- Extended clinical experiences – at least 30 weeks of supervised practicum and student teaching opportunities in each programme that are carefully chosen to support the ideas presented in simultaneous, closely interwoven coursework;
- Extensive use of case methods, teacher research, performance assessment, and portfolio evaluation that apply learning to real problems of practice;
- Explicit strategies to help students to confront their own deep-seated beliefs and assumptions about learning and students and to learn about the experiences of people different from themselves; and
- Strong relationships, common knowledge, and shared beliefs among school and university-based faculty jointly engaged in transforming teaching, schooling, and teacher education (Darling-Hammond & Baratz-Snowden, 2005).

However, there are still questions on how much and what kind of preparation pre-service teachers need in order to be prepared for their teaching (Al-Weher & Abu-Jaber, 2007). Furthermore, pre-service teachers are expected to learn more during their ITE if they have a 'positive' and 'near learning transfer' (Perkins & Salomon, 1996). 'Positive learning transfer' occurs when learning in one context improves performance in some other context, while 'near transfer' refers to transfer between similar contexts. Lind and Wansbrough (2009) produced a synthesis of literature to address the requirements of New Zealand Initial Teacher Education programmes which include aspects of practicum, mentoring and collaboration. They also emphasized subject knowledge and pedagogical aspects but the importance of ICT use during field experience was overlooked.

2.2.1Field Experience in ITE

Based on the theory of constructivist learning, students can increase their knowledge and skills by being able to build on their existing knowledge with 'hands on' learning experiences (Moore, 2003, p. 33). Therefore, pre-service teachers should not only be able to build on their existing learning experiences during field experience but also add more to their overall learning experience occasionally including content knowledge. Other benefits associated with field experiences include: 1) exposing pre-service teachers to participation in cooperative learning; 2) opening new opportunities for pre-service teachers to learn from other professional teachers who are experts in the use of technology in teaching; 3) increasing pre-service teachers' exposure to opportunities to make important teaching and learning decisions; and 4) allowing pre-service teachers to gain more access to technological tools which can be used in teaching (Doering, Hughes, & Huffman, 2003). Likewise, field experience is equally important in terms of creating a positive attitude among teachers who are required to make use of technology in teaching (Bahr et al., 2004). After investigating the gap between the confidence level of pre-service teachers and their knowledge and skills in integrating technology inside the class, Pope, Hare and Howard (2005) found that the confidence level of pre-service teachers is most likely to increase as their knowledge and skills in integrating the use of certain technologies in teaching increases.

According to Darling-Hammond and Baratz-Snowden (2005), a successful field experience has the following characteristics:

- Clarity of goals, including the use of standards guiding the performances and practices to be developed;
- Modelling of good practices by more expert teachers in which teachers make their thinking visible;
- Frequent opportunities for practice with continuous formative feedback and coaching;
- Multiple opportunities to relate classroom work to university coursework;
- Graduated responsibility for all aspects of classroom teaching; and

- Structured opportunities to reflect on practice with an eye toward improving it.

Gaining pre-service field experience is another way of preparing pre-service teachers to teach in schools. Basically, the term "field experience" is often used interchangeably with other terms such as: "classroom observation", "practice teaching", and/or "student teaching" (Hunt, 1995, p. 37). It means that field experience is gained through real-life exposure to teaching a large group of students inside or outside the vicinity of a classroom. During the field experience, pre-service teachers are provided with a hands-on opportunity to put what they have learned into classroom instruction (Darling-Hammond & Baratz-Snowden, 2005; Smith & Lev-Ari, 2005). For this reason, gaining sufficient field experience is very important since the process of undergoing such placements would prepare them in creating new ideas and implementing strategic ways as to how they can effectively incorporate the use of ICT in their lesson plan, class management, and in teaching (Doering, Hughes, & Huffman, 2003).

Smith and Lev-Ari (2005) conducted a study with students in a four-year teacher education programme in one of the largest teacher education colleges in Israel which examined the value of the practical component of their education, including the roles of people in the teacher education institution and in the context of the practicum (school). They reported that students considered the practicum the most significant part in the preparation for teaching; and the mentor at school was found to be the most highly valued support and resource for the student teacher. Furthermore, the findings showed that student teachers seek and find support from their peers. This indicates the advantage of having groups of student teachers in schools instead of individual students (Smith & Lev-Ari, 2005).

In the Malaysian context, quite a number of studies have been conducted to understand the dilemma faced by pre-service teachers during their teaching practices. Ong et al. (2004), for example, identified that challenges faced during the practicum include supervision and heavy non-teaching workloads. Pre-service

teachers encountered problems with both their supervisors and cooperating teachers because they were not able to communicate with both of them due to heavy workloads (Md Yunos, et.al, 2010). Furthermore, Kabilan and Izzaham (2008) found three main challenges faced by a Malaysian English Language teacher during teaching practice which include mixed ability class, use of mother tongue and expectations of teacher centredness. A more recent study by Goh and Matthew (2011), employing reflective journal writing, identified four different types of concerns which include classroom management and student discipline, institutional and personal adjustments, classroom teaching and student learning.

2.2.2 Support during ITE field experience

Utilizing good support during field experience is crucial in meeting the need for the development of prospective teachers. A number of studies have identified the associate teacher as the most significant influence on the development of pre-service teachers during field experience (Killian, & Wilkins, 2009; Haigh &Ward, 2004; Koerner, Rust, & Baumgartner, 2002). Killian and Wilkins (2009) recommend that selection of associate teachers includes sufficient teaching experience and successful supervision of prior pre-service teachers. Others have recommended selecting cooperating teachers on the basis of practices that are collaborative and congruent with the university supervisor and consistent with the teacher education model (Koerner, Rust, & Baumgartner, 2002; Timperley, Black, Rubie, Stavert & Taylor-Patel, 2000). Furthermore, it is important to establish a close coordination of course work and field experiences, as well as shared responsibility between campus- and school-based teacher educators for the preparation of student teachers (Killian, & Wilkins, 2009). Killian and Wilkins further suggest that pre-service teachers who were placed with highly effective teachers gained more confidence in teaching. In addition, there is a strong need to establish a partnership with a good level of understanding and cooperation between ITE, the school and the pre-service teachers during field experience (Carpenter & Blance, 2007). Pungur (2007) also shares a similar view of the importance of mentoring and partnership during pre-service teachers' field experience. In that respect, based on the analysis of three ITE programmes from the United States, Canada and Hong Kong, Pungur suggests a hybrid model which emphasizes the

responsibilities of the mentor teacher, two supervising lecturers with one from the specializing curriculum area and one from the pedagogy area (or one supervising lecturer with a combination of both) and a school coordinator. Palmer (1998) stated that good teachers "must be truly present in the classroom, deeply engaged with their students and their subject, and able to weave an intricate web of connections" so that pre-service teachers and students could benefit more from the collaboration/partnership.

Pre-service teachers can receive adequate support and added knowledge from their associate teacher, advisor or cooperating teacher during field experience (Rozelle & Wilson, 2012; Seferoglu, 2000; Duquette, 1994). However, after investigating the effectiveness of cooperative teachers' supervision in field experience, Haciomeroglu (2013) found that "cooperative teachers as a supervisor seemed to be deficient for interacting with student teachers as well as assisting them to develop critical point of views in teaching". Furthermore, the continuous practice and exposure to the use of teaching technologies is the best solution in terms of increasing pre-service teachers' knowledge, skills, and self-confidence in the use of more advanced technologies in teaching (Zhou & Zhang, 2011; Markauskaite, 2007; Bahr et al., 2004; Doering, Hughes, & Huffman, 2003).

In the process of engaging in collaborative work, reflection, and inquiry, pre-service teachers will have more opportunity to learn from the professional experiences of each teacher particularly when it comes to ways in which they can effectively integrate the use of ICT in the school curriculum (Henderson et al., 2013). In other words, collaborative work, reflection, and inquiry can somehow bridge the gap between the old and new teaching strategies. Therefore, by gaining hands-on experiences, pre-service teachers can further develop and enhance their existing knowledge specifically with regards to content, pedagogy, and the use of technology (Bransford, Darling-Hammond & LePage, 2005).

2.3 ICT in ITE

Information Communication Technology (ICT) has become an increasingly important issue in the field of initial teacher education since ICT was first introduced in the UK about 1980s (Davis, 1992). However, how to adequately prepare pre-service teachers to effectively use ICT in teaching remains a challenging issue for initial teacher education (Law, 2010; Kirschner & Davis, 2003; Kirschner & Selinger, 2003; UNESCO, 2002; UNESCO Bangkok 2014; McDougall, 2008).

There are many ways to prepare pre-service teachers to use ICT effectively inside and outside the classroom environment (Peytcheva-Forsyth & Yovkova, 2012; McPherson et al., 2011; Michael & Miller, 2011; Brush &Saye, 2009; Doering, Hughes, & Huffman, 2003). For instance, to prepare pre-service teachers to use ICT inside the classroom, exposing this group of learners to the positive effects of establishing collaborative relationships among teachers is important since this particular strategy will allow pre-service teachers to continuously exert an effort to work in collaboration with other teachers and pre-service teachers (Michael & Miller, 2011; Kluth & Straut, 2003). Several studies suggest that pre-service and in-service teachers should continuously receive proper training when it comes to the practice of integrating ICT in teaching (Markauskaite, 2007; Batane, 2004; Mitchem, Wells, & Wells, 2003). Aside from completing an Initial Teacher Education programme, this group of learners should also take courses or lectures on technology leadership, single or multiple technology courses, complete mini-workshops on the proper integration of ICT in teaching and the school curriculum before they start teaching in schools (Zhou & Zhang, 2011; Gao et al., 2010). In most cases, undergoing a single technology course is not enough to prepare pre-service teachers to teach using various technologies (Kay, 2006; Moursund & Bielefeldt, 1999). Because of the risks of pre-service teachers suffering from lack of competency and self-confidence about teaching in schools using various technologies (Russell et al., 2003), the practice of collaborative work, reflection, and inquiry should be combined with the completion of an Initial Teacher Education programme, other courses and mini-workshops related to technology

leadership and strategies which can be used in ICT integration in teaching and the school curriculum (Zhou & Zhang, 2011; Gao et al., 2010; Markauskaite, 2007; Batane, 2004; Mitchem, Wells, & Wells, 2003).

It is also noted that there are quite a lot of factors that can positively or negatively affect pre-service teachers' preparedness in the use of ICT in teaching. Among these factors are: 1) eagerness of pre-service teachers to use ICT in teaching (Wang, 2002; Galanouli & McNair, 2001); 2) easy access to basic computer skills training (Gill & Dalgarno, 2008; Rainer, Laosethakul, & Astone, 2003), 3) access to ICT (Markauskaite, 2006); and 4) maintaining collaboration between and among faculty members (i.e. associate teacher, advisor or cooperating teacher), pre-service teachers, and schools (Aderibigbe, 2011; Sim, 2010; Davies & Dunnill, 2008).

In New Zealand, Hope (2001) distributed a questionnaire at the beginning of the ICT-oriented coursework to assess pre-service teachers' prior knowledge about ICT. The pre-service teachers were either in their second or final year or in a one-year graduate programme. The finding showed that pre-service teachers were not confident to use ICT. Furthermore, pre-service teachers should also be prepared with technology skills in teaching (Hope, 2001). Fook, Sidhu, Md Shah and Abdul Aziz (2011) reported that Teaching English as Second Language (TESL) pre-service teachers had positive attitudes towards the integration of ICT in the ESL classroom. The study involved 70 pre-service teachers in their final semester at a public university in Malaysia. They had completed 12 weeks of practicum teaching in secondary schools and attended two basic computing courses (Computer in Education and Computer Assisted Language Learning and Teaching). The findings also showed that pre-service teachers perceived that courses related to ICT offered during their undergraduate programme are sufficient in providing relevant knowledge and information with regards to the implementation and integration of ICT in the classroom, however, most of the participants perceived themselves at the intermediate competency level when it comes to their ability in using ICT effectively and they revealed that they did not use computers in their teaching frequently. This is in line with the findings of Abdul Razak and Embi (2004) which

reported that ESL teachers in Malaysian secondary schools perceived themselves as not competent to use ICT in their language teaching. In a large scale questionnaire, the majority of them felt that they have not acquired the new skills, especially those related to the use of online teaching and learning.

According to Davis' (2010) overview, the five major strategies that have been commonly implemented in order to integrate ICT in the teaching and learning process during ITE programmes are: 1) stand-alone technology course; 2) workshops; 3) integrating ICT in method and foundation courses; 4) modeling how to use ICT; 5) early field experience and a later practicum in schools that include ICT. These strategies may be combined and ICT may also be adopted as a mode of study (e.g. online and blended learning). Davis also noted that some ITE programmes do not integrate the ICT, instead only offering strategies that aim to develop the student teachers' ICT skills and knowledge of technologies, without clarifiying the ways that those skills and ICT knowledge may be effectively applied to enhance student learning in schools. ITE programmes vary enormously within and between countries (Darling-Hammond & Baratz-Snowden, 2005; Kane, 2005), which is to say that ICT practices in ITE vary even more between contexts (Kirschner & Davis, 2003; Law & Plomp, 2003).

Davis's (2010) international encyclopedia entry also briefly described three applications of ICT to address "common challenges in preservice teacher education: digital images, electronic portfolios, and distance education including telementoring" (p. 219). Other ways to prepare pre-service teachers include to provide a mentor in the ITE programme (Jane, 2007), the use of educational simulation software within course activities (Peytcheva-Forsyth & Yovkova, 2012; McPherson et al., 2011), and the use of interactive video conferencing (Kent, 2007). Specifically the study of McPherson et al. (2011) compared the differences between the use of a web-based simulated classroom (simSchool) with a face-to-face training session with the opportunity to watch online videos among the pre-service teachers and in-service special education students. The study found that pre-service teachers and in-service special education students who were active in

participating in the teaching simulation course and other related computer games were able to get higher scores compared to those students who only received face-to-face training sessions and watched online videos. The pre-service teachers may also make full use of interactive video conferencing for those planning online or distance learning options (Kent, 2007). Brush and Saye (2009) explained that interactive activities such as role-playing, thinking-out-loud, and video conferencing are among the few most effective strategies when it comes to developing pre-service teachers' knowledge and skills.

2.3.1 ICT in ITE Field experiences

Several studies have reported the importance of providing a technology-rich environment for pre-service teachers during field experience (Dawson, 2006; Niess, 2005; Damon, Steven, Briant, Valerie & Linda, 2004; Brush, et al., 2003). A study of technology enhanced field experiences by Dawson (2006) with 30 elementary pre-service teachers showed that pre-service teachers had developed their confidence in using ICT for teaching. This finding also aligned with that of Brush et al. (2003) which found that most of the participants in the study had the confidence to integrate ICT in their teaching. The level of pre-service teachers' use of ICT was categorized at Level 2 or 3, which means that they are able to use ICT to "provide in-depth coverage of content, and [emphasize] higher-level thinking" (Dawson, 2006). However, limited ICT resources contribute to the minimal use of ICT during field experience. Furthermore, the failure to integrate technology during field experiences was not influenced by the complexity of the context only, but also the challenge of knowledge transfer (Dawson & Dana, 2007) and the associate teacher's skill and knowledge of ICT integration in teaching (Niess, 2005).

A study by Niess (2005) with 22 student teachers in a 1-year teacher preparation program at the graduate level focused on the preparation of science and mathematics teachers to integrate technology. The student teachers were also provided with the Technology and Pedagogy course in planning for teaching a sequence of lessons that integrate ICT prior to the field experience. It is noted that placing pre-service teachers in a well-equipped ICT environment during field

experience was a challenge, and that efforts were made so that the student teachers were provided with well-equipped ICT facilities during their field experience. The findings showed that the majority of student teachers who participated had made varying degrees of progress in the development of TPACK. This despite lack of associate teacher's skill and knowledge of ICTintegration in teaching, and the need for student teachers to practise to enhance their knowledge and skills to integrate ICT in teaching.

2.4   Concerns about ICT Integration in Schools

Despite the huge investment in professional development training programmes, the purchase of ICT equipment, and the establishment of ICT infrastructure, ICT integration in schools is limited (Buabeng-Andoh, 2012). There are barriers and concerns being faced by most teachers (in-service and pre-service) during the period of integrating ICT in teaching.

In a more complex teaching and learning environment, the benefits of ICT integration in education are highly dependent on school teachers' and staffs' ability to embed ICT (Davis, 2008). Several studies reported that ICT adoption and integration in schools is limited (Buabeng-Andoh, 2012; Wright, 2010; O'Dwyer, Carey, & Kleiman, 2007). One of the most common challenges that can impede the success rate of ICT integration is the readiness of students to learn using a wide range of ICT (Wright, 2010; O'Dwyer, Carey, & Kleiman, 2007). Likewise, the commitment and knowledge of school teachers when it comes to the use of ICT in teaching can also affect the success rate of ICT integration (Keengwe, Onchwari, & Wachira, 2008; Gulbahar, 2007; Hew & Brush, 2007; Mishra & Koehler, 2006). It is apparent that not all school teachers are knowledgeable when it comes to maximizing the use of ICT (Lisowski, Lisowski, &Nicolia, 2006). Therefore, the availability of technical support and training to school teachers is very important (Md Yunus, 2007).

ICT integration in schools is a very complex matter. To be able to successfully integrate ICT in schools, it is important to integrate ICT not only inside the

classroom but also with the course curriculum, the library, the school management, and other related educational settings such as online courses (Goktas, Yildirim, & Yildirim, 2009). Unfortunately, not all school teachers are able to effectively integrate ICT in teaching. One of the main concerns with regards to ICT integration in the classroom is the attitude of teachers when it comes to the use of technology in teaching instructions (Bingimlas, 2009; Lisowski, Lisowski, & Nicolia, 2006). Other possible barriers that can cause failure in ICT integration in education include: the absence of in-service training, lack of support and guidance coming from the associate teacher or cooperating teacher during the field experience, and no access to necessary ICT such as software, hardware, and other related tools and equipment (Buabeng-Andoh, 2012; Afshari et al., 2009; Md Yunus, 2007; Bingimlas, 2009; Goktas, Yildirim, & Yildirim, 2009; Balanskat et al., 2006; Lisowski, Lisowski, & Nicolia, 2006). In the case of some schools in rural areas or in developing countries, poverty and issues related to the availability of substantial financial resources can be a serious problem when it comes to gaining access to a wide-range of ICT resources (Khan, Hasan, & Clement, 2012; Afshari et al., 2009; Lisowski, Lisowski, & Nicolia, 2006). In short, barriers preventing a successful ICT implementation in school can be summarized as "attitudinal barriers", "skill barriers", and "technology barriers" (Lisowski, Lisowski, & Nicolia, 2006, p. 75).

It is possible for school teachers to develop a negative attitude when it comes to the use of ICT in teaching because of their lack of self-confidence, competence, and access to necessary ICT resources such as up-to-date hardware and software, access to high speed Internet, and so on (Khan, Hasan, & Clement, 2012; Salehi & Salehi, 2012; Bingimlas, 2009). It is also possible that the students themselves have problems with regards to the required skills that will allow them to "access, process, and use information" that are made available through the use of ICTs (Salehi & Salehi, 2012, p. 8). Several studies mentioned that problems related to the adequacy of time, technical support, availability of necessary professional development, unreliable ICT tools and equipment, and access to necessary ICT equipment are all classified as "extrinsic barriers" or "meso barriers"; whereas problems related to lack of self-confidence, personal beliefs about the use of ICT in

teaching, self-efficacy, negative attitude and beliefs, and resistance to change are all classified as "intrinsic barriers" or "micro barriers" (Salehi & Salehi, 2012; Afshari et al., 2009; Bingimlas, 2009; Balanskat et al., 2006; Ertmer, Ottenbreit-Leftwich, & York, 2006-2007, p. 55; Ertmer, 1999, pp. 51-52). Several studies explained that due to the "shortage of teachers", most of the currently employed teachers are already overloaded with work (Khan, Hasan, & Clement, 2012). For this reason, most school teachers will have no time to create a new strategy on how they can effectively incorporate the use of ICT with the course curriculum (Khan, Hasan, & Clement, 2012; Afshari et al., 2009). Another possible barrier to a successful integration of ICT is the limited time allowed in class (Salehi & Salehi, 2012).

In some studies, internal or intrinsic barriers are classified as the "second order" whereas external or extrinsic barriers are classified as the "first order" (Khan, Hasan, & Clement, 2012; Keengwe et al., 2008; Snoeyink & Ertmer, 2001; Ertmer, 1999). In line with this, Khan, Hasan and Clement (2012) explained that the second order barriers are mostly school- and teacher-related factors such as the organizational norms and culture with regards to the use of ICT in teaching and beliefs with regards to their openness to embrace organizational change. In other words, barriers to an effective ICT integration in schools can also occur due to the negligence of either the school or the teacher (BECTA, 2004). In line with this, the research findings of Buabeng-Andoh (2012) strongly suggest that barriers to the successful adoption and integration of ICT in schools are not limited to problems or issues related to "teacher-level" and "school-level" but also some "system-level factors".

To increase the hands-on experiences, skills, and competencies of pre-service teachers in the use of ICT in teaching, related courses and training should be made readily available in order to prepare them to use ICT in their chosen career (Goktas, Yildirim, & Yildirim, 2009). In other words, technical support, adequate time, and professional development programmes should be extended to teachers in order to increase the levels of their self-confidence and competency in the use of ICT in

teaching (Bingimlas, 2009). Unfortunately, several studies mentioned that not all pre-service teachers are able to take courses or training programmes that are sufficient to increase their knowledge, skills, and competencies in the use of ICT in teaching (Goktas, Yildirim, & Yildirim, 2009; Bullock, 2004). This further explains why some pre-service teachers can be reluctant about trying to integrate ICT in teaching.

There are several reasons why pre-service teachers could feel less confident when instructed to use ICT in teaching. Limitations in teachers' ICT knowledge and skills could somehow make them feel uneasy or anxious about the use of ICT tools when teaching a large group of students (Bingimlas, 2009; Albirini, 2006; Balanskat et al., 2006; BECTA, 2004). It is also possible that schools where the pre-service teachers completed their teaching practice did not provide the pre-service teachers with access to a wide range of ICT tools; nor were they given enough technical support during their professional development training (Bingimlas, 2009; Earle, 2002).

Research indicated that the integration of ICT requires teachers to acquire knowledge of ICT (technology), content, pedagogy and the intersection of those (Mishra & Koehler, 2005; Schmidt, et. al., 2009; Archambault & Crippen, 2009; Lux, Bangert & Whittier, 2011). Therefore, it may be valuable to understand pre-service teachers' perception of their TPACK knowledge and skill as a way to estimate how well they are prepared to effectively integrate ICT in their teaching.

2.5 The TPACK Framework

The TPACK framework clarifies the complexity of teaching with ICT. Pre-service teachers are being prepared to continue throughout their career to improve the effectiveness of their teaching methods, to learn more about the use of ICT, to increase their knowledge of certain subject matter, and to know how their students think and learn (Alayyar, Fisser, & Voogt, 2012). The framework shows the interaction of knowledge about how to teach, what to teach, and how to do so with the use of ICT. In a technology-enhanced learning environment, pre-service

teachers are expected to become creative. For instance, the act of combining the use of "online lectures" and "classroom discussion", or requiring their students to submit their own "wikis" or "videos" in order to increase the students' engagement in learning (Wankel & Blessinger, 2013, p. 82). As a standard practice, pre-service teachers should first be able to understand the linkages between "technological knowledge", "pedagogical knowledge", and "content knowledge" before they can become creative in the use of ICT in schools (Mishra & Koehler, 2006). Therefore, closely examining the theory behind the TPACK framework is important.

Technological Pedagogical Content Knowledge (TPACK) framework shown in figure 1.1 was selected as a useful theoretical framework for this research. This framework (TPACK) was presented by Mishra and Koehler (2006) and was derived from Shulman's Pedagogical Content Knowledge (PCK) model. According to Shulman (1986), pedagogical content knowledge (PCK) is a "specific category of knowledge which goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge for teaching". As an extension of Shulman's concept of pedagogical content knowledge, the TPACK framework is more complex because the model is composed of seven constructs known as: 1) Technological Knowledge (TK); 2) Content Knowledge (CK); 3) Pedagogical Knowledge (PK); 4) Pedagogical Content Knowledge (PCK); 5) Technological Content Knowledge (TCK); 6) Technological Pedagogical Knowledge (TPK); and 7) Technological Pedagogical Content Knowledge (TPACK) (Baran, Chuang, & Thompson, 2011; Schmidt et al., 2009; Mishra & Koehler, 2006; Koehler & Mishra, 2005; Koehler, Mishra, & Yahya, 2007). The TPACK framework strongly suggests that "there are four or more kinds of interrelated knowledge" in teaching (Mishra & Koehler, 2006, p. 1025). In line with this, the acronym was changed from TPCK to TPACK to emphasize the integrated nature of the components (Thompson & Mishra, 2007). Furthermore, the TPACK model presents an effective way of thinking about integrating technology through the provision of specific knowledge associated with technology integration into the learning environments (Polly & Brantley-Dias, 2009).

2.5.1 Technological Knowledge (TK)

Technological Knowledge (TK) refers to the knowledge of standard and advanced hardware and software including the ability of pre-service teachers to troubleshoot when problems related to technical issues arise (Angeli & Valanides, 2005, p. 294). It means that TK is all about effectively managing and maintaining the condition of high- and low-technologies including ICT such as wireless broadband, dial-up internet connection, creating digital photos and videos, hardware and software programs, and the management of interactive whiteboards, blackboards, etc. (Baran, Chuang, & Thompson, 2011). Aside from the ability of pre-service teachers to adopt the constantly changing technologies, TK can also refer to the best way of optimizing students' learning by being able to accurately identify useful technologies that can be used in teaching (Koehler & Mishra, 2009, 2008; Mishra & Koehler, 2006).

2.5.2 Content Knowledge (CK)

Shulman (1986, p. 9) defined content knowledge (CK) as "the amount and organization of knowledge per se in the mind of the teacher". In other words, CK refers to knowledge of the subject matter which pre-service teachers are expected to learn and eventually to teach their students (Baran, Chuang, & Thompson, 2011). In general, teachers who lack subject matter knowledge are limited in their ability to explain or answer questions that are raised by their students (Nilsson, 2008). To ensure that all teachers are capable of answering each of the students' queries in a more logical and rational way, pre-service teachers should strengthen their knowledge of content.

2.5.3 Pedagogical Knowledge (PK)

Pedagogical knowledge (PK) refers to knowledge that has been gained through collected practices, processes, strategies, procedures, and methods of teaching and learning (Koehler & Mishra, 2005). A good example of PK is classroom management (Mishra & Koehler, 2006). In the absence of PK, it would be very difficult for pre-service teachers to teach inside the classroom (Ng, Nicholas, & Williams, 2010). PK can also pertain to knowledge of educational instructions, skills in classroom management, the use of effective teaching strategies,

development of curriculum and lesson plans, assessment and evaluation methods, and overall student learning (Baran, Chuang, & Thompson, 2011). Therefore, gaining a substantial knowledge of pedagogy is important for teachers because it will enable them to use several approaches in delivering the content to students (Hinostroza et al., 2008).

2.5.4 Pedagogical Content Knowledge (PCK)

Pedagogical Content Knowledge (PCK) pertains to the manner in which the content can be represented and formulated to make it comprehensible to others (Shulman, 1986). Commonly used to improve the outcome of the teaching process, PCK combines or integrates the concept of both knowledge of pedagogy and content (Baran, Chuang, & Thompson, 2011; Mishra & Koehler, 2006). It means that PCK is the knowledge of pedagogy that is applicable to a specific content area (Koehler & Mishra, 2005). In other words, PCK may also include the need to understand the students' preconceptions and misconceptions with regard to a specific content area.

2.5.5 Technological Content Knowledge (TCK)

Technological Content Knowledge (TCK) is basically "an understanding of the manner in which technology and content influence and constrain one another" (Koehler & Mishra, 2009). It is the knowledge of how subject matter can be transformed through the adoption of specific or mixed technologies (Mishra & Koehler, 2006). In other words, using various technologies, TCK is about the knowledge of technology which can be used in representing specific subject matter (Baran, Chuang, & Thompson, 2011).

2.5.6 Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge (TPK) is a clear understanding on how pre-service teachers can effectively apply technology in their teaching approach and practices (Baran, Chuang, & Thompson, 2011). Therefore, TPK is about having the knowledge of how to improve teaching and learning processes when technologies are being fully utilized (Harris, Mishra, & Koehler, 2009; Koehler & Mishra, 2008, p. 17). In some cases, TPK can also address "how pedagogies change while using ICT" (Alayyar, Fisser & Voogt, 2012, p. 1299).

2.5.7 *Technological Pedagogical Content Knowledge (TPACK)*

Specifically, the Technological Pedagogical Content Knowledge (TPACK) arises out of the intersection between the knowledge of content, technology, and pedagogy which can be defined as knowing how to represent subject matter with technology in pedagogically sound ways. Applicable to all pre-service teachers, the process of developing knowledge of technology, pedagogy and content is important to allow them to meet the challenges they will be facing when integrating ICT into classroom instruction. This particular framework strongly suggests that the effectiveness of the pre-service teacher's teaching approach should start with knowing how the content, technology, and pedagogy interplay with one another; the pre-service teacher is expected to comply with the main purpose of each of these three sources of knowledge (Alayyar, Fisser, & Voogt, 2012; Koehler & Mishra, 2009, 2008) in order to enhance teaching with technology (Mishra & Koehler, 2006). According to Koehler and Mishra (2008),

> *TPCK is different from knowledge of all three concepts individually…the basis of effective teaching with technology requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones (p.17-18).*

2.6 The Importance of TPACK in ITE

Effective pre-service teachers are those who know not only the relationship between the content and technology but also the relationship between pedagogy and technology and pedagogy and content (Polly et al., 2010; Koehler, Mishra & Yahya, 2007). Specifically the use of the TPACK framework can create an added value since the structure of this particular model can be used to simplify topics that are not easy for pre-service teachers to understand (Baran, Chuang, & Thompson,

2011; Angeli & Valanides, 2009). Through the use of the TPACK framework, pre-service teachers can increase their competencies by being able to create good educational materials and useful instructional material designs that can utilize both pedagogical knowledge and ICT (Koehler & Mishra, 2009). In other words, the TPACK model can equip pre-service teachers with sufficient knowledge and skills needed to enable them to fully utilize the available ICT tools in teaching (Alayyar, Fisser & Voogt, 2012; Schmidt et al., 2009). This explains why the TPACK framework has been considered as a useful tool whenever there is a strong need to understand how pre-service teachers can integrate technology into teaching and learning (Baran, Chuang, & Thompson, 2011).

The TPACK framework can be used by pre-service teachers to allow them to develop strategies that will be effective for students' learning. For example, during the planning stage, the TPACK framework can be used to enable pre-service teachers to effectively integrate the use of ICT in designing content (Harris, Mishra, & Koehler, 2009). This simply means that pre-service teachers will have to focus first on the lesson content before analyzing how they can effectively integrate the use of technology. In most cases, specific technology will be chosen depending on the type of activity pre-service teachers want to deliver (Harris, Mishra, & Koehler, 2009). In other words, this strategy seeks to consider what is expected that students will do in class during and after the lecture discussion (i.e. question and answer portion, role playing, online games as a homework, etc.). Through the use of the TPACK framework, pre-service teachers can shift from content design to the type of activities that will be conducted in class (Baran, Chuang, & Thompson, 2011). Likewise, the TPACK model can also be utilized by both pre-service teachers and students. As part of the GeoThentic Project in 2008, the TPACK framework was used to allow teachers and students to use geo-spatial technologies when solving multifaceted problems using the online learning environment (Baran, Chuang, & Thompson, 2011). Furthermore, the TPACK model was used throughout the development and assessment stage of the project (Baran, Chuang, & Thompson, 2011; Doering et al.,2009)

There is a huge difference between being able to learn more about the use of technology and being able to integrate the concept of TK, CK, and PK. For instance, the TPACK framework was used by several researchers in Arizona State University to allow them to design and create a faculty development programme (Archambault et al., 2010). According to Archambault et al. (2010), the TPACK framework has been useful in helping them design tools in Web 2.0 such as the social networking system that will empower the faculty members to teach several educational courses. Using ICT tools, the faculty members were able to easily change the pedagogy used in teaching as well as the content within the shortest possible time (Archambault et al., 2010). To improve both pedagogy and content, the TPACK framework enabled them to shift their focus from the use of social networking tools to re-designing the main uses of the social networking tools (Archambault et al., 2010).

As the most suitable model when introducing some technology courses to pre-service teachers, the TPACK framework was also used in Iowa State University (Baran, Chuang, & Thompson, 2011). Using the TPACK framework, Baran, Chuang and Thompson (2011) explained that there was a shift from teaching pre-service teachers about the proper usage of computers and other related ICT to the need to help them design and implement useful content-based lectures using a wide-range of ICT. As a result, the pre-service teachers were able to increase their skills not only in the use of effective technology when designing course-related content and pedagogy (Baran, Chuang, & Thompson, 2011). According to Nelson, Christopher and Mims (2009), teachers who are highly competent in the use of the TPACK framework are the ones who often show higher competency not only in understanding and applying pedagogy, content, and technology in teaching but also their capability in organizing, collaborating, and developing more opportunities for learning. Since the TPACK framework serves as a useful model in enabling pre-service teachers to gain better understanding of the relationship between technology, content, and pedagogy (Angeli & Valanides, 2009, 2005; Koehler & Mishra, 2008, p. 17), the use of this particular framework is important in terms of

increasing the ability of pre-service teachers to successfully adopt the use of technology in teaching.

Several research studies have shown that a positive attitude and having competitive skills are some of the key factors that will encourage pre-service teachers to use ICT in education (Christensen & Knezek, 2008; Niess, 2008; Albirini, 2006). For this reason, the TPACK framework is considered as an important tool because this model was purposely designed to help us understand and identify effective ways in which pre-service teachers' knowledge, skills, and attitude in becoming ICT integrating teachers can increase (Alayyar, Fisser, & Voogt, 2012; Mishra & Koehler, 2006). For example, after examining and comparing the differences between having experts of ICT, pedagogy, and content coach a group of pre-service teachers, and training a group of pre-service teachers with the use of a blended approach such as access to online portals and the opportunity to meet some experts each time they wanted, Alayyar, Fisser and Voogt (2012) found that both techniques are effective in increasing pre-service teachers' attitudes and skills regarding using ICT in teaching. Thus, measuring the TPACK of pre-service teachers is one of the common ways to evaluate or assess their skills in integrating the use of technology in teaching (Schmidt et al., 2009; Sahin, 2011; Lux, Bangert & Whittier, 2011). Therefore, after reviewing the importance of TPACK in teaching, the next section focuses on discussing the different ways of measuring the pre-service teachers' TPACK.

2.7   Measuring TPACK

Several studies have acknowledged the need to develop a more reliable and valid instrument when measuring pre-service teachers' TPACK (Mishra & Koehler, 2006; Schmidt et. al., 2009; Archambault & Crippen, 2009). In line with this, several TPACK surveys that were developed and tested on teachers in the United States were reported to be of high internal reliability (Schmidt et al. 2009; Archambault & Crippen, 2009). Likewise, several studies attempted to validate the TPACK instrument in different contexts of study (Jang & Tsai, 2012; Sahin, 2011; Lee & Tsai, 2010; Koh, Chai & Tsai, 2010; Angeli & Valanides, 2009;

Archambault & Crippen, 2009; Graham et. al., 2009; Schmidt et. al., 2009; Koehler & Mishra, 2005).

In general, there are different ways of measuring the TPACK of pre-service teachers. In most cases, this can be done by conducting self-reporting surveys using pre- and post-surveys or course-specific surveys, the use of a "technology integration assessment rubric", a test-retest method, and performance-based measurements like the individual task-based assessment (Jang & Tsai, 2012; Sahin, 2011; Albion, Jamieson-Proctor & Finger, 2010; Harris, Grandgenett, & Hofer, 2010; Koh, Chai & Tsai, 2010; Lee & Tsai, 2010; Schmidt et al., 2009; Archambault & Crippen, 2009; Koehler & Mishra, 2005). Besides measuring pre-service teachers' knowledge and skills of TPACK quantitatively, it is also possible to use qualitative techniques (Abbitt, 2011; Graham, Burgoyne, & Borup, 2010; Koehler, Mishra, & Yahya, 2007). A good example of qualitative techniques can be done through classroom observations and/or data gathered from a one-on-one interview with the pre-service teachers (Niess, 2007; Niess, Suharwoto, & Lee et al., 2006). It is also possible to observe the ability of the pre-service teachers to create their own lesson plans using various ICT tools in teaching, observe the results of design-based activities, or analyze their ability to reflect on what they have learned after class (Koh & Divaharan, 2011).

Efforts to construct surveys that attempted to measure participants' learning in relation to TPACK began with Koehler and Mishra (2005). They developed a course-specific questionnaire consisting of 14 items to measure 13 Masters students' TPACK development as they worked collaboratively with four faculty members in designing an online course. Although the findings indicated significant changes in participants' knowledge of technology application and TPACK, the items used were highly contextualized to the design of an online course. Several studies were also carried out to examine the development of TPACK in professional development programmes (Graham, et. al., 2009; Guzey & Roehrig, 2009; Jimoyiannis, 2010; Jang, 2010).

Graham et al. (2009), for example, developed a pre-post questionnaire consisting of 31 items to measure TPACK confidence among in-service science teachers. The instrument measured the four technology-related domains within TPACK known as the TPACK, TPK, TCK, and TK. This study involved fifteen in-service teachers who participated in the SciencePlus professional development programme through Brigham Young University. Eleven of the fifteen participants were elementary education teachers and four were secondary education teachers. High reliability of at least 0.90 was reported for the four constructs assessed in the study. They also found significant improvement in each domain after completing the SciencePlus professional development. However, the study was limited to a pilot group of 15 teachers and the technology-related items were specific to Science. Authors also noted that the small sample size in the study did not allow for testing of construct validity.

A number of existing studies have also concentrated on the development of the TPACK model (Angeli & Valanides, 2009; Lee & Tsai, 2010; Jimoyiannis, 2010; Jang & Tsai, 2012, Yurdakul, et. al., 2012). For instance, Angeli and Valanides (2009) considered ICT-TPCK as a strand of TPCK based on knowledge of five domains: ICT, content, pedagogy, learners, and context. Their model is clearly related to Mishra and Koehler's (2006) conceptualization of TPCK with additional elements. An investigation was conducted with 215 first-year and second-year pre-service primary education teachers during the course of three consecutive semesters, spring of 2007, fall of 2007, and spring of 2008. Three forms of assessment known as the "expert assessment", "peer assessment", and "self-assessment" of ICT-TPCK were utilized in two design tasks using a list of criteria for guidance. Eventually, Angeli and Valanides (2009) found that the students' total ICT-TPCK competency was increased significantly between the two tasks. However, Albion, Jamieson-Proctor and Finger (2010) argued that the individual task-based assessment which took a longer period with specific design of activities was not a suitable rapid measure of TPCK for large numbers of teachers.

With regards to measuring teachers' TPACK in terms of World Wide Web use, Lee and Tsai (2010) developed a new 30 item questionnaire, the Technological Pedagogical Content Knowledge-Web (TPCK-Web) based on their TPCK-W framework. The participants in the study were 558 teachers from a selection of schools in Taiwan, ranging from elementary to high school. Researchers used the Web Knowledge (WK) domain in TPCK-W survey in measuring the technology knowledge (TK). The TPCK-W survey consisted of five scales with regards to TPCK-W framework: two scales investigating the teachers' Web knowledge (Web-general and Web-communicative), three scales assessing teachers' Web-Pedagogical Knowledge (WPK), Web-Content Knowledge (WCK), and Web-Pedagogical-Content Knowledge (WPCK). Similarly, in another study, Jang and Tsai (2012) developed an IWB-TPACK survey to examine 614 Taiwanese elementary Mathematics and Science teachers with respect to the use of interactive whiteboard (IWB). The study reported that four factors with 30 items were extracted from eight factors observed in the IWB-TPACK. The four-factor (CK, PCK in the Context, IWB-based TK and TPCK in the Context) IWB-TPACK model was reported to measure the Taiwanese elementary teachers' context better than the original eight-factor model.

In another study, the Technological Pedagogical Science Knowledge (TPASK) was designed for Science teachers' professional development (Jimoyiannis, 2010). The TPASK model was developed based on the TPACK model and the authentic learning approach to enhance Science teachers' representation of TPASK. Six Science teachers were involved in this qualitative case study which concentrated on a general theory module and on ICT in Science education module in the context of the TPASK framework. However, these studies were intended to develop a model based on the TPACK model which involved the specific content knowledge or was limited to the integration of technology knowledge based on a specific technology use.

Building on the TPACK framework, a few studies were conducted to develop a survey measuring teachers' TPACK (Archambault & Crippen, 2009; Schmidt, et.

el., 2009; Sahin, 2011; Lux & Whittier, 2011). Archambault and Crippen (2009) developed a survey consisting of 24 items to assess K-12 online educators' TPACK. The survey was administered with 596 teachers from 25 states in the USA, with an overall response rate of 33%. Alpha reliabilities for the 7 TPACK elements ranged from .77 for Pedagogical Knowledge (3 items), .89 for Technological Knowledge (3 items), .76 for Content Knowledge (3 items), .80 for Pedagogical Content Knowledge (4 items), .70 for Technological Content Knowledge (3 items), .77 for Technological Pedagogy (4 items) and .79 for Technological Content Pedagogy Knowledge (4 items) and there were significant correlations between all domains of TPACK. Revisiting the study to establish construct validity of the instrument used, Archambault and Barnett (2010) reported that three separate factors (pedagogical content, technology-curricular content knowledge and technological knowledge) were extracted which explained 58.2% of the amount of variance through factor analysis using varimax rotation. Further analysis with a Structural Equation Model (SEM) approach was performed to identify how TPACK constructs should be represented in a model (Jones, Adelson & Archambault, 2011). Jones et al. (2011) reported that there were discriminant validity issues when all seven constructs became the latent construct. Thus, they proposed CK and PK as indicators measuring PCK; TK, TCK and TPK as another set of indicators for TPACK and suggested that this model had the best goodness-of-fitness (GOF) with the data in the study. Although the instrument was reported to be reliable and valid, the items were specific to teaching online among in-service teachers and are not suitable for assessment of TPACK in broader educational and technological contexts.

A different set of surveys was developed in order to measure pre-service teachers' TPACK (Schmidt et al., 2009; Sahin, 2011; Lux, Bangert & Whittier, 2011). Schmidt et al. (2009) developed a questionnaire and tested this with pre-service teachers majoring in elementary and early childhood education, focusing on four content areas (Mathematics, Literacy, Science and Social Studies). The initial survey items were partly adapted from other surveys found in the literature and some items were written by the research team. The survey items were then revised

in an iterative process among the research team before being sent out to experts in TPACK for content validity. Three national experts of TPACK in the USA were given the initial pool of 44 items for evaluation and validation. The research team then collaborated to review the comments and suggestions made by the three TPACK experts and produced an instrument consisting of 46 items measuring the TPACK constructs. Participants were 124 pre-service teachers who were enrolled in an Introduction to Instructional Technology course at a large Midwestern University. The early intervention work was carried out, with one researcher in the team redesigning the introductory course using TPACK as an organizing framework. During the intervention course, the participants were required to make a connection between CK, TK and PK in designing a comprehensive lesson plan. The alpha reliability values ranged from 0.75 to 0.92 for the various elements of the TPACK model, suggesting that the instrument was reliable. They found that all domains within the TPACK framework were significantly correlated with TPACK and the highest correlation was between Technological Pedagogical Knowledge and TPACK ($r=.71$). However, the construct validity of the entire instrument was not established as they reported that the sample size was too small to perform a factor analysis. Subsequently, Schmidt et al. (2009) pointed out the need to validate the instrument after pre-service teachers finished their method class and field experience. Therefore, it is valuable to conduct a study that measures pre-service teachers' development of TPACK before, during and after finishing field experience.

In contrast to the findings of Schmidt et al. (2009), Lux, Bangert and Whittier (2011) reported a six-factor model with TCK domain not emerging after the exploratory factor analysis. They developed and validated the Preservice Teacher Technological Pedagogical Content Knowledge (PT-TPACK) instrument with 120 pre-service teachers, the majority of whom had participated in some kind of field experience during their preparation programme. Although, the study did not clearly state whether the pre-service teachers had had TPACK introduced before the survey was administered, it is believed that the six-factor model emerged not only after the method course but also during field experience (Lux, Bangert & Whittier,

2011). Furthermore, the absence of TCK domain in their study was believed to be because the pre-service teachers could not separate the selection of their PK when choosing the technology to be used in teaching (Lux, Bangert & Whittier, 2011). Additionally, to understand and develop TPACK, one needs to concentrate on choosing the appropriate technology within specific topics and pedagogical activities as TPACK is contextualised to specific topics and activities (Cox & Graham, 2009).

Few studies have been conducted outside the USA to measure teachers' TPACK (Lee & Tsai, 2010; Koh, Chai & Tsai, 2010; Sahin, 2011). For example, Koh, Chai and Tsai (2010) revised Schmidt et al.'s (2009) survey to examine 1185 Singaporean pre-service teachers' technological pedagogical content knowledge (TPACK). These teachers were enrolled in the Postgraduate Diploma/Diploma in Education programme at a higher education institute in Singapore. A TPACK survey was administered at the beginning of the semester to capture their baseline TPACK profile before they began any form of ICT instruction during teacher training. The survey was composed of 29 items measured with a seven-point Likert-type scale: (1) strongly disagree; (2) disagree; (3) slightly disagree; (4) neither agree nor disagree; (5) slightly agree; (6) agree; and (7) strongly agree. A seven-point Likert-type scale was used because they argued that the larger the number of options within the range, the more reliable the scale. However, Dawes (2007) indicates that a reliable scale could be a 5- or 7- point Likert type scale. The exploratory factor analysis established construct validity for items of TK and CK. The other items, however, were interpreted as three factors: knowledge of pedagogy (KP), knowledge of teaching with technology (KTT) and knowledge from critical reflection (KCR). Researchers found that the participants were not able to distinguish between their knowledge of general pedagogies and how these were used to teach particular subject areas. Therefore, the items for pedagogical knowledge and pedagogical content knowledge were identified as 'Knowledge of Pedagogy' (KP). The KTT factor consisted of items measuring TPK, TCK and TPACK. The fifth factor 'Knowledge from Critical Reflection' (KCR) was composed of items that were related to the teachers' reflections about technology

integration. The alpha coefficients for these factors indicated highly adequate internal consistency in assessing the pre-service teachers' knowledge of TPACK. Following this, Chai, Koh, Tsai and Tan (2011) suggested the use of more contextualised items, as pointed out by Cox and Graham (2009), in measuring TPACK which yielded a five-factor model which then contributed to a better TPACK structure. Another instrument validation was performed by Chai, Koh and Tsai (2011) and administered with 214 Singaporean pre-service teachers. In order to differentiate between PCK items, and TPK and TCK items, the phrase, "Without using technology …" was inserted into PCK. Furthermore, the instrument was also highly contextualised to the ICT course offered in the programme and used Jonassen et al.'s (2008) meaningful learning framework which emphasized the specific activity. It was reported that the study found a seven-factor model of TPACK.

Sahin (2011) also reported the TPACK survey was reliable and a valid measure to be used with pre-service teachers. The TPACK survey used in Sahin (2011) was developed and validated in five phases, namely, 1) item pool of 60 items then reduced to 47 items after expert evaluation; 2) validity and reliability was assessed with 348 pre-service teachers; 3) discriminant validity was tested with 205 pre-service teachers; 4) test-retest reliability was performed with 76 pre-service teachers; and 5) translation phase involved 84 pre-service teachers to check the validation of the translation from Turkish to English.

The construct validity of the instrument, however, appears to be inconsistent in many studies. Some studies identified all seven domains of the TPACK models. For example, Schmidt et al. (2009) and Lux, Bangert & Whittier (2011) identified a seven- and six-factor model respectively, while others found domains that had been interpreted as a combined domain; Chai, Koh & Tsai (2010) found a four-factor model and Koh, Chai & Tsai (2010) a five-factor model of TPACK. The inconsistent findings of the TPACK structure raise some issues associated with the design of the TPACK instrument and the lack of studies of instrument validation. Thus, there is the need to re-examine the validity and reliability of TPACK in other

contexts. Although studies suggested that TPACK was highly contextualised to the specific topics and activities, the adapted TPACK survey used in this study emphasized a broader ICT context, and was for pre-service teachers, specifically, those who teach in secondary schools. Furthermore, the TPACK questionnaire was previously developed in the USA and has not been tested in a New Zealand and Malaysian education setting. Having said that, although the TPACK survey was still undergoing the refining and validating process (Schmidt et. al., 2009), it is regarded as a reliable indicator to measure pre-service teachers' perceptions of TPACK development using self-rated methodology (Chai, Koh & Tsai, 2010; Abbitt, 2012).

The next section will talk about the importance of preparing the pre-service teachers to deal with the complexity of integrating the use of technologies in teaching. Often times, the transfer of knowledge can be achieved by receiving Initial Teacher Education, exposure to field experience, support from associate teacher/cooperating teacher, access to ICT, and collaboration between ITE and schools.

2.8   The context of the Case Study Research in New Zealand

The following section provides a general overview of the New Zealand and Malaysian Education Systems, National ICT policy and plans, as well as the background of the Initial Teacher Education programmes in New Zealand and Malaysia. Comparative perspectives are discussed further in section 7.2. This information is essential to understand the current ICT use in education in the countries under review.

2.8.1   Overview of the New Zealand Education Systems

The New Zealand education system includes early childhood education, primary, intermediate, secondary schooling and tertiary education (Ministry of Education New Zealand, 2008). The primary schooling starts with Year 1 to Year 8 (ages 5 to 12) then continues at the secondary level from Year 9 to Year 13 (ages 13 to 17). Students in Year 7 and Year 8 may also attend the intermediate schools which provide a transition from primary schooling to secondary schooling. In terms of the

education management system, New Zealand schools have the power and responsibility to personalize and manage the school curriculum which aligns with the National Curriculum in order to ensure teaching and learning are meaningful and beneficial to the learners in their context (Kidman & Stevens, 2011).

2.8.2 ICT Policies and Plans of New Zealand

In general, ICT policies play a significant role in setting goals and vision with regards to the use of ICT in education (Vanderlinde, Van Braak, & Dexter, 2012; Jones, 2003). In some cases, innovation in the use of ICT in education can arise with the support and financial sponsorship of NGOs and other private sector organisations (Avvisati, et al., 2013) and the presence of ICT policies bridges the gap between vision and goals (Bassi, 2011). ICT policies are a "set of principles or a broad course of action that guides the behavior of governments, organizations, corporations, and individuals" (Bassi, 2011, p. 2).

New Zealand's vision is "to improve learner achievement in an innovative education sector, fully connected and supported by the smart use of ICT" (Ministry of Education, 2006, p. 2, 7). In line with this, the goal of New Zealand's ICT framework for education is to make the vision more realistic by informing people about the need to create a "more learner-centred education system", guiding the stakeholders within the educational system on how to make important decisions with regards to the smart use of ICT, increasing the access of the stakeholders to connectivity by reducing the cost of using technology, increasing the confidence-level of the stakeholders through proper training, and emphasising the need to invest more money for the future development of the ICT infrastructure (Ministry of Education, 2006, p. 2). In other words, a significant part of New Zealand's plan is to improve the students' and teachers' access to a wide-range of digital technologies, increasing their literacy and competency when it comes to the use of digital technologies, and eventually promoting the importance and practice of shared resources.

Back in 1998, New Zealand's ICT strategic policy was focused on the need to build more ICT infrastructure and increase local schools' capability to establish or set-up

their own ICT infrastructure within the school vicinity (Ward & Parr, 2011). In 2002, the ICT strategy policy shifted its focus to the need to integrate the use of ICT in the school curriculum and teaching and learning practices (see *Digital Horizons Strategy: Learning through ICT* in Ward & Parr, 2011; Allan, 2007). In 2006, the ICT strategy policies in New Zealand became more focused on the development and implementation of e-learning action plans (see *Enabling the 21st Century Learner: An e-Learning Action Plan for Schools 2006–2010*, 2013).To reach its goal, New Zealand's Ministry of Education plans to work from bottom to top by engaging learners and local schools in the use of different ICT tools that will address the gap between actual practice and the ICT strategies that were developed for this purpose (Ministry of Education New Zealand, 2013).

2.8.3   ICT in Education: New Zealand's Experience

New Zealand is known for having the "highest access to telecommunications per capita" (UNESCO Bangkok, 2013). Due to the low cost of Internet access, a lot of people in New Zealand are able to adopt the use of new technology. As well as basic ICT, the Ministry of Education highly recommends the use of more advanced ICT tools such as Ultra-Fast Broadband (UFB), Virtual Learning Network (VLN), video conferencing (VC) in more than 250 schools nationwide (Dabner, Davis, & Zaka, 2012; Barbour, Davis, & Wenmoth, 2011; Horn & Staker, 2011; Bolstad & Lin, 2009). As part of the virtual learning environment, many local schools in New Zealand took advantage of an open source course management system such as Moodle (Petrova, 2005).

ICT is applied in all phases of education. ICT has been widely promoted in early childhood learning in New Zealand (Bolstad, 2004). For example, some pre-school teachers may encourage parents to make use of an iPad as a way of encouraging the child to actively participate in learning and digital play (Naughton, 2011). At the same time, ICT also plays a crucial role in higher education. Since 2011, tertiary education providers in New Zealand are expected to maximize the use of mobile apps, tablet computing, collaborative environment, and cloud computing which will lead to the use of electronic publishing, digital identity, game-based learning, and personal environment (Johnson, Adams, & Cummins, 2011). Furthermore,the

integration of ICT in education in New Zealand schools and universities has increased and is moving towards 21st century learning environments which include virtual schooling and blended online learning, and aims to implement Ultra-fast Broadband in Schools (UFBiS) and a Network for Learning (N4L) for all schools by 2016 (Davis, 2012). By 2016, tertiary education in New Zealand is expected to make full use of augmented reality, gesture-based computing, the next-generation batteries, and smart objectives (Johnson, Adams, & Cummins, 2011).

Challenges that most school teachers in New Zealand are currently facing include the need to effectively integrate academic content with teaching pedagogy and the use of technology (Otrel-Cass, Khoo & Cowie, 2012), so that professional development has been provided nationwide. The ICT Professional Development (ICT PD) cluster programme which started in 1999 aimed to develop the teachers' confidence and capability in using ICT, increasing their skills and pedagogical understandings of ICT, and integrating ICT effectively within the curriculum (Sahin & Ham, 2010; Ham, 2008, 2009). There have been many evaluations of the various cohorts since then and although differences have been reported in the findings between the various cohorts that participated in the programme, there was a significant improvement in teachers' confidence and capability in using ICT, and their understandings of the use of ICT in teaching and learning.

From 2002, laptops have been provided for secondary school teachers (STELA) followed by the Laptop for Teachers (TELA) scheme, which was staggered to Years 8 and 7 teachers, Years 4 to 6 teachers and finally to Years 1 to 3 teachers (Cowie, et al., 2010; Parr & Ward, 2010; Cowie, et al., 2008). The scheme was initiated to provide schools with laptops for their teachers. Teachers in state and integrated schools could apply for a laptop through their schools. Moreover, schools were expected to manage the integration of laptops into the curriculum, provide the technical support and the additional ICT infrastructure cost, as well as provide the training for teachers (Cowie, et al., 2010; Cowie, et al., 2008). Teachers were encouraged to use ICT and increase their confidence and competence in using ICT for teaching and learning (Parr & Ward, 2010). Evaluations found that

teachers had developed expertise and showed more interest in using ICT (Cowie, et al., 2010; Cowie, et al., 2008). However, at that time, teachers were predominantly using the laptop for lesson preparation, writing reports and other administrative tasks (Cowie, et al., 2010; Cowie, et al., 2008).

2.8.4 Initial Teacher Education (ITE) in New Zealand

Training and development of teachers is one of the major concerns for the improvement of education of the New Zealand government. Colleges and Universities offering initial teacher training are supervised and approved by the Ministry of Education, as is the accreditation of the student teacher educators. Initial Teacher Education qualifications in New Zealand are offered by a variety of providers (Ministry of Education New Zealand, 2008).

2.8.5 Context of the Case Study 1: New Zealand

Case Study 1 focused on field experiences of students in The Graduate Diploma Programme in Teaching and Learning (Secondary) offered by the College of Education, University of Canterbury, New Zealand. In 2011 this programme was offered only on the Christchurch campus for two consecutive academic semesters in one academic year. Pre-service teachers in this programme were required to enrol as full-time students with four major courses: Professional Studies, Major Teaching Studies, Additional Teaching Studies and Education Studies (Graduate Diploma in Teaching and Learning (Secondary) brochure, 2010). In Professional Studies, pre-service teachers learnt about the secondary school student, presentation skills, lesson planning, classroom management, questioning skills, learning theories and teaching strategies. Education Studies provided pre-service teachers with the opportunities to explore issues surrounding the history, sociology, philosophy, politics, cultural contexts, and psychology of education. ICT in education and e-learning were also part of Education Studies. Major Teaching Studies comprised nineteen content areas for pre-service teachers to choose from, plus sixteen content areas under Additional Teaching Studies. For example, content area 1 in Computing and ICT and content area 2 in Mathematics. Prior to starting their field experience, the students were taught about the TPACK framework and

encouraged to use the TPACK framework as they integrated technology into their lesson plans (see McGrath & Morrow, 2009).

Another important component of this programme consisted of 14 weeks of field experience. Field experience is the school-based requirement of the programme and provides the contexts in which students develop skills and gain experience in practical situations. Pre-service teachers had an initial seven weeks of field experience at one secondary school where they were assigned to classrooms in which to teach. During their first placement, the pre-service teachers worked closely with one or two co-operating teachers and the visiting university lecturer. Pre-service teachers were expected to plan, prepare, teach and evaluate part-lessons, progressing to a short sequence of whole lessons. After completing the first phase of field experience, pre-service teachers went back to the University for another ten weeks of classes before the second phase of field experience followed for another seven weeks in a school assigned by the College. Again, the pre-service teachers worked closely with one or more associate teachers and the visiting lecturer. During the second placement in a different school, pre-service teachers were required to take a greater role in planning and teaching a sequence of lessons, building towards teaching a unit of work with at least one class and taking responsibility for class management. The same procedure of assessment was applied in the second field experience. Finally, pre-service teachers were required to complete another five weeks of classes at the University.

2.9   The context of Case Study Research in Malaysia

This research includes two very different contexts for ICT in ITE. Therefore, this section provides an overview of the education systems, as well as ICT policy and plans, in Malaysia.

2.9.1   Overview of the Malaysian Education Systems

The Malaysian education system includes pre-school, primary and secondary schooling (12 to 13 years of formal schooling) and tertiary education (Ministry of Education Malaysia, 2012). There are three types of school in Malaysia: national schools, Chinese national-type schools and Tamil national-type schools. The

primary school level starts at Standard 1 to Standard 6 (ages 7 to 12), and continues to the lower secondary from Form 1 to Form 3 (at age 13 to 15) and upper secondary from Form 4 to Form 5 (at age 16 to 17) in secondary level. Malaysia has a highly centralized system of education with a school curriculum managed with a 'top–down' approach in which each school follows the same curriculum, policies and teaching programmes with an emphasis on high achievement in the examinations.

2.9.2   ICT Policies and Plans of Malaysia

Generally, all countries have their own national policies and plans with regards to the use of ICT in education (see section 2.9.2 for ICT Policies and Plans of New Zealand). Although these policies and plans vary from one another, most discuss what is expected from school teachers and students, and focus on school infrastructure, software development, the importance of ICT training, how to access online contents, how to create curricula for online or distance learning, and so on (Bassi, 2011; Ward & Parr, 2011; Lim, 2010).

Considering the importance of the ICT industry, in January 1997, the Ministry of Education conceptualised the vision of the Malaysian Smart School and the Ministry was made responsible for managing its "Smart School Flagship" (Ministry of Education Malaysia, 1998). Under the Smart School project, about 8,000 schools were to be equipped with computer facilities by the end of the year 2005. By the year 2010, it was projected that about 10,000 primary and secondary schools would have computer facilities. A total of "88 Smart Schools" were selected as model schools particularly to promote best practices when it comes to the use of ICT in teaching (Frost & Sullivan, 2010, pp. 2 – 3). Basically, the Smart School in Malaysia evolved in four different stages known as: 1) Wave 1 – The Pilot (1999-2002) which focused on the implementation of 88 Smart Schools; 2) Wave 2 – The Post-Pilot (2002-2005) which focused on analyzing the lessons learned from the first wave; 3) Wave 3 – Making all Schools Smart (2005-2010) which aimed to extend the use of ICT in other schools; and 4) Wave 4 – Consolidate and Stabilize (2010-2020) which aims to integrate the use of technology in all schools nationwide (Frost & Sullivan, 2010, pp. 11 – 12).

Malaysia's "Vision 2020" aims to become a "fully-developed nation by 2020" (Frost & Sullivan, 2010, p. 14). Specifically the National Policy of Malaysia with regards to the use of ICT in education aims to "leverage the use of ICT as an enabler for education in order to create, promote, and sustain the development of a knowledgeable, innovative, and creative society which ultimately supports the national agenda of attaining a knowledge-based economy" (Frost & Sullivan, 2010, p. 31). To reach its goal, the National IT Council (NITC) created the National IT Agenda (NITA) which serves as a universal framework necessary for transforming Malaysia into a fully developed nation by 2020 (NITC Malaysia, 2013).

2.9.3 ICT in Education: Malaysia's Experience

With the purpose of becoming a well-developed nation in 2020, the Ministry of Education (MOE) in Malaysia requires the implementation and use of a wide range of ICT in local schools nationwide (Ismail, Azizan, & Azman, 2011; Lim & Chai, 2008; Smeets, 2005). Since the use of graphics and multimedia courseware can help increase the quality of teaching and improve interactivity in learning, all of the in-service teachers and pre-service teachers in Malaysia are required to undergo a series of ICT training programmes (Mahmud & Ismail, 2010; Lau & Sim, 2008). Even though school teachers in Malaysia have for long time been required to use ICT in class activities, several studies suggest that not all teachers are able to maximize the use of these technologies in teaching despite its availability in schools (Ismail, Azizan, & Azman, 2011; Mahmud & Ismail, 2010; Eteokleous, 2008; Lau & Sim, 2008). In line with this, several studies also pointed out that age, gender, and lack of experience and knowledge in the use of ICT (Eteokleous, 2008; Yang & Huang, 2008; Tella et al., 2007), having no access to ICT tools such as the Internet or personal computer, projectors, and laptops, the absence of ICT support groups (Slaouti & Barton, 2007; ChanLin et al., 2006), having weak experiences in ICT training, the development of a negative attitude, belief, and perception with regards to the use of ICT, insufficient knowledge and skills in the use of ICT, and the lack of commitment in the use of ICT in teaching (Mahmud & Ismail, 2010; Ertmer, Addison & Lane et al., 1999) are among the common barriers that can impede school teachers from making full use of ICT inside the classroom. In some cases, having low levels of self-confidence with regard to the use of ICT in

teaching, access to the school facilities, access to ICT courses and related training, and resistance to change also serve as barriers to the use of ICT in teaching (Tella et al., 2007; BECTA, 2004).

Most teachers in Malaysia have moderate knowledge and skills when it comes to the use of ICT (Alazam et al., 2012; Mahmud & Ismail, 2010). After exploring the impact of ICT training and experiences on the basic ICT literacy of school teachers in Malaysia, Mahmud and Ismail (2010) conducted a quantitative research survey of 303 teachers who were randomly invited to participate in the study. They found that most of these school teachers in Malaysia had a moderate basic ICT knowledge and skills and that most also have a positive perception with regards to the use of ICT in teaching. In line with this, Md Yunus (2007) also found that teachers had positive attitudes toward ICT use in teaching, however, teachers' low level of access to school computers and lack of competence in using ICT in teaching hindered them from future use of ICT. To determine whether or not all teachers in Malaysia are making full use of ICT in schools, Lau and Sim (2008) conducted a quantitative and qualitative research survey study of 250 secondary school teachers in Mathematics and Science and found that experienced teachers in this country are more eager to make use of ICT in schools.

Additionally, there appears to be a strong correlation between ICT integration inside the classroom and proficiency in the use of ICT rather than demographic factors such as age, educational attainment, gender, or teaching experiences (Alazam et al., 2012). Although male pre-service teachers are more confident as compared to female pre-service teachers, Bakar and Mohamed (2008) revealed that most of the pre-service teachers in Malaysia are confident enough with regards to their ability to integrate the use of ICT in teaching. To further increase the confidence level of school teachers in Malaysia, Ismail, Azizan and Azman (2011) strongly suggest the need to promote ready access to the Internet at home and in school for school teachers.

2.9.4 Initial Teacher Education (ITE) in Malaysia

The training and development of teachers is one of the major concerns for the improvement of education of the Malaysian government. Initial Teacher Education qualifications in Malaysia are offered by a variety of providers (Ministry of Education Malaysia, 2012). As noted above, all pre-service teachers in Malaysia are required to undergo a series of ICT training programmes (Mahmud & Ismail, 2010; Lau & Sim, 2008).

2.9.5 Context of the Case Study 2: Malaysia

The Case Study 2 was of ITE programme at the Division of Educational Studies College of Arts and Sciences at Universiti Utara Malaysia, Malaysia, which offered the Bachelor of Education with Honours for eligible students who had completed their matriculation programme, Malaysian Higher Education Certificate (*Sijil Tinggi Pelajaran Malaysia*), or diploma programme. In 2010 this was a four-year programme designed to produce graduate secondary school teachers majoring in one of the following fields: Business Administration, Accounting, or Information Technology. In addition, students were also required to take professional courses in Education and to choose one other minor area of study such as Teaching English as a Second Language (TESL), Interactive Multimedia, Mathematics, Moral Education, or Bahasa Malaysia. During the four-year programme pre-service teachers were required to enrol in University Core courses with a total of 22 credit hours, a programme core courses with a total of 109 credit hours and an elective course with 3 credit hours. The Programme Core courses consisted of enrichment components, education components, compulsory components and field experience.

Another core component of this programme consisted of three weeks of school orientation plan and ten weeks of field experience. During the school orientation plan, pre-service teachers were required to make an observation of a school setting, the infrastructure available, classroom observation and to produce a report based on their observation. They were not given a class to teach during this three week programme. Prior to their field experience, pre-service teachers had a micro teaching session. They were divided into small groups based on their major subject, in which each pre-service teacher was required to teach their major subject in a

small group and was assessed by the lecturer. They also had teaching method classes for both major and minor subjects in order to prepare them with the pedagogy skills and knowledge and subject-related teaching approach. For the selection of a school placement for teaching practice, pre-service teachers were required to submit the application form of their teaching practice plan to the Educational Studies Department, completing their personal information, school and subjects intended to teach. Then, the forms were submitted to the chosen schools for their feedback and availability of placement for pre-service teachers to complete their field experience. However, there was a problem for pre-service teachers to integrate ICT in their lessons as the Department did not request any ICT availability from the school. During the ten week field experience, pre-service teachers were supervised by a cooperating teacher from the same discipline as the pre-service teacher, and a visiting lecturer. It was expected that the cooperating teacher will observe and guide the pre-service teacher during the ten weeks of field experience. The visiting lecturer also observed the pre-service teacher three to four times to monitor the pre-service teacher's progress closely. Both the cooperating teacher and visiting lecturer were advised to observe the pre-service teacher once or twice together. Pre-service teachers were given the subject to teach based on their application with the maximum of 12 hours of teaching per week. The cooperating teacher provided each pre-service teacher with feedback regarding the strengths and weaknesses observed during his/her teaching lesson and gave suggestions for improvement. After completing a ten-week field experience, the pre-service teachers went back to the University for their final semester to complete the ITE programme.

2.10 Chapter Conclusion

This review of literature has examined a range of literature relevant to the research presented in this thesis. It has also used the research literature and other documents to provide an introduction to the two contexts in which this research was undertaken. In the following chapter, the methodology of this study will be presented in detail, including the strategies for data collection and analysis and the ethical processes.

CHAPTER 3: RESEARCH METHODOLOGY

3.1   Introduction

The present study illustrates the pre-service teachers' experiences of ICT practices in secondary school and the development of their TPACK through field experience. A case study approach was used because this qualitative methodology is ideally suited to obtaining clear descriptions of the phenomenon being studied (Yin, 2009). The purpose of this chapter is to communicate the methodology that was utilised to identify the development and experiences of ICT integration during field experience among pre-service teachers in New Zealand and Malaysia. The research design is explained and several aspects of case study are explored. The trustworthiness of the study, the ethical protection of the participants and a description of the selected instrument are explained. The data collection procedures and the data analysis process are also described.

3.2   Research Design

This is a case study of the phenomenon of field experience used in the preparation of secondary school teachers in the Graduate Diploma in Teaching and Learning at University of Canterbury, New Zealand (Case Study 1) and the Bachelor of Education at Universiti Utara Malaysia, Malaysia (Case Study 2). Because the study sought to provide a rich, thick description of the pre-service teachers' experience and development of ICT knowledge and TPACK level, a multiple case study design (Yin, 2009) or "collective case study" (Stake, 2000, p.437) was conducted. There were three embedded cases in Case Study 1 and seven embedded cases in Case Study 2, each pre-service teacher constituting one case.

Multiple case studies are conducted when a researcher wants to understand the connection between the in-depth analyses of individual cases and the investigation of the broader context of the cases (Stake, 1998; Yin, 1994). Focussing on multiple cases allowed the researcher to explore the general situation of pre-service teachers' experience whilst also recognising the uniqueness of the setting and context of each case. Multiple cases also allow greater opportunity to generalise across several

representations of the phenomenon (Yin, 2009) and to provide greater confidence in the findings (Yin, 2012).

Several researchers have different interpretations of the term case study research. Case study examines "a contemporary phenomenon in depth and within its real-life context" (Yin, 2009) and assumes that examining the context related to the case is fundamental to the understanding of the case (Yin, 2012). Stake (2006) views case study as a study of the experience of real cases enacted in real situations. The chosen case study can consist of a program, an entity, or an individual bounded by time and place (Bogdan & Biklen, 2003; Stake, 2006) and data collection approach (Creswell, 2007). It is argued that case studies lack in rigor and reliability and that they do not address the issue of generalizability in contrast to quantitative methods (Hartley, 1994, p.208). Stake (2006) however argues that case studies are usually "studies of particularization more than generalization" and Yin (2000) states that generalizability can be made either through sampling generalizability or theoretical generalizability. Hence, the intention of this study was to gain in-depth information of each participant in the study. This would allow theoretical generalizability to be made from the data.

3.3 Researcher's Role

To illustrate the researcher's role in a qualitative case study, Merriam (1998) describes the researcher as a primary tool to gather and analyse data. The researcher as 'research instrument' outlines the research design, the collection of data, the analysis and interpretation of the data (Bogdan & Biklen, 2007) because the "researchers bring their own specific background to the study" (Bogdan & Biklen, 2007, p. 55). As described earlier in section 1.5, the researcher in this study is a teacher educator, at the University Utara Malaysia. Hence, the researcher was familiar with the context, able to access documents and the people she required to provide relevant information. The researcher also contributed in revising ICT courses and taught most of the ICT subjects in education courses. Additionally, she had the opportunity of bringing additional data for the project as a teacher educator in the same programme in Malaysia, which makes her a participant-observer. A

researcher who is a participant-observer may assume a variety of roles within a case study and in the events being studied (Yin, 2009, p. 111). According to Yin (2009), a participant-observer could play different types of role. However, the researcher chose not to participate within Case Study 2 in order to avoid being an interruption to the setting due to the nature of the course structure. Since the researcher will play the dual role of participant and researcher, researcher's reflections and perceptions will be included as part of the field notes. However, being part of the research context and playing the dual role of participant and researcher can lead to bias. Thus, to minimize the potential for bias, a series of measures have been taken to ensure the trustworthiness of the study.

3.4   Trustworthiness of the study

In qualitative research, trustworthiness features are based on issues of reliability and validity. Reliability refers to the consistency with which something is measured over time and validity refers to the degree to which something measures what it is designed to measure (Merriam, 1998). Qualitative research addresses the issues of reliability and validity in a way that contrasts with a quantitative approach. According to Denzin and Lincoln (1994), qualitative research should assess the credibility, dependability, conformability and transferability of the findings instead of using reliability and validity which are more relevant in quantitative research (see details in section 4.5.2 and 4.5.3 for reliability and validity in quantitative research). Thus, the researcher discussed the credibility of the findings to measure internal validity, applied the term dependability in place of reliability and used transferability with regards to the external validity (Merriam, 1998).

3.4.1   Credibility

The credibility or internal validity of the study suggests the findings of the study should be accurate and credible from the perspective of the researcher, the participant and the reader (Merriam, 1998). This criterion becomes a key component of the research design (Creswell, 2003); Miles & Huberman, 1994). Therefore, the researcher needs to demonstrate the credibility of the findings in order to be accepted by the reader as valid. To maximise the credibility (internal

validity) of the findings in this study, the researcher employed various strategies (Creswell, 2007), namely, triangulation, member checks, long-term observation and peer validation (Merriam, 1998).

Triangulation. The use of multiple data sources to establish the credibility of the findings (Merriam, 1998; Creswell, 2007; Yin, 2009) was achieved by using data obtained from survey, interviews, classroom observation and documents. These different methods helped to check consistency between what the participants reported in the survey, said in the interviews, performed during classroom observation and described in their lesson plan. For instance, in order to determine the consistency in pre-service teachers' feedback on TPACK understanding gathered from the survey method, the researcher employed methods such as interviews, classroom observation and lesson plans to triangulate and further support the evidence from the survey.

Member checks. Participants' feedback was obtained to validate the accuracy of the recorded information from the interview transcripts and case stories. This strategy involves returning the transcripts and findings of the study to the participants so that they can reflect on the interpretations that the researcher has made in order to protect against researcher's bias (Lincoln & Guba, 1985). If the researcher's interpretation of the meaning of the events has been accepted by the people whose sense-making is under study, the study has achieved interpretive validity (Eisenhart, 2006), in other words, the interpretations of the findings are accurate and credible (Merriam, 1998). In this study, the researcher returned the transcripts and the participants' case stories to the participants and invited them to give feedback on anything they felt did not accurately reflect what was said. This offered them the opportunity to add further information for some aspects that might appear unclear.

Long-term observation. The researcher gathered data over a period of time with repeated observations in order to increase the validity of the findings (Merriam, 1998). In this study, at least two classroom observations were carried out with the

pre-service teachers. Furthermore, most of the interview sessions were conducted during the school period which enabled the researcher to observe the phenomenon and obtain more insights about the context.

Peer validation. The researcher discussed the findings and the interpretation of the findings with academic colleagues in order to ensure that the interpretations were not based on the researcher's needs and her own biases. Furthermore, the researcher discussed researcher's perspective, the data analysis, the coding and the findings with her supervisors so that the interpretations that the researcher made were validated and justified according to the data (Merriam, 1998).

3.4.2 Dependability and Conformability

Reliability in qualitative research is related to the issue of consistency and dependability of the data collected in the study (Lincoln & Guba, 1985). The purpose is to ensure that if a researcher followed the same procedures and conducted the same case study again, the same outcome and conclusion could be achieved (Yin, 2003; Cohen et al., 2000). Reliability in qualitative research involves member checks, long-term observation and triangulation, the same measures used to check the credibility of the findings (Lincoln & Guba, 1985). The data reviewed could also be supported with the research audit trail (Lincoln & Guba, 1985) to make note of the researcher's thinking and reflection, and reporting of the justification for all decisions made during the research process. Maintaining the audit trail, as well as keeping an ongoing reflection using a researcher's journal and memos, field notes and transcripts, also offers the reader an opportunity to assess the conformability of the findings.

3.4.3 Transferability

Transferability refers to the extent to which the phenomenon under study can be transferred to another context (Lincon & Guba, 1985). It is possible to test for transferability in this study by comparing its situation to other situations to see the extent that the interpretation might be applicable in such settings, or at least to help readers in understanding other situations (Yin, 1994). The greater the similarity between the cases, the greater is the degree of transferability. Thus, by providing a

rich, thick description (Merriam, 1998, p. 29) in the report, giving voice to the research participants when reporting findings and describing the findings with enough detail in each case (Creswell, 2007; Lincoln & Guba, 1985), the reader could determine the transferability and external validity of the research outcomes. As suggested by Rubin and Rubin (1995), the researcher outlined in detail the steps taken in the research process, offering the reader a detailed description of the research design, data collection procedure, sampling and data analysis. By being transparent, communicable and coherent, the reader is able to assess what the researcher has done and to apply it to other contexts.

3.5 Data Collection Procedure

There are three main paradigms in educational research: positivist, interpretivist, and pragmatist (Mackenzie & Knipe, 2006). The positivist approach, which is also associated with quantitative research, emphasises empirical means (or objectivity) to create knowledge, while the interpretivist approach, associated with qualitative research, is more subjective and is used to obtain an in-depth understanding of the context from the perspective of participants. A pragmatic paradigm emphasizes all possible approaches that could help the researcher to best answer the research questions. This allows the researcher to employ multiple approaches in data collection and analysis that suit the study (Creswell, 2003).

This study was underpinned by a pragmatic paradigm which employed both the qualitative and quantitative approaches in data collection and analysis to provide opportunities for in depth understanding of the experiences and perceptions of the research participants. This paradigm was congruent with the case study's qualitative methodology and its focus on answering both 'how' and 'why' questions (Creswell, 2003). The data collection and analysis were carried out sequentially with the intention that the interviews would enrich the findings in the survey (Creswell, 2003).

A multiple case studies design was used in this study to provide "rich, thick description" (Merriam, 1998, p. 29), thus, data were gathered from multiple

sources. Simons (2009) states the three qualitative methods often used in case study research are interview, classroom observation and document study. According to Creswell (1998), the selection of research methods and instruments that are used in the process of data collection also establishes the boundaries of the cases chosen. Thus, data for this study were gathered through a questionnaire, interviews and classroom observation. Documents such as lesson plans, visiting lecturer's feedback and researcher's journal were also used in order to triangulate the data gathered from multiple perspectives. These methods were chosen as most appropriate for yielding answers to the research questions. Multiple methods of data collection can strengthen internal validity (Merriam, 1998) or trustworthiness. The three sources of data on pre-service teachers' experience and development of ICT knowledge and TPACK mastery level were also intended to provide a richer description of their field experiences.

3.5.1 Data collection process in New Zealand

The process of collecting data also consisted of obtaining consent from the participants, asking them to complete a pre-survey and post-survey, conducting interviews and observing a classroom session. The University of Canterbury requires ethical approval to be granted before research can be conducted, thus, an ethical application for the research proposal was sent to and approved by the College of Education Ethical Clearance Committee (see Appendix A for ethical approval). Following the ethical approval, the information sheet and consent form were submitted to obtain permission to carry out the research within the Teacher Education Programme. Then, letters including the information sheet and consent forms were distributed to the research participants in the Professional Studies class (see section 3.5.1 for participant selection in New Zealand). The participation criteria were explained to the participants and it was made clear that the participation was voluntary and information given was confidential.

The researcher then started to access the participants (pre-service teachers who volunteered to participate in the follow-up study) at their practicum schools by contacting the school principal. This was appropriate as the researcher expected to interview the pre-service teachers during the school session where the liaison

teacher and the associate teacher also would be involved in the data collection process. The participants were provided with an information sheet (see Appendices D - M) explaining the purpose of the study, what data would be collected, what participation would be involved, use of the findings, consent form, the voluntary nature of participation, privacy and confidentiality of the participants. The consent form explained that participation was voluntary, that the participant might decline or withdraw at any stage without penalty of any kind and could do so without having to provide reasons. The researcher and supervisors' contact information were also provided. The consent form was signed and obtained from each participant. The participants were informed that the interview would be audio recorded and the data would be stored and protected following the requirements outlined by the University of Canterbury.

3.5.2 *Data collection process in Malaysia*

In order to collect data in Malaysia, an application for conducting research was submitted to the Educational Policy Research and Planning Section, Ministry of Education and Economic Planning Unit (EPU), Ministry of Current Affairs. EPU is a Malaysian government agency under the Prime Minister's department that is responsible for pre-approving any research conducted by international institutions in Malaysia. This is part of the requirement for any research conducted in or about Malaysia. The researcher assured the research officer that a copy of the results of the study would be given to the agency, with the intention of providing new insights and understanding about some of the issues facing teacher educators and pre-service teachers. After gaining permission to collect data from the Educational Policy Research and Planning Section, Ministry of Education and Economic Planning Unit, Ministry of Current Affairs (see Appendix C for research approval), the researcher approached the Head of the Department of Educational Studies Division to get consent and cooperation for data collection, and permission to contact individual lecturers in order to discuss the research project and to request their participation. An information sheet and consent form was included, explaining the purpose of the study and strict confidentiality of the data. Pre-service teachers were also made aware that any part of their responses in completing the questionnaire, being observed in a classroom and having an

interview would bear no weight on their final results of the teaching practicum. Next, the researcher sought permission from the school principal to contact individual teachers to request their participation and to meet the pre-service teacher on a regular basis during the school day.

The data collected was treated in a way that protected the confidentiality, anonymity and privacy of the participants in the study so that the collected data did not give negative feedback to them (Bogdan & Biklen, 2007; Kvale, 2009). Although the researcher could not promise their full anonymity due to the small number of participants involved, the researcher used pseudonyms as agreed by each participant (Kvale, 2009) to protect their identity. No information obtained during the study was discussed with people other than the researcher's supervisors. The researcher had a transcriber to help her transcribe the recorded interviews both for Case Study 1 and Case Study 2. However, to ensure what the participants had told the researcher remained confidential, the transcriptionist was not familiar with the research situation and was from a different field. The transcribed audiotapes were stored in a locked cabinet, the consent forms and transcripts were stored separately in a locked filing cabinet at home. Data will be retained for at least five years after which they will be destroyed. The data stored on the researcher's personal computer can be accessed by a password known only to the researcher.

3.6 Sampling

In a case study, 'purposive sampling' (Simons, 2009) is used in order to facilitate in-depth investigation. According to Merriam (1998), "the power of purposeful sampling lies in selecting information-rich cases for in-depth study". Furthermore, the information-rich cases are "those from which one can learn a great deal about issues of central importance to the purpose of the research" (Patton, 1990, p. 169). The purposeful selection of research participants thus represents a key decision in qualitative research. In this case study, the strategy used was maximum variation sampling to represent diverse cases in order to fully display multiple perspectives about the cases (Miles & Huberman, 1994). The focus of the study was within the TPACK framework which consists of technological knowledge (TK), pedagogical

knowledge (PK) and content knowledge (CK). Therefore, the researcher selected the participants who had key roles and who could provide rich information for the area of study (Stake, 2006). The study also involved pre-service teachers undertaking field experience at schools. Hence, the participants involved at the university level were pre-service teachers, university lecturers including ICT lecturers (TK), method course lecturers (PK), the programme coordinator (CK) and field experience coordinator. Participants involved at schools were liaison teachers, associate teachers and visiting lecturers. The sample, however, was a compromise between what was possible and what would have been ideal when dealing with human and real life contexts within a limited timeframe. The following sub-section describes the participant selection in New Zealand and Malaysia.

3.6.1 Participant Selection in New Zealand

The researcher had been given five minutes to present a summary of the research in the Professional Studies class to inform the students of the nature of her study and the data collection process, and to invite them to participate in the study. Following that, the researcher also attended the Professional Studies class throughout the study block to get to know the students and at the same time to show her interest in getting their participation for her study. The researcher believed that gaining access and establishing rapport with the participants so that the participants could provide good data was an important step in the data collection process (Creswell, 1998). The pre-service teachers were informed that the pre-survey would be distributed using Survey Monkey and the link to the survey would be sent to their email address. After access to the participants' email addresses was granted, a total of 112 TPACK questionnaires were distributed electronically using Survey Monkey to the participants in Case Study 1 in New Zealand in 2010. The survey was distributed on the day the pre-service teachers started their field experience. They were given two weeks to complete the survey and a follow-up email was sent to all pre-service teachers after another two weeks to remind them about completing the TPACK survey. However, the return rate was low (21 respondents). Even though actions had been taken to maximize the response rate, there were no further responses. For the post-survey, the researcher sought permission from the lecturer of the Professional and Education Studies class to personally distribute the post-

survey to the same group of participants before the class started. The return rate was increased with a total of 50 respondents. For the follow-up study, the researcher had three pre-service teachers who volunteered to participate in the interview and classroom observations: two from the first group (Cohort 2010) and one from the second group (Cohort 2012) of participants. Details of the three pre-service teachers who participated in the follow-up study are described in section 6.2. However, classroom observation with the first two pre-service teachers (Cohort 2010) could not be conducted as the schools closed due to the Christchurch earthquake in September 2010, thus leaving classroom observation data from one participant only. The second data collection process was conducted in New Zealand due to the small sample size in the first stage of data collection (see details in section 3.6 of how the two groups were formed).

Table 3.1: Profile of New Zealand participants based on gender and major courses

Profile		Cohort 2010 (N=112)	Cohort 2012 (N=122)
Gender			
	Female	66	71
	Male	46	51
Major Courses	Technology	7	5
	Art Education	13	15
	Science Education	20	15
	Language	18	32
	Physical Education	19	27
	Social Studies	27	20
	Mathematics Education	8	8

3.6.2 *Participant Selection in Malaysia*

After getting the permission from the Head of the Department of Educational Studies Division, the researcher sought permission from the lecturer to be present in the class during the micro teaching session. From there, the researcher was able to contact the President of the Educational Studies Student Society, to discuss the distribution of the pre-survey. The pre-survey was distributed during the teaching

practice briefing session, three weeks before teaching practice started. The sample from the Malaysian case study comprises 150 pre-service teachers. The breakdown of the group on the basis of gender, age and major course taken is presented in Table 3.2.

Table 3.2: Profile of Malaysian participants based on gender, age and major courses taken

Profile		Respondents (N)
Gender		
	Female	126
	Male	24
Age		
	22-24	135
	25-28	15
Major Courses		
	ICT	24
	Accounting	25
	Business Management	25
	Moral Education	55
	Counselling	21

For interviews and classroom observations in Malaysia, the selection was also purposeful, designed to maximize the richness of the data. To maximise variation among the chosen sample, the researcher wanted to select at least one pre-service teacher from ICT major, non-ICT major and perceived good and average level of TPACK concepts understanding. There were 24 potential participants for ICT major and 32 for non-ICT major. Taking into consideration the second requirement for participant selection, seven pre-service teachers (3 pre-service teachers with ICT major, 2 pre-service teachers with ICT minor and 2 pre-service teachers with non-ICT major or minor) were identified to participate in the study. All seven pre-service teachers who had been identified through maximum variation sampling strategy were invited to participate in the study. After giving their agreement to participate, the researcher conducted the first interview meeting with each

participant. After the first interview session was completed, the researcher structured the scheduled meeting which consisted of the place and time for the follow-up interview, classroom observation and third interview which were agreed to by all participants. One week before the interview or classroom observation, the researcher contacted the participants to confirm their availability, time and place. The researcher arrived at the interview fifteen to thirty minutes before the interview started, to set up the recording equipment. After the follow-up interview, the participants were informed of their next interview session one day earlier to confirm the interview meeting.

3.7   Data collection timeline

Table 3.3 summarizes the data collection for three embedded case studies in New Zealand which took place in 2010 and 2012. Data gathering was staggered, with distribution of the pre-survey to pre-service teachers before field experience, interviews with three pre-service teachers at school, the classroom observation and the post-survey after field experience was completed (see Table 3.3). Classroom observations for Case Study 1 were initiated during the first week in September 2010, but, because of a major earthquake, the observations could not be done. The researcher gathered data from the first group of pre-service teachers which was comprised of 112 from Cohort 2010 as tabulated in Table 3.3. Due to the small sample size of respondents (specifically for validation of TPACK survey and quantitative analysis), the researcher had to gather more data in August 2012 from the second group of 122 pre-service teachers (Cohort 2012) as shown in Table 3.3. Details of TPACK questionnaire design and distribution are described in section 4.3 and 4.4.

Table 3.3: Data collection timeline in New Zealand

Month	Data Sources	Participants	Location
August 2010 (second stage of data collection)	Pre-survey First Interview	112 pre-service teachers Vanessa Paige	Online Survey Secondary School A Secondary School B
September 2010	Classroom Observation, follow-up Interview	Interrupted and cancelled due to earthquake	
October 2010	Third Interview Post-survey	Vanessa Paige 124 Pre-service teachers	Meeting Room, Library Meeting Room, Library Lecture Room
August 2012 (second stage of data collection)	Pre-survey First Interview	122 Pre-service teachers Melinda	Lecture Room Meeting Room, Library
September 2012	Classroom Observation, follow-up Interview	Melinda	Secondary School C
October 2012	Post-survey Third Interview	Pre-service teachers Melinda	Lecture Room Meeting Room, Library

Table 3.4 illustrates the data collection timeline in 2011 for Case Study 2 in Malaysia. Data collection in Malaysia started in April 2011 with the distribution of the pre-survey to 150 pre-service teachers at Lecture Hall 3 during the teaching practice briefing session. Interviews were conducted with the seven pre-service teachers at different schools as agreed by the participants. Having two classroom observations for all seven participants meant that the classes were observed while the pre-service teachers were teaching on different topics or subjects. The post-survey was distributed in September 2011 to 129 pre-service teachers during their post-teaching practice session. The number of participants was decreased because all 21 pre-service teachers with Counselling Guidance major had completed their degree course and the researcher was not able to contact them.

Table 3.4: Data collection timeline in Malaysia

Month	Data Sources	Participants	Location
April 2011	Pre-survey	150 Pre-service teachers	Lecture Hall 3
May 2011	First interview	Ida Adys & Lynna Ramli, Zaman, Ria & Ayu	Secondary School D Secondary School E Secondary School F
June 2011	Classroom Observation 1	Ida Adys & Lynna Ramli, Zaman, Ria & Ayu	Technology Room Computer Lab Classroom
July 2011	Classroom Observation 2	Ida Adyss & Lynna Ramli, Zaman, Ria & Ayu	Technology Room Computer Lab Computer Room
August 2011	Third interview	Ida Adys & Lynna Ramli, Zaman, Ria & Ayu	Secondary School D Secondary School E Secondary School F
Sept 2011	Post-survey	129 Pre-service teachers	Lecture Room

3.8 Instrumentation

The use of multiple methods and triangulation is critical in attempting to obtain an in-depth understanding of the phenomenon under study (Creswell & Clark, 2011). Therefore, in conducting the multiple methods of data collection, the researcher divided the following section into two phases, namely, Phase 1, the distribution of the TPACK survey and Phase II, the interviews, classroom observations and documents.

3.8.1 Phase 1: Survey

As part of data collection in this research, a questionnaire was administered to measure the pre-service teachers' level of Technological Pedagogical Content Knowledge before starting and after completing field experience. The original TPACK questionnaires by Schmidt et al. (2009) and Archambault and Crippen (2010) were adapted to suit the current context of the study. The decision to use a particular instrument was dependent upon its reliability, validity in previous studies and suitability to be adapted for use among pre-service teachers at secondary school level in New Zealand and Malaysia. The details of the New Zealand and Malaysian TPACK survey design, survey administration and findings are discussed in Chapter 4: Methodological Findings. The descriptive and t-test findings are discussed in Chapter 5: Quantitative Findings.

3.8.2 Phase II: Interview and Classroom Observation

Bogdan and Biklen (2007) describe an interview as "a purposeful conversation usually between two people (but sometimes involving more) that is directed by one in order to get information" (p. 135). An interview is "literally an inter view, an exchange of views between two persons talking about common themes of interest" (Kvale, 2009, p. 2). Kvale (2009) further states that an "interview attempts to understand the world from the subjects' point of view". According to Yin (1994, p.85), "Interviews are an essential source of case study evidence because most case studies are about human affairs". The rationale for using semi-structured interviews was that these offered a systematic opportunity for the collection of qualitative data. The interviewees were given the questions prior to the interview with the purpose of allowing them greater time to be critically reflective of their personal perspectives and practice towards the use of ICT (Brookfield, 1995). Semi-structured interviews are conducted based on an interview guide, include a list of questions and focus on certain topics that have to be covered (Kvale, 2009). The researcher may use a variety of probes like "Tell me more about it" to achieve the objective of a particular topic or interest (Cannell and Kahn, 1968, cited in Bernard and Ryan, 2010).

The interview questions

The researcher developed the interview protocols based on the research questions outlined in section 1.8 and after review of the literature. The development of the interview protocol could increase the reliability of the case study (Yin, 2009). Four interview protocols were developed: one for the pre-service teachers, one for the associate teacher, one for the visiting lecturer and one for the university lecturer. Participants were asked to discuss their roles during their field experience. Pre-service teachers' concerns, their prior knowledge of ICT and understanding of TPACK concepts were discussed with three pre-service teachers in Case Study 1 and seven pre-service teachers in Case Study 2. The interview questions were then field-tested with students enrolled in the Graduate Diploma at the College of Education, University of Canterbury, New Zealand for Case Study 1 and with students enrolled in the Educational Studies programme in Malaysia for Case Study

2. The researcher made some changes in the interview protocols based on feedback from the participants which consisted of clarification and simplification of the questions. In addition to that, the interview protocols were reviewed and tested with a research member in a similar field of study and the researcher's supervisors before using them in the actual interview process. For research participants in Case Study 2, they were not introduced to the TPACK concepts before the field experience started, therefore, the researcher distributed the TPACK notes to all pre-service teachers using a social interaction medium (Facebook). It was also the initiative taken to reach other pre-service teachers from the same year group who were too far away to meet physically during field experience (see Appendix B for second ethical approval). This also presents an interesting aspect of the study as the Malaysian pre-service teachers were not familiar with TPACK unless they read the notes.

The interviews were conducted upon completion of each survey. The potential participants who were identified from the consent forms were subsequently contacted. Ten participants (three in New Zealand and seven in Malaysia) voluntarily expressed their willingness to participate in the follow-up study. The interviews were conducted with ten pre-service teachers in three stages; before, during (follow-up interview) and after field experience. The researcher started the interview session with the questions regarding their background, concerns, prior knowledge to start the teaching practice and their level of understanding of TPACK. The follow-up interview sought to discuss the classroom observation with pre-service teachers. The third interview focussed on their experience and development of their knowledge during field experience. The interviews in Malaysia were conducted in Malay as most of the Malay participants preferred to speak Malay and they could explain certain issues better in their preferred language. Most of the interviews lasted approximately 30-45 minutes. The researcher negotiated the time and place of each interview with each participant. Interviews were conducted during or after the school session and all interviews were recorded on tape to protect all information to be used for analysis (Merriam, 1998).

Classroom Observation

Another source of qualitative data in this study was classroom observation notes. Due to circumstances, the classroom observation could not be done in the New Zealand case study with the two pre-service teachers in the first group (2010). Thus, data from classroom observation notes were gathered from one participant in the second group (2012) who volunteered to participate in the follow-up study. With regards to the data from classroom observation in Malaysia, all seven participants responded positively to the invitation. For each classroom observation, the researcher asked the pre-service teacher to choose a class to be observed with a request that they have at least one ICT subject or the use of ICT in the class. The researcher used the Technology Integration Assessment Instrument (TIAI) observation instrument (Harris, Grandgenett & Hofer, 2010) to record the observation notes during the class period. After each observation, the researcher had a follow-up interview with the pre-service teacher to discuss further the classroom observation. The researcher highlighted important notes to be discussed with the participants and verified the observation notes with them to ensure the accuracy of the data and validate the researcher's perceptions of the observation.

Documents

In addition to the interviews and classroom observations, the researcher collected data from the lesson plan and visiting lecturer's evaluation form to support the main sources of data collection and to provide more description for the participants' case stories.

3.9   Data Analysis Procedures

This section describes the procedures for data analysis in order to answer the research questions. As quantitative and qualitative approaches were used in this study, the analysis of data involved three different phases: 1) Statistical analysis for quantitative survey data; 2) Chronology time-series analysis for qualitative data (Yin, 2009); and 3) Comparative analysis of the two cases (Stake, 2006).

3.9.1 Data analysis procedure in quantitative research

The three research questions which guided the quantitative data analysis were: 1) Does the theoretical TPACK measurement model fit the data collected in each of the two ITE programmes in New Zealand and Malaysia? 2) What are pre-service teachers' perceptions of their own TPACK levels before and after field experience in a school? and 3) Are there any significant differences in pre-service teachers' perceptions of all seven domains of TPACK level (TK, CK, PK, PCK, TPK, TCK, and TPACK) before and after completing field experience in a school? The first research question checked the reliability and validity of each TPACK domain subscale using Cronbach's alpha reliability technique and confirmatory factor analysis (CFA) with SPSS and AMOS version 19.0. Details of reliability and validity test and results are presented in section 4.5 and 4.6 for the New Zealand context, and 4.9 and 4.10 for the Malaysian context. A measure of pre-service teachers'perceptions of TPACK level was determined by calculating a mean score of the items that describe each TPACK domain, rated on a 5-point Likert type scale. For the purpose of measuring the significant differences before and after field experience, a paired-samples t-test was conducted using SPSS version 19.0 with the respondents who participated in both surveys. The findings of these data are presented in Chapter 5: Quantitative Findings. The researcher then continued the data analysis process with the qualitative data: interview, classroom observation notes and researcher's journals.

3.9.2 Data analysis procedure in qualitative research

According to Miles and Huberman (1994), there are "three concurrent flows of activity: data reduction, data display, and conclusion drawing/verification" (p. 21) involved in qualitative data analysis. Bogdan and Biklen (2007), on the other hand, stated that data analysis involves data analysis and data interpretation. For Kvale (2009), to analyse means "to separate something into parts or elements". Case study research provides a rich thick description of the setting or individuals, searching for themes, patterns or issues during data analysis (Stake, 1995). This case study presented a time series of the development and experience of ICT integration among pre-service teachers and their Technological Pedagogical Content Knowledge (TPACK) before, during and after completing field experience (Yin,

2009). According to Yin (2009), case study analysis using chronologies is considered a special form of time-series analysis which is able to trace changes over time. The chronology time-series can be richer and more insightful (Yin, 2009); thus to provide participants' case stories in this study, the researcher assembled the data into a descriptive picture of what occurred, added some researcher's reflection and let the data "speak for themselves" (Neuman, 2003). Following Miles and Huberman's (1994) data analysis procedures, in the following section the researcher presents the three steps involved, namely, data reduction, data display and data verification or conclusion.

Data reduction

The first step in the data reduction process was to organize the available data by school. For example, data from the New Zealand case study with three participants were sorted into three cases (SSA, SSB and SSC). For the Malaysian case study, data from seven participants were arranged into three embedded-cases (SSD, SSE and SSF) to match the schools where participants completed their field experiences. The interview tapes were then transcribed verbatim (Bogdan & Biklen, 2003, 2007; Miles & Huberman, 1994). This process could provide the researcher with an understanding of the participant's context before conducting the follow-up interviews. After completing the interview session, the researcher coded the interview tape and transcriptions accordingly to ensure the anonymity of the participants. After completing transcription of the interview data, the researcher made two copies of each transcription in order to keep the original copy for reference while doing the analysis on the other copy. Then, the researcher began by familiarizing herself with the data to obtain a sense of the overall data. According to Lincoln and Guba (1985), the initial stage of data analysis can be defined as a process of making sense of data. Reading the transcriptions several times and making notes on the information gathered, as well as recording researcher's reflections in the journal was an initial sorting-out process. As the interview transcripts were partially transcribed with the assistance of a trancriber, the researcher had to listen to the audio-tape while reading the interview transcripts to ensure the reliability and the consistency of the transcripts. Listening to the

interview for a sense of the whole involves listening to the entire tapes several times and reading the transcriptions a number of times in order to provide a context (Cohen, Manion & Morrison, 2007). The interview transcripts were forwarded to the participants to check the validity of the transcribing process (Silverman, 2001).

The analysis process continued with a coding process which started by reading through the transcripts with the research objectives in mind (Auerbach & Silverstein, 2003) to get a good feel for the data. Then, the process continued by looking for patterns, themes and assigning coding categories (Creswell, 2003; Miles & Huberman, 1994; Stake, 1995; Yin, 2003; Kvale, 2009). Coding involves "attaching one or more keywords to a text segment" (Kvale, 2009). At first, the researcher started assigning codes that were more precise and meaningful (Miles & Huberman, 1994) to the data by organizing the repeating ideas into themes, organizing the themes and sorting these into several categories based on the research questions. Then, the analysis compared the data from each pre-service teacher in the same case study. The data were reviewed several times until no new relevant categories could be identified and this process is referred to as 'saturating the data' (Lincoln & Guba, 1985).

Cross-case analysis was then conducted to look for similarities and differences between Initial Teacher Education in New Zealand and Malaysia. The cross-case findings were intended to present additional information to enhance readers' understanding of the issues being studied. To analyze multiple cases in the study, as suggested by Yin (2009), cross-case synthesis was conducted, treating each embedded case as a separate case within a larger case. The researcher then looked for similarities and differences between each case and the others following replication logic (Yin, 2009, pp. 53-56) in order to draw the cross-case conclusion about the pre-service teachers' experience and development of ICT integration during field experience guided by the key concepts of the research questions (Stake, 2006).

Data Display

The interpretation phase began when the coding process was completed. For data display, the researcher described four individual case stories, two from each case study, in Chapter 6, which consisted of pre-service teachers' TPACK, concerns towards ICT integration in school and how to develop TPACK and ICT practices. These four case stories were also triangulated with other participants' data within each context to support the findings. Each case is presented based on the analysis of the data before, during and after field experience and structured around the research questions. Each of four participants' case stories is described and presented in a way that would guide the reader to visualize the setting and understand their perspectives, thus, the researcher used quotations from the participants. According to Yin (2007), the analysis process could also be interpreted by writing of a story of the respondents.

For the first part of data display, the researcher presents the methodological findings of the TPACK survey in Chapter 4. Chapter 5 includes the profile of respondents and descriptive statistics. Chapter 6 has a detailed description of the participants' case stories in the New Zealand and Malaysian contexts. There are several ways of presenting the qualitative data (Creswell, 2005). The researcher has chosen to develop and craft profiles or vignettes of individual participants which Miles and Huberman (1994) describe as "a concrete focused story". These are then grouped into categories. Chapter 7 presents the comparative findings observed between the two contexts which are supported with multiple sources of data.

Data Verification

The data analysis process is an iterative cycle; therefore, the researcher would go back and forth across the data to cross-check the coding in order to enhance the validity of the interpretation. Discussion with 'critical friends' and supervisors took place to strengthen the reliability of the data analysis process. The verification of quantitative data was conducted using the reliability and validity analysis (see section 3.8.3 for details). Each case story was completed with a validation process from the participants by returning the story to them to read, and make further

comments if necessary. This could further validate the finding from the data analysis process (see section 3.3 for details).

3.10 Chapter Summary

In this chapter, research procedures, the participant selection process, interview protocol instrument development, data collection procedure, and data analysis have been described. The study involved a qualitative case study approach, using various methods of data collection. A questionnaire, semi-structured interviews and classroom observations formed the methods selected to gather the data. Finally, the researcher has described the measures taken to ensure the reliability and validity of this study. The findings are separately presented in Chapter 4: Methodological Findings of TPACK Survey, Chapter 5: Quantitative Findings, Chapter 6: Participants' Case Stories and Chapter 7: Discussion.

CHAPTER 4: METHODOLOGICAL FINDINGS OF TPACK SURVEY

4.1 Introduction

This chapter presents the development process of the TPACK instrument for measuring pre-service teachers' TPACK levels in New Zealand and Malaysia. The chapter begins with a summary of the TPACK instruments used in previous studies to measure teachers' TPACK. The design and distribution of the TPACK surveys used in this study are discussed, followed by a description of the reliability and validity test of both surveys. The findings to the research question 1: "Does the theoretical TPACK measurement model fit the data collected in each of the two ITE programmes in New Zealand and Malaysia" are presented. The survey development process and findings are presented separately, beginning with the New Zealand TPACK survey.

4.2 TPACK Instruments

The measurement of TPACK was introduced in section 2.7. Measurement of teachers' perceptions of TPACK may be used to estimate preparation for effective integration of ICT in classroom instruction (Mishra, & Koehler, 2006; Schmidt, et al., 2009; Lux, Bangert, & Whittier, 2011). Studies have been conducted to measure teachers' TPACK development (Koehler & Mishra, 2005; Graham, Burgoyne, Cantrell, Smith, St. Clair, & Harris, 2009; Jimoyiannis, 2010; Jang, 2010), in-service teachers' TPACK (Archambault, & Crippen, 2009; Lee & Tsai, 2010; Jang & Tsai, 2012) and pre-service teachers' TPACK (Schmidt, et al., 2009; Lux, Bangert, & Whittier, 2011; Sahin, 2011; Chai, Koh, Tsai & Tan, 2011; Yurdakul, Odabasi, Kilicer, Coklar, Birinci, & Kurt, 2012). However, the majority of the TPACK studies have investigated teachers in the USA (e.g. Schmidt, et al., 2009; Lux, Bangert, & Whittier, 2011) and very few studies have been conducted outside North America, and they include Taiwan (e.g. Jang & Tsai (2012)) and Singapore (Koh, Chai & Tsai (2010)). Before the start of this research there had been no studies of TPACK in New Zealand or Malaysia.

The reliability coefficients of TPACK survey items reported in most studies showed consistency of items measuring TPACK development which indicates good internal reliability. The construct validity of the instrument, however, appeared to be inconsistent in many studies, as discussed previously. Thus, there is the need to re-examine the validity and reliability of TPACK in a broader ICT context and specifically with pre-service teachers, and in this case, those who will teach in secondary schools.

Furthermore, as noted earlier, the TPACK questionnaire was developed in the USA as well as the adaptation for the few studies outside the USA. These informed the adaptation and testing of the TPACK instrument in both a New Zealand and Malaysian teacher education setting, as described later (section 4.3 and 4.7)

The design of the TPACK survey research instruments for this study started in 2009 with cultural adaptations and piloting in New Zealand and in Malaysia in 2010. These took place before a highly relevant national project in Australia namely, Teaching Teachers for the Future (TTF), within which TPACK instrumentation was refined and implemented with large samples of pre-service teachers. While it was not possible for this study to benefit from that extensive development of a new instrument (TTF TPACK survey), it has been possible to inform the findings and discussion with that TTF research. The project and relevant findings are therefore introduced below.

Starting in 2011, the 15 month long Teaching Teachers for the Future (TTF) project was funded by the Australian Government Department of Education to help teachers and school leaders with the ICT integration across curriculum areas of English, Mathematics, Science and History. The TTF project involved 39 Australian Higher Education Institutions (HEI). The TTF site provides digital resources for pre-service teachers, teacher educators and teachers with rich professional learning 'anywhere, anytime' packages (Australian Government Department of Education, 2013). The digital resources were developed to link technology, pedagogy and content knowledge, following the TPACK learning

framework. The project developed a TTF TPACK survey to measure pre-service teachers' perception of their TPACK confidence and perception of usefulness of TPACK to support teachers and students' learning.

Development of TTF TPACK survey was based on a theorised 4-factor structure, comprising scales to measure pre-service teachers' perceptions of confidence with and usefulness of ICT. The TTF TPACK survey was developed based on the TPACK Confidence Survey (TCS) developed by Albion, Jamieson-Proctor and Finger (2010), and TCS was developed based on an earlier instrument to measure ICT integration in the classroom (Jamieson-Proctor, Watson, Finger, Grimbeek, & Burnett, 2007).

The TTF TPACK survey was used to evaluate the changes in pre-service teachers' TPACK as a result of their involvement in the TTF intervention conducted throughout 2011 at 39 Australian HEIs. The survey was administered pre and post-survey in each HEI to seek evidence of changes to the pre-service teachers' perceptions of their confidence to use ICT and to support their future students' learning with ICT. The study also aimed to measure the pre-service teachers' perceptions of usefulness of ICT for teaching and learning. Administered pre-survey online using Qualtrics survey software to all students (N = 12 881) in teacher preparation programs at participating HEIs in May - July 2011 and post-survey in October – November 2011 (N = 5809).

A set of 24 items was developed to measure pre-service teachers' use of ICT in their own teaching in two scales; TPK/TCK Confidence and TPK/TCK Usefulness. For TPACK construct, 20 items for two scales; TPACK Confidence and TPACK Usefulness were extended with four items describing how pre-service teachers might support future school students' use of ICT in the curriculum from the original TPACK Confidence Survey (TCS). The TTF TPACK survey provided seven response categories, coded 0 to 6. The TTF survey was analysed using parametric (SPSS and AMOS) and Rasch analyses. Two sets of EFA were conducted to examine both confidence and usefulness scales for TPK and TCK. All

items loaded on single factors at .4 or higher when two items from TPK/TCK Confidence and two items from TPK/TCK Usefulness scales were removed. All items of TPACK confidence and TPACK usefulness loaded on single factor at .4 or higher when two items from TPACK scales were removed. The pre- and post-test data for four-groups of TTF TPACK survey (TPK/TCK Confidence, TPK/TCK Usefulness, TPACK Confidence and TPACK Usefulness) were further analysed using the Rasch Rating Scale Model and this led to the removal of six items and combining the response categories for three scales.

It may be helpful to contrast the TTF measure with those applied in this research study. The TTF TPACK survey measures two perceptions of pre-service teachers (1) ICT use for future teaching and (2) support of students' learning. These are two of the seven TPACK domains. In contrast, the current study and that of Schmidt et al. measures the perceptions of pre-service teachers in all seven TPACK domains. As discussed later, it appears that the selection of two of the seven domains and the addition of a view on teacher's use and students' learning may improve the measurement of TPACK.

In 2009, when the instruments for this study were being designed, Schmidt et al., (2009) noted that, although the TPACK survey was still undergoing refinement and validation, it was already regarded as a reliable indicator of pre-service teachers' perceptions of TPACK using self-rated methodology (see also, Chai, Koh & Tsai, 2010; Abbitt, 2012). The TPACK survey designed by Schmidt et al. (2009) was selected for the present study and then adapted to the chosen settings. As noted earlier, the TTF TPACK survey had not been developed at that time and it did not influence the design of research instrument used in New Zealand and Malaysia.

4.3   Design of research instrument in New Zealand

4.3.1   Re-design of TPACK Survey

The New Zealand TPACK survey was revised based on the Schmidt et al.'s (2009) TPACK survey. Firstly, all six items from TK were adopted for the New Zealand TPACK survey. For CK domain, two items which measure the CK for the specific

curriculum areas of Mathematics, Social Studies, Science, and Literacy were changed so that they measure the CK of the pre-service teachers' major and minor subjects during teacher training, i.e. ICT (CK1) and Economics (CK2). Therefore, the item "I have sufficient knowledge about social studies" was changed to "I have sufficient knowledge about my subject matter". In addition, the New Zealand TPACK survey also included an item from Archambault and Crippen's (2009) survey, asking about participants' ability to decide on the scope and the sequence of concepts taught. This item was revised to "I can comfortably plan the scope and sequence of concepts that need to be taught within my class".

As with the items for the measurement of CK and TK, the rest of the items for measuring the other domains, i.e., PK, PCK, TCK, PCK, TPK, and TPACK, came from either Schmidt et al. (2009) or Archambault and Crippen (2009), or a combination of both. For example, all five items measuring pre-service teachers' PK were taken from Schmidt et al. (2009), whereas, for PCK and TCK, the items were a combination of those of Archambault and Crippen's (2009) and Schmidt et al.'s (2009). Five items which measure PCK were adapted from Archambault and Crippen (2009) and one item from Schmidt et al. (2009); and, three items which measure TCK were from the former and two items from the latter, respectively. Finally, for the TPK and TPACK domains, all five items for each domain were adapted from Schmidt et al. (2009). However, an item in the TPACK domain "I can teach lessons that appropriately combine mathematics, technologies and teaching approaches" was changed to "I can teach lessons that appropriately combine my subject matter, technologies, and teaching approaches". The final adapted version of the New Zealand TPACK survey consists of 36 items which were used to measure pre-service teachers' perceptions of TPACK in New Zealand with a five-point Likert-type scale: (1) strongly disagree; (2) disagree; (3) neutral; (4) agree and (5) strongly agree. Further details on the instrumentation, which includes number of items and sample items, are provided in Appendix P. In order to complete the re-design stage, the New Zealand TPACK survey was distributed to the pilot group of pre-service teachers to examine the reliability of the instruments.

4.3.2   TPACK Survey Administration for Pilot in New Zealand

A pilot study was administered in August 2010 to examine the reliability of the instruments used in this study. A total of 30 pre-service teachers were selected from a group who were attending their first semester of the Graduate Diploma Programme at College of Education, University of Canterbury. This group of pre-service teachers was selected because they have similar criteria to the target group of pre-service teachers; they were preparing for their first field experience at the time the recruitment process took place. Therefore, this could provide information on the reliability and validity of the instrument for survey. A total of 15 teachers (50.0%) returned the questionnaire and the final data entered for the analysis of the pilot study came from 12 respondents. Three surveys were removed because of incomplete data for almost all subscales. Due to the small number of respondents, the reliability analysis could not be performed (Hertzog, 2008). As such, the researcher decided to proceed with the main data collection and carry out the reliability analysis later (see 4.4).

4.4   Main Study: New Zealand context

As described earlier in section 3.6, a total of 112 TPACK questionnaires were first distributed electronically using Survey Monkey to the participants in New Zealand in 2010. However, the return rate was only 18.8% (21 respondents). At this point, the researcher decided that it would be important to run the reliability test before the next round of data collection for the post-survey. Data from these 21 respondents were combined with those of the respondents in the pilot study (12 respondents), providing enough data for a reliability test of the TPACK instrument used in this study ($\underline{N}$ = 33). Based on the results, the alpha values of all TPACK scales indicated good reliability of the instrument ($\alpha > .60$; Hair et al., 2010).

Table 4.1: Reliability of the TPACK Scales in New Zealand

Subscales	Reliability (α)
Technological Knowledge	.98
Content Knowledge	.99
Pedagogical Knowledge	.98
Pedagogical Content Knowledge	.98
Technological Pedagogical Knowledge	.99
Technological Content Knowledge	.99
Technological Pedagogical Content Knowledge	.98

In order to ensure a better response rate in the post-survey, the researcher sought permission from the lecturer of the Professional and Education Studies class to personally distribute the post-survey before the class started and wait for the students to return it after the class finished. The return rate was increased to 44.6% (50 respondents). After data screening, eight cases were eliminated due to inadequate information answered. This left the final data set of 42 respondents ($\underline{N}$ = 42).

Considering the fact that the sample size was small for the pre- and post-survey, the researcher conducted a second phase of data collection with a second group of pre-service teachers. This group had similar criteria to the first group of pre-service teachers. The second pre-survey was distributed in July 2012 to 122 pre-service teachers in a Professional and Education Studies class. Five minutes introduction was given to explain the study and the need for participation in this study at the end of class. Response rate was 80.6% (100 respondents). Only one case was eliminated due to an unanswered questionnaire leaving the final data set of 99 respondents (N = 99). Therefore, a total of 120 respondents were involved in the pre-survey data analysis which comprised 21 respondents from the first pre-survey and 99 from the second pre-survey.

The second post-survey was distributed in October 2012 to a similar group of 122 pre-service teachers in a Teaching Studies class. The return rate was 87.7% (107 respondents). After data screening, five cases were eliminated due to inadequate information answered, thus the final data set consisted of 102 respondents ($\underline{N}$ =

102). Hence, a total of 144 respondents were gathered; ($\underline{N}$ = 42) from the first post-survey and ($\underline{N}$ = 102) from the second post-survey.

Table 4.2 Distribution of surveys in New Zealand including returned, eliminated and completed surveys

Distribution of surveys	Returned Surveys	Eliminated Surveys	Completed Surveys	Total
Pre-survey				120
First phase of data collection (N = 112)	21	-	21	
Second phase of data collection (N = 122)	100	1	99	
Post-survey				144
First phase of data collection (N = 112)	50	8	42	
Second phase of data collection (N = 122)	107	5	102	

4.4.1   Data screening

Data gathered in New Zealand was screened before further analysis was conducted. According to Tabachnik and Fidell (2007), data screening process involves: 1) checking for accuracy of data input; 2) missing values; and 3) assessing normality and detecting univariate and multivariate outliers.

1)   Accuracy of data input.

Screening for accuracy of data input involved examination of descriptive statistics and graphic representations of the variables. First, examining the univariate descriptive statistics did not show any unusual data. All values for the five-point Likert scale were within range. Results of means and standard deviations were also plausible.

2)   Dealing with missing values

Close observation of the data found that there were only three missing values, involving 2 of 120 cases. Among the cases with missing values, there was only one case with two missing values and one case with one missing value. The

missing values were observed for the items on Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK) domains. The researcher chose to insert a group mean for the missing values; in this case, the mean value for TPK and TPACK were calculated and inserted in place of the missing values. This method of estimation was chosen for the treatment of the missing data because of the very small number of missing values and cases involved (Hair et. al., 2010).

3)   Normality and Outliers

Normality of the data was assessed for the measured variables. Table 4.3 shows that all measured variables in Case Study 1 exhibited normal distributions (skewness and kurtosis were less than +/- 2, Tabachnick & Fidell, 2007). The observation of univariate outliers was done by looking at the z-scores of the measured variables. Any case with a z-score of more than 3.29 indicates a potential outlier (Tabachnick & Fidell, 2007). As for the multivariate outliers, they were detected through the computation of Mahalanobis distance at $p<.001$. Any case with a Mahalanobis distance value greater than the upper critical value of chi-square distribution with 36 degrees of freedom (following the number of measured variables), $\chi2(36, 0.001) = 67.99$, was considered as a multivariate outlier (Tabachnick & Fidell, 2007). A closer observation of the data found none of the cases were identified as multivariate outliers. Following Tabachnick and Fidell (2007), cases with values larger than 1 are a potential problem. From this data, the Maximum value for Cook's Distance is .38, suggesting no major problems.

Table 4.3 Values of skewness and kurtosis for each measured variable

| Measured variables | Skewness | Kurtosis |
	Pre-survey	Pre-survey
TK1	-.55	-.26
TK2	-.26	-.55
TK3	-.19	-.43
TK4	-.69	.78
TK5	-.20	-.37
TK6	-.55	.02
CK1	-.43	.93
CK2	-.08	-.46
CK3	-.10	-.69
CK4	-.48	1.55
CK5	-.42	-.64
PK1	-.76	.53
PK2	-.04	.11
PK3	-.37	.50
PK4	-.31	.48
PK5	-.53	.60
PCK1	-.48	.59
PCK2	.38	1.19
PCK3	-.40	.15
PCK4	.01	.05
PCK5	-.46	.28
TCK1	-.49	.51
TCK2	-.57	.97
TCK3	-.72	1.11
TCK4	-.44	.99
TCK5	-.36	-.06
TPK1	-.16	.04
TPK2	-.40	.42
TPK3	-.91	1.20
TPK4	-.79	1.13
TPK5	-.35	1.14
TPACK1	-.20	.06
TPACK2	.01	-.27
TPACK3	-.72	1.11
TPACK4	-.23	-.33
TPACK5	-.73	1.73

Note: Normality was evident when absolute values of skewness and kurtosis were less than 2.0 (Tabachnick &Fidell, 2007)

4.5   Measuring TPACK in New Zealand: Reliability and Validity

After data screening, the analysis proceeded to the assessment of reliability for internal consistency and validity of the instruments used for measuring the seven domains in the study, namely, Technological Knowledge (TK), Content

Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK) and Technological Pedagogical Content Knowledge (TPACK).

4.5.1 Reliability

Internal consistency refers to the degree to which the different items in a scale measure the same construct (Hair et al., 2010). For the TPACK questionnaire, reliability was assessed by tests of internal consistency of each of the subscales and the overall sum score. Cronbach's alpha coefficients above 0.70 are generally viewed as acceptable (Hair et al., 2010). Findings from the pre-survey analysis showed the internal consistency (Cronbach's alpha values) for each domain ranged from .70 to .87, as presented in Table 4.4. As a general rule of thumb Hair et al. (2010) suggested the values of 0.60 to 0.70 to be the lower limit of acceptability. This suggests that the TPACK survey was reliable and consistent to measure pre-service teachers' knowledge of TPACK in New Zealand.

Table 4.2: Reliability of the TPACK Scales: Case Study in New Zealand

Subscales	Reliability (α)
Technological Knowledge	.87
Pedagogical Knowledge	.76
Content Knowledge	.80
Pedagogical Content Knowledge	.70
Technological Pedagogical Knowledge	.75
Technological Content Knowledge	.85
Technological Pedagogical Content Knowledge	.82

4.5.2 Validity

The researcher proceeded with the confirmatory factor analysis (CFA) of the New Zealand TPACK survey by assessing the fit of the measurement model with the data in the study based on the *apriori* theoretical model. CFA deals specifically with measurement models, that is, the relationships between observed measures or indicators and latent variables or factors (Brown, 2006). First, for model identification: 1) one path is fixed to 1 on each latent variable; 2) there were a minimum of three indicators per latent variable; and 3) the errors of the indicators were independent of each other. Then, all 36 items were analysed using AMOS

19.0, and its parameters were estimated via maximum likelihood procedure. The model was evaluated for goodness of fit using the standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), comparative fit index (CFI), and the Tucker-Lewis index (TLI).

A ratio less than 5:1 may produce unstable results (Kline, 1998), therefore use of more than one fit index (from two different categories) is recommended to evaluate model fit (Hu & Bentler, 1998, 1999). If a model has a "good" fit using more than one category, the model certainly is a well-fitting model (Kim & Bentler, 2006). A good-fitting model is indicated by a non-significant $\chi 2$ ($p > 0.05$). However it is believed that chi-square tests are sensitive to sample size, producing a significant result when large sample sizes are involved (Bentler, 1995). In addition, the chi-square statistic is widely recognized to be biased with small sample sizes (Jackson, 2003; MacCallum, Widaman, Preacher, & Hong, 2001). Due to these problems, the ratio of the $\chi 2$ to degrees of freedom ($\chi 2 /df$) less than 3 was suggested to indicate a good-fitting model (Chin& Todd, 1995) with several other fit indices, SRMR, TLI, CFI and RMSEA. The Standardized Root Mean SquareResidual (SRMR) was represented as the average discrepancy between the correlations observed and the correlations predicted by the model (Brown, 2006). SRMR value ranges between 0.0 and 1.0, however, values of .08 or less are desired (Hu & Bentler, 1999). The Tucker Lewis fit index (TLI), an incremental fit measure, with a value of 0.9 or more indicates a good fit (Hair, et al. 1998). Comparative Fit Index (CFI) values greater than .90 support acceptable model fit (Bentler, 1990). The Root Mean Square Error of Approximation (RMSEA) measures the mean discrepancy between the population estimates from the model and the observed sample values. RMSEA values of .08 or less indicate adequate model fit (Brown & Cudeck, 1993). Another aspect of model evaluation involves the parameters estimated as greater than the absolute value of 1.96 significant at $p < .05$ ($t > 1.96$, $p < .05$), and the interpretability or strength of the parameter estimates (i.e., absence ofHeywood cases and no negative variances).

4.6 Findings: Does the theoretical TPACK measurement model fit the data collected in the ITE programme in New Zealand?

The results for the measurement model as shown in figure 4.1 suggested that the seven-factor model fits the data reasonably well, $\chi^2/df = 1.633$ ($\chi^2 = 935.654$, df= 573) and p = .000, TLI = .79, CFI = .81, RMSEA = .073 (.064 - .081) and SRMR = .08. Fit indices suggest an acceptable model fit (Brown, 2006).
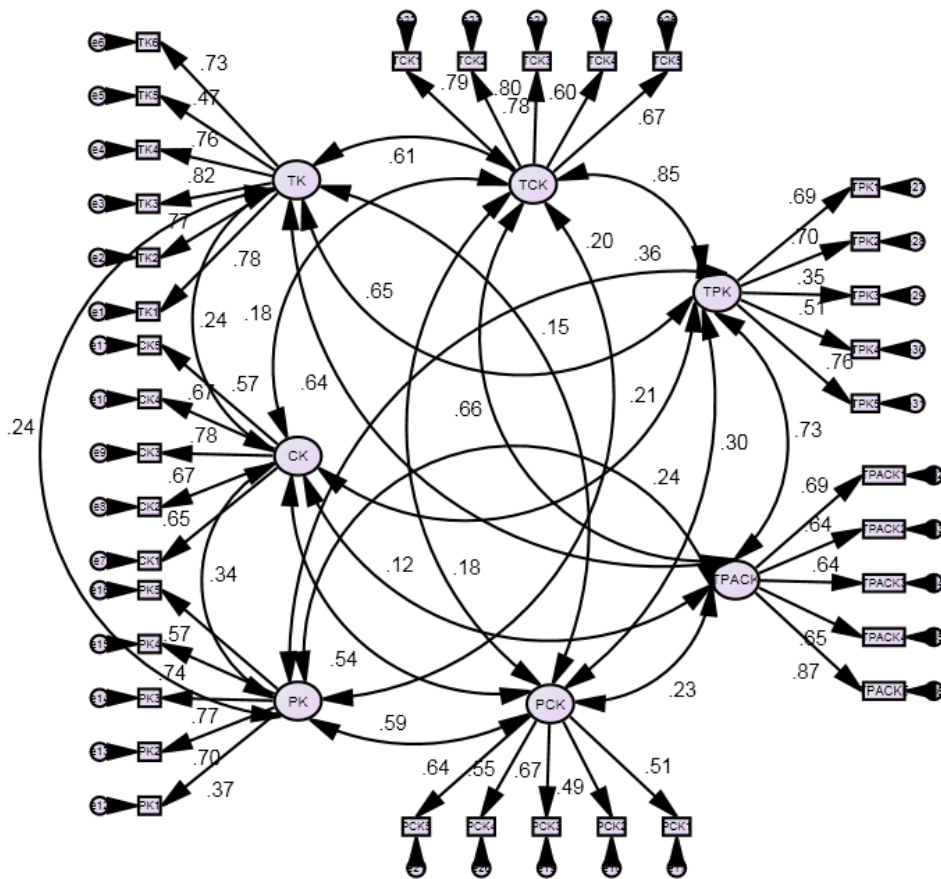
Figure 4.1: New Zealand Measurement Model

Factor loadings estimates revealed that the indicators were strongly related to their purported latent factors (ranging from β=.35, t=3.45 to β=.87, t=7.95, significant at p<.05) establishing the convergent validity of the measurement model as shown in Table 4.5. Comrey and Lee (1992) suggested loadings greater than .70 are considered excellent, .63 very good, .55 good, .45 fair, and .32 poor. Factor loadings of >.50 are recommended for the sample size of <200 (Hair et. al., 2010).

However, Tabachnik and Fidell (2007) further suggest that variables with loadings of .32 and above are also interpreted. Thus, the researcher decided to keep items with factor loadings less than .50 (i.e., TPK3, TPK4, TK5 and PK1) in the New Zealand measurement model for further data analysis.

Table 4.3: Factor Loading of TPACK Domains in New Zealand Context

Items	Factor Loadings						
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
TK1	.78						
TK2	.77						
TK3	.82						
TK4	.76						
TK5	.47						
TK6	.73						
CK1		.65					
CK2		.67					
CK3		.78					
CK4		.67					
CK5		.57					
PK1			.37				
PK2			.70				
PK3			.77				
PK4			.74				
PK5			.57				
PCK1				.51			
PCK2				.49			
PCK3				.67			
PCK4				.55			
PCK5				.64			
TCK1					.79		
TCK2					.80		
TCK3					.78		
TCK4					.60		
TCK5					.67		
TPK1						.69	
TPK2						.70	
TPK3						.35	
TPK4						.51	
TPK5						.75	
TPACK1							.69
TPACK2							.64
TPACK3							.64
TPACK4							.65
TPACK5							.87

The correlations between the seven TPACK domains were all positive ranging from the lowest value r=.1, t=1.03, p>.05 (between Content Knowledge and Technological Pedagogical Content Knowledge (TPACK), but it was a non-significant relationship) to the highest, r=.84, t=5.12, p<.05 (between TPK and TCK). Beta values of less than .90 indicated that the TPACK factors were able to be discriminated from each other (Hair et. al., 2010).

Table 4.4: Correlations between TPACK Subscales in New Zealand Context

TPACK Subscales	TK	CK	PK	PCK	TCK	TPK	TPACK
TK	1.00	.24**	.25	.15	.63*	.65*	.66*
CK		1.00	.34**	.53*	.18	.20	.13
PK			1.00	.59*	.19	.36**	.26**
PCK				1.00	.17	.29**	.25
TCK					1.00	.84*	.70*
TPK						1.00	.73*
TPACK							1.00

Note: *. Correlation is significant at the 0.01 level (2-tailed); **. Correlation is significant at the 0.05 level (2-tailed); TK = Technological Knowledge; CK = Content Knowledge; PK = Pedagogical Knowledge; PCK = Pedagogical Content Knowledge; TCK = Technological Content Knowledge; TPK = Technological Pedagogical Knowledge; TPACK = Technological Pedagogical Content Knowledge

4.7   Design of research instrument in Malaysia

4.7.1   Re-design of TPACK Survey for Malaysian Context

For the case study in Malaysia, the adapted TPACK survey administered in New Zealand was translated from the source language (SLQ1) into the target language (Bahasa Malaysia version) by three people in the ICT in Education field who are bilingual. Translation is needed whenever two or more languages are used by the community of the target population, in this case Malaysian pre-service teachers, and it was an iterative process (Harkness, 2006). Following Brinslin's (1980) suggestion, a combination of pretesting, decentering, back translation and committee approach was used to check for the appropriateness of the Bahasa Malaysia version of the TPACK survey among the pre-service teachers in Malaysia. The Bahasa Malaysia version was then pretested among five pre-service teachers. Based on their comments, the wordings of some items and the definition of each TPACK domain were slightly changed, removed and agreed upon to

produce one set of corresponding items with appropriate wording in Malay (decentering). The decentering method allows items to be translated appropriately into the targeted language without using the exact word-for-word translation from the original language. According to Brislin et al. (1970), in back-translation, a target language version is translated back into the source language version in order to verify translation of the research instrument. The Bahasa Malaysia version was then back translated into the source language (SLQ2) by another two people in the field who are bilingual to ensure accuracy (Brinslin, 1970). The two source-language questionnaires (SLQ1 & SLQ2) were compared and if the source language questionnaire (SLQ1) was equivalent to the retranslated back source language questionnaire (SLQ2), then the target language questionnaire was accepted (Harkness, &Schoua-Glusberg, 1998). Finally, even though there were high values of reliability reported in previous studies, the Bahasa Malaysia version of the TPACK survey was piloted with 30 pre-service teachers to re-examine the status of its internal consistency and validity because of the adaptations and the different setting. The final translated questionnaire resulted in 37 items. Further details on the instrumentation, which includes number of items and sample items, are provided in Appendix Q.

4.7.2 TPACK Survey Administration for Pilot Study in Malaysia

A pilot study was administered in December 2010 to examine the reliability of the instruments used in this study. A total of 30 pre-service teachers who had completed their field experience and were in their final year of a programme at Universiti Utara Malaysia were selected as representative of the targeted sample for the main study in order to establish the reliability and validity of responses to the survey questions. The returned questionnaires were gathered from 25 pre-service teachers (83.3%). Findings from the survey showed the reliability of the constructs ranged from .86 for Pedagogical Content Knowledge (PCK) to .92 for Technological Content Knowledge (TCK) (see Table 4.7). Similarly with Case Study 1, $\alpha > .60$ of all TPACK scales, indicating reliability of the instrument (Hair et al., 2010) to be used in the Malaysian context.

4.8 Main Study: Malaysian Context

For the pre-survey, a total of 150 TPACK questionnaires were personally administered to the participants in Case Study 2 during the teaching practice briefing session. 96% of pre-service teachers (144 respondents) returned the questionnaires. Three cases were removed during the data screening process due to insufficient information being provided which resulted in the final data coming from 141 respondents (N = 141). For the post-survey, the questionnaires were distributed during the pre-service teachers' post-teaching practice briefing session.

Table 4.5: Reliability of the TPACK Scales: Pilot Study in Malaysia

Subscales	Reliability (α)
Technological Knowledge	.87
Pedagogical Knowledge	.89
Content Knowledge	.87
Pedagogical Content Knowledge	.86
Technological Pedagogical Knowledge	.88
Technological Content Knowledge	.92
Technological Pedagogical Content Knowledge	.91

From post-survey analysis, the response rate was slightly decreased to 68.7% (103 respondents) and four cases were eliminated because of too many missing data in the survey. Therefore, the final data comprised 99 respondents ($\underline{N}$ = 99). After a closer observation of the data, a major difference in the number of respondents was due to the absence of 21 students from the Moral and Counselling Guidance majors. For the Moral and Counselling Guidance major students, teaching practice was their final course requirement to complete the teacher education program. Thus, the final data from the post-survey comprised pre-service teachers majoring in Accounting, ICT, Business Management and Moral in Education.

4.8.1 Data screening

Data screening was conducted following a similar procedure to that discussed in 4.4.1, involving checking of data accuracy input, addressing missing values, and determining normality and eliminating outliers.

1)   Accuracy of data input.

There was no out-of range value when checked against the five-point Likert scale used in the questionnaire with plausible results of means and standard deviations for the measured variables.

2)   Dealing with missing values

Close observation of the data found that there were only six missing values, involving 5 of 141 cases. Among the cases with missing values, there was only one case with two missing values and four cases with one missing value. The missing values were observed for the items on Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK) and Technological Pedagogical Content Knowledge (TPACK) domains. The same method of imputation data was applied by inserting the group mean to the missing values because of the small number of missing values and cases involved (Hair et al., 2010).

3)   Normality and Outliers

Normality of the data for pre- and post-surveys was assessed for the measured variables. Table 4.8 shows that all measured variables in Case Study 2 exhibited normal distributions (skewness and kurtosis were less than +/- 2, Tabachnick & Fidell, 2007). The measured variables of TCK2, TCK5 (two of the indicators for Technological Content Knowledge) and TPK1 (one of the indicators for Technological Pedagogical Knowledge) from pre-survey data and CK2, CK5, PCK2, TPK1 and TPK2 from post-survey data showed kurtosis value >+/- 2.0. However, these values of kurtosis did not indicate a significant departure from normality because the value of z-kurtosis (kurtosis value divided by the standard error of kurtosis) for this variable was still less than 10.0; thus data for the variable could still be considered as normally distributed (Kline, 1998).

The observation of univariate outliers was done by looking at the z-scores of the measured variables. Any case with a z-score of the measured variables more than 3.29 was considered as an outlier (Tabachnick & Fidell, 2007). From this data, none were observed as univariate outliers. The criterion for multivariate outliers is

Mahalanobis distance at p<.001. Mahalanobis distance is evaluated as χ2 with degrees of freedom equal to the number of measured variables, in this case 37. Any case with a Mahalanobis distance value greater than χ2(37) = 69.35 would be a multivariate outlier (Tabachnick & Fidell, 2007). None of the cases was detected as multivariate outliers.

Table 4.6: Values of skewness and kurtosis for each measured variable in Malaysian Context

Measured variables	Skewness	Kurtosis
	Pre-survey	Pre-survey
TK1	-.56	.34
TK2	-.08	-.43
TK3	-.05	-.16
TK4	-.08	-.12
TK5	-.22	-.20
TK6	-.21	.03
CK1	-.67	1.29
CK2	-.01	.33
CK3	-.43	.80
CK4	-.24	.10
CK5	.05	-.24
CK6	.06	-.39
PK1	.01	.11
PK2	.02	.50
PK3	-.20	.60
PK4	-.00	.11
PK5	-.07	-.14
PCK1	-.04	.41
PCK2	.01	-.08
PCK3	.14	-.47
PCK4	-.09	.47
PCK5	-.05	.40
TCK1	-.59	1.30
TCK2	-.30	2.84 (z-kurtosis=6.99)
TCK3	-.26	1.11
TCK4	-.38	1.70
TCK5	-.56	2.02 (z-kurtosis=4.99)
TPK1	-.45	2.20 (z-kurtosis=5.41)
TPK2	-.05	.99
TPK3	-.42	.36
TPK4	-.02	.78
TPK5	.00	-.03
TPACK1	.02	1.11
TPACK2	.05	1.80
TPACK3	-.11	1.79
TPACK4	.09	-.47
TPACK5	-.02	.41

Note: Normality was evident when absolute values of skewness and kurtosis were less than 2.0 (Tabachnick &Fidell, 2007); z-kurtosis value was less than 10.0 (Kline, 1998)for kurtosis >2.0.

4.9 Measuring TPACK in Malaysia: Reliability and Validity

The assessment of internal consistency was conducted for the TPACK survey used in the Malaysian context (see section 4.5.1 for details of the procedure).

4.9.1 Reliability

Findings from survey analysis showed (see table 4.9) the reliability of the constructs ranged between .79 (TPK) and .88 (PK).

Table 4.7: Reliability of the TPACK Scales: Case Study in Malaysia

Subscales	Reliability (α)
Technological Knowledge	.82
Pedagogical Knowledge	.88
Content Knowledge	.85
Pedagogical Content Knowledge	.85
Technological Pedagogical Knowledge	.79
Technological Content Knowledge	.84
Technological Pedagogical Content Knowledge	.84

4.9.2 Validity

A similar procedure as that discussed in section 4.5.2 was conducted to assess the validity of the 37 item TPACK survey. The model was evaluated for goodness of fit using the ratio of the $\chi2$ to degree of freedom ($\chi2$ /df), standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA), comparative fit index (CFI), and the Tucker-Lewis index (TLI). It is recommended to use more than one fit index (from two different categories) to evaluate the model fit (Hu & Bentler, 1998, 1999) as a ratio less than 5:1 may produce unstable results (Kline, 1998). According to Kim & Bentler (2006), if a model has a "good" fit using more than one category, the model is an acceptabe fit with the data under study. The chi-square statisticis recognized to be biased with small sample sizes (Jackson, 2003; MacCallum, Widaman, Preacher, & Hong, 2001). Thus the ratio of the $\chi2$ to degrees of freedom ($\chi2$ /df) less than 3 was suggested to indicate a good-fitting model (Chin, et al. 1995). The parameters estimated were greater than the absolute value of 1.96 significant at p< .05 (t>1.96, p<.05), and the interpretability or strength of the parameter estimates (i.e., absence of Heywood cases and no negative variances) was also observed.

4.10 Findings:Does the theoretical TPACK measurement model fit the data collected in the ITE programme in Malaysia?

The results for the measurement modelas shown in figure 4.2 suggested that the seven-factor model fits the data reasonably well, χ^2/df = 1.672 (χ^2 = 1016.630, df= 608) and p = .000, TLI = .85, CFI = .86, RMSEA = .07 (.06 - .08) and SRMR = .06, fit indices suggesting an acceptable-fitting model (Brown, 2006).
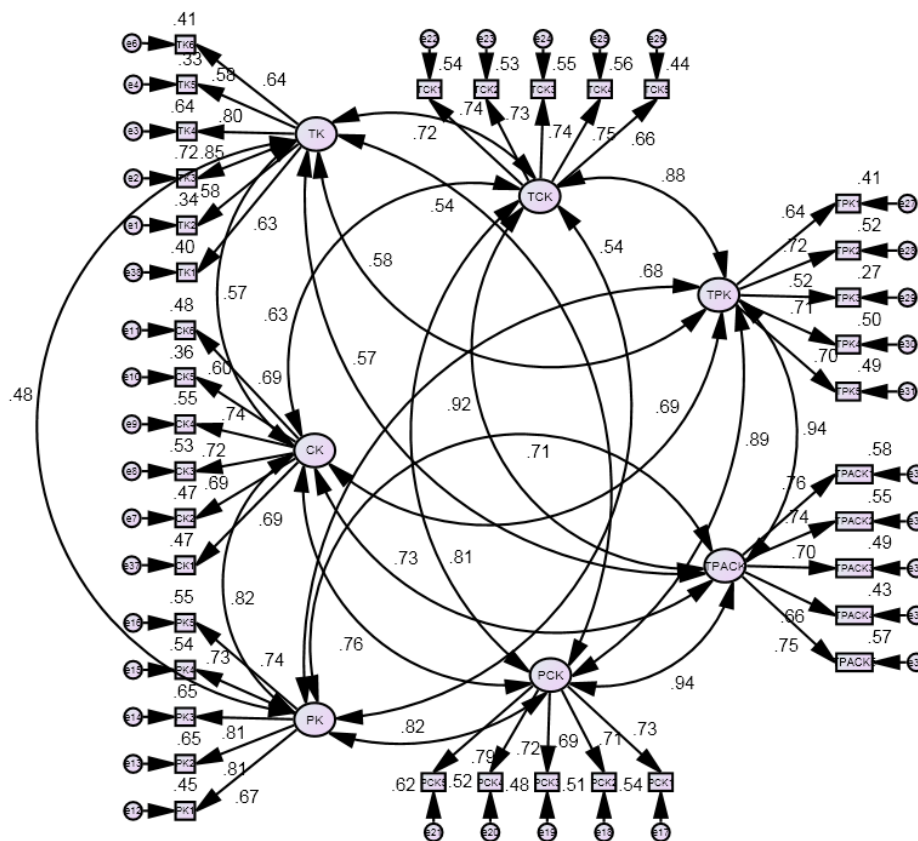
Figure 4.2: Malaysian Measurement Model

Table 4.10 presented the factor loadings estimates for all seven TPACK constructs. It was observed that the indicators were strongly related to their purported latent factors (ranging from β=.52, t=5.46 to β=.85, t=6.87, significant at p<.001) establishing the convergent validity of the measurement model.

Table 4.8: Factor Loadings for 37 items of TPACK Domains in Malaysian Context

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
TK1	.63						
TK2	.57						
TK3	.85						
TK4	.80						
TK5	.52						
TK6	.64						
CK1		.69					
CK2		.69					
CK3		.73					
CK4		.74					
CK5		.60					
CK6		.69					
PK1			.67				
PK2			.81				
PK3			.81				
PK4			.74				
PK5			.74				
PCK1				.73			
PCK2				.71			
PCK3				.69			
PCK4				.72			
PCK5				.79			
TCK1					.74		
TCK2					.73		
TCK3					.74		
TCK4					.75		
TCK5					.66		
TPK1						.64	
TPK2						.72	
TPK3						.52	
TPK4						.71	
TPK5						.70	
TPACK1							.76
TPACK2							.74
TPACK3							.70
TPACK4							.66
TPACK5							.75

The correlations between the seven knowledge domains were all positive, ranging from the lowest value r = .48, t=3.75, p<.001 between TK and PK, to the highest, r=.94, t=5.50, p<.001 between TPK and TPACK and r=.94, t=5.97, p<.001 between PCK and TPACK. It was observed that the correlations between PCK and

TPACK, TPK and TPACK; and TCK and TPACK were more than .90, indicating that there is a high potential for overlapping between these three domains. In other words, Malaysian pre-service teachers could not differentiate the three domains, PCK, TPK, TCK from the domain of TPACK. The correlations between the other latent variables was less than .90 (Hair et. al., 2010), thus establishing the discriminant validity.

Table 4.9: Correlations between TPACK Subscales in Malaysian Context

TPACK Subscales	TK	CK	PK	PCK	TCK	TPK	TPACK
TK	1.00	.59*	.48*	.54*	.72*	.59*	.57*
CK		1.00	.82*	.76*	.64*	.69*	.73*
PK			1.00	.82*	.54*	.68*	.71*
PCK				1.00	.82*	.89*	.94*
TCK					1.00	.88*	.92*
TPK						1.00	.94*
TPACK							1.00

Note: *. Correlation is significant at the 0.001 level (2-tailed); TK = Technological Knowledge; CK = Content Knowledge; PK = Pedagogical Knowledge; PCK = Pedagogical Content Knowledge; TCK = Technological Content Knowledge; TPK = Technological Pedagogical Knowledge; TPACK = Technological Pedagogical Content Knowledge

4.11 Chapter Summary

To summarize, this chapter has given a detailed report on results of the confirmatory analysis of the overall measurement model in the New Zealand and Malaysian contexts. The results from this study found that the TPACK survey is reliable and valid. The overall measurement models in New Zealand and Malaysia were both found to have an adequate fit. These results serve to answer Research Question 1. Although the findings of the present study confirm the validity of the seven-factor model in the New Zealand context, the inconsistencies in findings with regard to the use of the TPACK survey in some settings (the overlapping domains in the Malaysian context) signify that there is still room for further investigation on this matter.

The TPACK survey could function as a data collection tool to strengthen these understandings in pre-service teachers and inform decisions about technology

integration with appropriate pedagogy, within their content areas. Further discussions and recommendations are presented in section 8.2.1. The following chapter, Chapter 5, presents pre-service teachers' perceptions of their TPACK level and development of their TPACK level after field experience. The chapter covers both New Zealand and Malaysian samples.

CHAPTER 5: QUANTITATIVE FINDINGS

5.1   Introduction

This chapter presents two sets of findings in order to answer the research questions: 2) What are pre-service teachers' perceptions of their own TPACK levels before and after field experience in a school? and 3) Are there any significant differences in pre-service teachers' perceptions of all seven domains of TPACK level (TK, CK, PK, PCK, TPK, TCK, and TPACK) before and after completing field experience in a school? The chapter covers both New Zealand and Malaysian samples starting with the New Zealand findings.

The respondents' gender, age and the major courses taken in the teacher education programme are provided first to describe the sample. The pre-service teachers' perceptions of their own TPACK mastery level and differences of pre-service teachers' perceptions of TPACK between pre- and post- surveys are presented. There were unexpected findings for both research questions 2 and 3 which led to a series of further analyses.

5.2   Findings of New Zealand TPACK Survey

5.2.1   Profile of respondents who participated in the TPACK survey in New Zealand

Respondents who participated in the TPACK survey in New Zealand comprised pre-service teachers in the same programme but from a different year. They were attending the one-year Graduate Diploma in Teaching and Learning (Secondary) in an Initial Teacher Education programme in a research university in New Zealand in 2010 and 2012. There were two groups because the number of respondents for pre- and post-survey in the first stage of data collection in 2010 was small, thus, the researcher conducted a second phase of data collection with a different group of pre-service teachers. The second group had similar criteria to the first group of pre-service teachers (see details in section 4.4). The sample of participants by gender, age and major course taken was presented in section 3.5.1. The distribution of the

TPACK survey among the two groups in New Zealand was described earlier in section 4.4. These findings were analysed from a total of 120 pre-service teachers (21 and 99 from the first pre-survey and second pre-survey respectively) and 144 (42 from the first post-survey and 102 from the second post-survey). The distribution of the 120 pre-service teachers in the pre-survey, 144 pre-service teachers in the post-survey and 107 who participated in both surveys is summarized in Table 5.1. Details of the number of participants who responded to the questionnaires were presented in section 4.4 to clarify the differences in the number of participants.

Table 5.1: Profile of New Zealand respondents based on gender, age and major

Profile		Pre-survey (N=120) Respondents (N)	Post-survey (N=144) Respondents (N)	Pre- and Post- (N=107) Respondents (N)
Gender				
	Female	68	85	62
	Male	52	59	45
Age				
	21-24	62	67	53
	25-29	28	41	26
	30-39	14	20	13
	>40	16	16	15
Major				
	Technology	6	9	5
	Arts Education	16	14	12
	Science Education	17	27	14
	Language	30	33	29
	Physical Education	23	28	24
	Social Studies	20	23	16
	Mathematics Education	8	10	7

5.2.2 What are pre-service teachers' perceptions of their own TPACK levels before and after field experience in a school?

In general, pre-service teachers felt fairly confident as shown in their score rating in both surveys. There were also small differences in all TPACK domains and all in a positive and predicted direction (see section 5.2.3 for significant difference). All mean scores ranged from 3.44 to 4.31. The mean scores for all TPACK domains indicate an overall positive response to the scales. In other words, generally, pre-service teachers agreed that their TPACK levels in order for them to effectively

integrate ICT in teaching during their field experience were above the mid-point of the scale before and after field experience. Table 5.2 presents the mean scores and standard deviations of TPACK domains for pre- and post-survey (n = 107). In general, both before and after field experience, pre-service teachers in New Zealand rated CK as the highest and TK as the lowest. Although the mean score for TK was the lowest among the seven domains of perceptions of TPACK understanding, on average, these pre-service teachers agreed that they have the necessary technological knowledge to be able to use ICT in teaching.

Table 5.2: Mean scores and standard deviations of TPACK domains and differences between pre- and post-survey (n = 107) distributed in New Zealand

Domains Subscales	Pre-survey		Post-survey		Difference
	Mean	SD	Mean	SD	
TK	3.44	.70	3.61	.68	+ 0.17
CK	4.22	.46	4.31	.48	+ 0.09
PK	3.82	.45	4.11	.60	+ 0.29
PCK	3.86	.41	4.02	.52	+ 0.16
TCK	3.78	.59	3.97	.61	+ 0.19
TPK	3.80	.51	3.92	.63	+ 0.12
TPACK	3.64	.53	4.00	.61	+ 0.36

Further examination of the pre-service teachers' perceptions of their TPACK level was conducted to identify the levels of specific skill/knowledge within each TPACK domain that pre-service teachers rated as the highest and the lowest mean score. The findings showed that pre-service teachers rated the same items within TK domain (TK6), PK domain (PK4) and PCK domain (PCK2) as the highest in the pre- and post- surveys. It was also observed that the same items were rated as the lowest in both surveys for TK (TK3), PK (PK1) and PCK (PCK3) domains which suggests that pre-service teachers agreed that they could perform less satisfactorily for the lowest rated skill/knowledge as compared to other skill/knowledge within each domain (see Table 5.3 for the highest and lowest mean scores of items rated). Detailed descriptions of the items are discussed in the following section.

Table 5.3: The highest and lowest mean scores of items for each domain, rated before and after field experience for New Zealand pre-service teachers (n=107)

	TPACK Domains	Highest Mean Score			Lowest Mean Score		
		Item	M	SD	Item	M	SD
Pre-survey	TK	**TK6**	3.72	.90	**TK3**	3.27	.90
	CK	CK5	4.36	.62	CK4	4.03	.62
	PK	**PK4**	3.90	.66	**PK1**	3.65	.53
	PCK	**PCK2**	4.12	.47	**PCK3**	3.63	.69
	TCK	**TCK4**	4.06	.64	TCK3	3.63	.75
	TPK	TPK3	3.90	.84	TPK5	3.68	.70
	TPACK	TPACK2	3.76	.58	**TPACK4**	3.33	.83
Post-survey	TK	**TK6**	3.84	.83	**TK3**	3.38	.91
	CK	CK2	4.36	.62	CK3	4.18	.70
		CK4	4.36	.52			
	PK	**PK4**	4.18	.70	**PK1**	4.04	.70
	PCK	**PCK2**	4.18	.60	**PCK3**	3.89	.68
	TCK	**TCK4**	4.09	.69	TCK2	3.80	.83
	TPK	TPK1	4.00	.71	TPK3	3.80	.95
		TPK2	4.00	.70			
	TPACK	TPACK5	4.11	.73	**TPACK4**	3.76	.91

Note: Items in bold text are those which were rated lowest and highest for each domain of TPACK in the pre- and post- survey to highlight that they were the same items.

A detailed analysis was first undertaken for TK, CK and PK because these are the three main individual domains in the TPACK. The findings of the TK domain, for example, showed that on average, pre-service teachers perceived that they "can learn to use new software easily" (TK6) before and after field experience. There was an increase of value in the mean score although it was a small difference. This would be likely to remain the same if there was little opportunity for pre-service teachers to practice and develop their confidence. Even though item TK3 in TK domain was rated as the lowest mean score in both surveys, pre-service teachers also perceived that, on average, they "know about a lot of different technologies".

For CK domain, item CK5, "I know about various examples of how my subject matter applies in the real world" was the highest mean score (M = 4.36, SD = .62) in the pre-survey but this changed to item CK2, "had various ways and strategies of developing their understanding of subject matter" and CK4, "comfortable in planning the scope and sequence of concepts that need to be taught within their class" in the post-survey. This may suggest that item CK5 is not relevant without

the real teaching practice for pre-service teachers to apply their subject matter. Although pre-service teachers rated the item CK4, "comfortable in planning the scope and sequence of concepts that need to be taught within their class" as the lowest mean score (M = 4.03, SD = .62) in CK domain, the mean score for the item was considerably high, which then rated as the highest mean score (M = 4.36, SD = .52) in the post-survey (see Table 5.3). In addition to that, on average, pre-service teachers agreed that they "had developed various ways and strategies of understanding their subject matter"(CK2), (M = 4.36, SD = .62) when they completed the field experience. Although they agreed that they had "a deep and wide understanding of the subjects they planned to teach" (CK3), however, it was their lowest mean score in CK domain in the post-survey.

In general, from the rating of PK domain, pre-service teachers perceived that they "can use a wide range of teaching approaches in a classroom setting" (PK4), the highest mean score before and after field experience. However, they rated that they "know how to assess student performance in a classroom" (PK1) as their lowest skill in PK though on average, the score showed a positive difference in the post-survey. This may suggest that inexperienced teachers still have doubts in assessing their students' performance as they are struggling with the new surrounding, the content to teach and teaching strategies. The description of further analysis for the combined domains, namely, PCK, TCK, TPK follows and ends with a presentation of the findings of further analysis of the TPACK.

Combined domains were more complex to understand but the findings were similar to the individual domains. Some items remained as the highest (PCK2 and TCK4) and the lowest (PCK3 and TPACK4) in both surveys, whereas, other items changed between the pre- and post-survey. For example, pre-service teachers agreed that they were "able to produce lesson plans with a good understanding of the topic in their subject matter that needed to be taught" (PCK2) (M = 4.12, SD = .47) before their field experience and rated the item highest after field experience with a slightly higher rating (M = 4.18, SD = .60). They also agreed that they "could anticipate student misconceptions within a particular topic" (PCK3) even

though it was their lowest mean score in PCK criteria with the mean score of (M = 3.63, SD = .69) for pre-survey and (M = 3.89, SD = .68) for post-survey. This would be likely to remain the same, unless they had more opportunity and support to practice and develop the skill during field experience.

From pre-survey analysis, item 4 in TCK domain was the highest mean score as participants agreed that they "could use technological representations (i.e. multimedia, visual demonstrations, etc.) to demonstrate specific concepts in their subject matter". The lowest mean score was for item TCK3, "I know about technologies that I can use for enhancing the understanding of specific concepts in my subject matter". After ten weeks of teaching practice in a secondary school, the pre-service teachers rated item TCK4, "could use technological representations (i.e. multimedia, visual demonstrations, etc.) to demonstrate specific concepts in their subject matter" as the highest mean score (M = 4.09, SD = .69) which showed that they perceived a small improvement as a result of their field experience. The lowest mean score (M = 3.80, SD = .83) was for a different item, i.e., TCK2, "I know how my subject matter can be represented by the application of technology".

For TPK, item 3, "My teacher education programme has stimulated me to think more deeply about how technology could influence the teaching approaches I use in my classroom" was rated with the highest mean score (M = 3.90, SD = .84). On the other hand, this was the lowest mean score (M = 3.80, SD = .95) in the post-survey. In the post field experience survey, item TPK1 "I can choose technologies that enhance the teaching approaches for a lesson" (M = 4.00, SD = .71) and TPK2 "I can choose technologies that enhance students' learning of a lesson" (M = 4.00, SD = .70) were the highest mean score as shown in Table 5.3. This suggests that the pre-service teachers acknowledged that the teacher preparation programme had prepared them with the technology-related skill and knowledge for them to be able to use ICT in teaching. However, some challenges during field experience hindered them from developing their skill and knowledge (see section 7.2 for further discussion).

In TPACK, the core domain, pre-service teachers rated different items highest in the pre- and post-survey. Item TPACK2 (M = 3.76, SD = .58), "I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn" was highest in the pre-survey. After field experience, item TPACK5 (M = 4.11, SD = .73), "I can choose technologies that enhance the understanding of the content for a lesson" was the highest mean score. Item TPACK4, "I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school" was rated with the lowest mean score (M = 3.33, SD = .83) in the pre-survey and (M = 3.76, SD = .91) in the post-survey, which may suggest that pre-service teachers had least confidence in helping other teachers to combine the use of ICT with an appropriate teaching method in the subject matter to be taught. As they were still learning themselves, this knowledge could be improved with continuous support and training provided for pre-service teachers (see section 7.2 for further discussion).

5.2.3   Are there any significant differences in pre-service teachers' perceptions of all seven domains of TPACK level (TK, CK, PK, PCK, TPK, TCK, and TPACK) before and after completing field experience in a school?

As described earlier that there was a small improvement between pre-survey and post-survey mean scores on all TPACK domains (see section 5.2.2). Even though the changes of the pre-service teachers' perceptions of their TPACK mastery level were not great, there were significant differences in some of the TPACK domains, namely, TK, PK, PCK, TCK and TPACK as shown in Table 5.4. The data was analysed with 107 respondents to look for the development of pre-service teachers' perceptions of their TPACK. The findings showed that the differences for TK, PCK and TCK indicated a small effect size and a medium effect size for PK and TPACK (Cohen, 1988). It would be expected that field experience would help pre-service teachers' PK and TPACK because field experience is more likely to develop pedagogical skills and knowledge than content skills and knowledge.

Table 5.4: Mean scores, standard deviations and effect size of TPACK domains for pre- and post-survey (n = 107) in New Zealand

Domains Subscales	Pre-survey		Post-survey		df	t	Effect Size (Cohen's d)
	Mean	SD	Mean	SD			
TK	3.44	.70	3.61	.68	106	2.25[*]	0.25 (small)
CK	4.22	.46	4.31	.48	106		
PK	3.82	.45	4.11	.60	106	4.97[*]	0.55 (medium)
PCK	3.86	.41	4.02	.52	106	2.46[*]	0.34 (small)
TCK	3.78	.59	3.97	.61	106	2.61[*]	0.32 (small)
TPK	3.80	.51	3.92	.63	106		
TPACK	3.64	.53	4.00	.61	106	5.16[*]	0.63 (medium)

Note: *. t-value is significant at $p < .05$; Cohen's d values were presented for TPACK domains with the significant difference

5.2.4   Further Analysis of New Zealand Data: PK and TPACK

Further analysis was done on sub-samples of students who had answered both surveys (n=107) based on their major course. This was because of the researcher's curiosity as to whether there would be any differences between major courses in the TPACK domains with significant differences. Even though this was not part of the research question, the researcher believed that the analysis was worth performing because a positive direction was expected for PK and TPACK in the pre- and post-survey. The researcher looked at the domains which showed significant differences with the medium effect size; namely PK and TPACK domains. First, the responses were re-categorized by grouping 'strongly disagree' with 'disagree' and 'strongly agree' with 'agree' groups. 'Neutral' remained as 'neutral'. Pre-service teachers in the New Zealand case study were grouped into the seven major courses taken in the teacher education programme: Arts Education, Language Education, Mathematics Education, Physical Education, Science Education, Social Studies and Technology Education. Table 5.5 summarizes the distribution of participants' ratings of 'disagree', 'neutral' and 'agree' for PK and TPACK in the pre-survey and post-survey.

Table 5.5: Distribution of participants' ratings for PK and TPACK by subgroup of major in pre- and post-survey (n = 107) in New Zealand

Domain			Group of major course (number of participants' ratings)						
			Art	Lan	Math	Phy	Sci	Soc	Tech
PK	Pre-Survey	Disagree	0	0	0	0	0	1	0
		Neutral	1	9	3	5	4	1	0
		Agree	11	20	4	19	10	14	5
	Post-Survey	Disagree	1	0	0	1	0	0	0
		Neutral	0	5	3	2	3	0	0
		Agree	11	24	4	21	11	16	5
Differences between pre- and post-survey		*Disagree*	*+1*	*n.a*	*n.a*	*+1*	*0*	*-1*	*n.a*
		Neutral	*-1*	*-4*	*0*	*-3*	*-1*	*-1*	*n.a*
		Agree	*0*	*+4*	*0*	*+2*	*+1*	*+2*	*0*
TPACK	Pre-Survey	Disagree	0	0	0	1	0	0	0
		Neutral	4	13	3	12	7	4	0
		Agree	8	16	4	11	7	12	5
	Post-Survey	Disagree	1	0	0	0	0	0	0
		Neutral	0	4	2	5	6	2	0
		Agree	11	25	5	19	8	14	5
Differences between pre- and post-survey		*Disagree*	*+1*	*n.a*	*n.a*	*-1*	*n.a*	*n.a*	*n.a*
		Neutral	*n.a*	*-9*	*-1*	*-7*	*-1*	*-2*	*n.a*
		Agree	*+3*	*+9*	*+1*	*+8*	*+1*	*+2*	*0*

Note: 0 = no change of participants' ratings; n.a = none; + sign with figure = number of participants' ratings increased in the post-survey; - sign with figure = number of participants' ratings decreased in the post-survey; Art=Arts Education Major; Lan=Language Education Major; Math=Mathematics Education Major; Phy=Physical Education Major; Sci=Science Education Major; Soc=Social Studies Major; Tech=Technology Education Major;

It was expected that the students would indicate that they perceived their competence had increased with field experience. However, the researcher found that there were some strange patterns, for example, the negative changes of PK and TPACK in the post-survey. Generally, for PK domain, more than half of the pre-service teachers from each major group rated 'agree' and/or 'strongly agree' before and after field experience. A closer look at TPACK domain (see Table 5.5) showed that more than half of the students, except for Physical Education students, agreed that they had the knowledge required in TPACK as a whole, before field experience. After field experience, there was a small difference in the number of pre-service teachers with majors in Arts Education, Mathematic Education, Science Education and Social Studies who rated 'agree'. On the other hand, the Physical

Education and Language students showed a big difference in their ratings for the pre-survey and post-survey. As the pre-service teachers had completed their field experience, it would be expected that their ratings would have moved in a positive and predicted direction. However, this finding was puzzling, and the researcher found that some unexpected cases who originally rated 'agree' in the pre-survey, had changed to 'disagree' in the post-survey. Some examples of the cases are shown in Table 5.6. Explanations and discussion from the findings of qualitative data are presented in section 6.2.1 and 7.2 to further explain this unexpected result.

Table 5.6: Changes of pre-service teachers' perception of PK level after field experience in New Zealand

Major	Rating of PK in the pre-survey		Rating towards PK in the post-survey	
Arts Education	Disagree	0	Disagree	0
			Neutral	0
			Agree	0
	Neutral	1	Disagree	1
			Neutral	0
			Agree	0
	Agree	11	Disagree	0
			Neutral	0
			Agree	11
Physical Education	Disagree	0	Disagree	0
			Neutral	0
			Agree	0
	Neutral	5	Disagree	0
			Neutral	1
			Agree	4
	Agree	19	Disagree	1
			Neutral	2
			Agree	16

On further examination of data for TPACK domain, the researcher found some cases that moved in an unexpected direction, as presented in Table 5.7. Science Education major, for example, showed that only one student had changed his/her perception of TPACK level, leaving the Science Education major as having the highest number of students who rated 'neutral' in the post-survey. Four of these pre-service teachers maintained their rating as 'neutral' after field experience while the other three changed their self-assessment of TPACK level and chose to 'agree'. There were two pre-service teachers who rated 'agree'for their TPACK in the pre-

survey but changed to being 'neutral' in the post-survey (see section 7.2 for further discussion).

Table 5.7: Changes of pre-service teachers' perception of TPACK level after field experience in New Zealand

Major	Rating of TPACK in the pre-survey		Rating towards TPACK in the post-survey	
Science Education	Disagree	0	Disagree Neutral Agree	0 0 0
	Neutral	7	Disagree Neutral Agree	0 4 3
	Agree	7	Disagree Neutral Agree	0 2 5
Art Education	Disagree	0	Disagree Neutral Agree	0 0 0
	Neutral	4	Disagree Neutral Agree	0 0 1
	Agree	8	Disagree Neutral Agree	1 0 10

5.2.5   Further Analysis of New Zealand Data: TK, PCK and TCK

Then, the analysis further clarified the other three domains: TK, PCK and TCK, which indicated significant differences with small effect size. Table 5.8 showed that all Technology Education students rated 'agree' in their TK, PCK and TCK domains in both the pre-survey and post-survey. There was an increase in the number of students who rated 'agree' after field experience except for the number of Science Education students which remained the same. Similar results were observed in the ratings for the PCK domain by the Mathematics Education students. The number of those who rated 'agree' decreased after field experience as shown in Table 5.8. The findings of TCK, as shown in Table 5.8 for pre-survey data showed that more than half of the pre-service teachers in all major groups agreed about their TCK mastery level. For TCK domain from the post-survey data, all Social Studies and Technology Education students rated 'agree' after they had completed their field experience.

Table 5.8: Distribution of participants' ratings for TK, PCK and TCK by subgroup of major in pre- and post-survey (n = 107) in New Zealand

Domain			Group of major course (distribution of participants' ratings)						
			Art	Lan	Math	Phy	Sci	Soc	Tech
TK	Pre-Survey	Disagree	1	2	2	3	1	1	0
		Neutral	3	12	2	13	4	6	0
		Agree	8	15	3	8	9	9	5
	Post-Survey	Disagree	0	3	1	1	1	0	0
		Neutral	3	10	2	8	4	4	0
		Agree	9	16	4	15	9	12	5
Differences between pre- and post-survey		*Disagree*	*-1*	*+1*	*-1*	*-2*	*0*	*-1*	*n.a*
		Neutral	*0*	*-2*	*0*	*-5*	*0*	*-2*	*n.a*
		Agree	*+1*	*+1*	*+1*	*+7*	*0*	*+3*	*0*
PCK	Pre-Survey	Disagree	0	0	0	0	0	0	0
		Neutral	1	6	0	7	5	2	0
		Agree	11	23	7	17	9	14	5
	Post-Survey	Disagree	0	0	0	1	0	0	0
		Neutral	2	2	2	3	4	0	0
		Agree	10	27	5	20	10	16	5
Differences between pre- and post-survey		*Disagree*	*n.a*	*n.a*	*n.a*	*+1*	*n.a*	*n.a*	*n.a*
		Neutral	*+1*	*-4*	*+2*	*-4*	*-1*	*-2*	*n.a*
		Agree	*-1*	*+4*	*-2*	*+3*	*+1*	*+2*	*0*
TCK	Pre-Survey	Disagree	0	1	0	1	0	0	0
		Neutral	5	7	3	7	4	4	0
		Agree	7	21	4	16	10	12	5
	Post-Survey	Disagree	0	1	0	1	0	0	0
		Neutral	3	2	3	4	6	0	0
		Agree	9	26	4	19	8	16	5
Differences between pre- and post-survey		*Disagree*	*n.a*	*0*	*n.a*	*0*	*n.a*	*n.a*	*n.a*
		Neutral	*-2*	*-5*	*0*	*-3*	*-4*	*-4*	*n.a*
		Agree	*+2*	*+5*	*0*	*+3*	*+4*	*+4*	*0*

Note: 0 = no change of participants' ratings; n.a = none; + sign with figure = number of participants' ratings increased in the post-survey; - sign with figure = number of participants' ratings decreased in the post-survey; Art=Arts Education Major; Lan=Language Education Major; Math=Mathematics Education Major; Phy=Physical Education Major; Sci=Science Education Major; Soc=Social Studies Major; Tech=Technology Education Major

The findings were perplexing to the researcher, triggering curiosity as to why the number of students rating 'disagree' had increased. For example, as shown in Table 5.9, two Language Education students rated 'disagree' in the pre-survey, and three students rated 'disagree' in the post-survey.

Table 5.9: Changes of pre-service teachers' perception of TK mastery level after field experience in New Zealand

Major	Rating of TK in the pre-survey		Rating towards TK in the post-survey	
Language Education	Disagree	2	Disagree Neutral Agree	1 1 0
	Neutral	12	Disagree Neutral Agree	0 9 3
	Agree	15	Disagree Neutral Agree	2 0 13

Further analysis of the New Zealand data in the PCK domain revealed that almost all pre-service teachers in Mathematics Education major perceived that they had the knowledge to practise the PCK (see Table 5.10). However, some cases were found to have moved in a negative direction. Two pre-service teachers in Mathematics Education major rated 'neutral' in the post-survey when they actually rated 'agree' in the pre-survey.

Table 5.10: Changes of pre-service teachers' perception of PCK mastery level after field experience in New Zealand

Major	Rating of PCK in the pre-survey		Rating towards PCK in the post-survey	
Mathematics Education	Disagree	0	Disagree Neutral Agree	0 0 0
	Neutral	0	Disagree Neutral Agree	0 0 0
	Agree	7	Disagree Neutral Agree	0 2 5

Looking at the findings from further analysis of TCK domain indicated that there were both positive and negative directions as observed in other domains of TPACK. Further analysis of New Zealand data was completed and there were no other unusual findings that emerged (refer Table 5.8) from the pre- and post-survey data distributed in New Zealand. It is to note that the findings from further analyses were not statistically tested. However, the confidence with respondents' responses

was not satisfactorily as to whether there would be any differences between major courses because a positive direction was expected for the TPACK domains in the pre- and post-survey.

In all, the changes in students' perceptions of their TPACK, specifically for TK, PK, PCK, TCK and TPACK before and after field experience were normal as they went through challenges and developed skills and knowledge during field experience. This section on unexpected findings prompted the researcher to undertake the qualitative aspect of this study, to better explain these inconsistencies. The following section describes the findings from the analysis of Malaysian data following the same stages of analysis as the New Zealand data.

5.3   Findings of Malaysian TPACK Survey

5.3.1   Profile of respondents who participated in the TPACK survey in Malaysia

Respondents who participated in the TPACK survey in Malaysia were pre-service teachers attending the four-year Bachelor of Education (Hons) Programme in an initial teacher education programme in a Malaysian management university in 2011. The sample from the Malaysian case study comprised 150 pre-service teachers. The breakdown of the group on the basis of gender, age and major course taken was presented in section 3.5.2. The distribution of the TPACK survey in Malaysia was described earlier in section 4.7.2. The respondents' profiles (a total of 141 and 99 respondents who participated in the pre-survey and post-survey respectively) are summarised in Table 5.11. The 99 respondents who completed the post-survey also completed the pre-survey which allowed for matched data.

Table 5.11: Profile of Malaysian respondents based on gender, age and major

Profile		Pre-survey (N=141) Respondents (N)	Post-survey (N=99)* Respondents (N)
Gender			
	Female	119	83
	Male	22	16
Age			
	22-24	129	92
	25-28	12	7
Major			
	Information Technology	27	21
	Accounting	23	22
	Business Management	22	21
	Moral Education	48	35
	Counselling	21	-

Note: * number of pre-service teachers participated both in pre- and post-survey

5.3.2 What are pre-service teachers' perceptions of their own TPACK levels before and after field experience in a school?

Generally, pre-service teachers in Malaysia perceived themselves as adequate in their TPACK level before and after field experience. The mean scores ranged from 3.76 to 4.06 and are presented in Table 5.12. It was found that there was a small improvement in pre-service teachers' perceptions of their own TPACK level in the post-survey in all seven TPACK domains (see section 5.3.3 for significant difference). Additionally, the mean scores indicate an overall positive response to the scales. That is, on the scale of 1 (strongly disagree) to 5 (strongly agree), the means for the respondents fell within the 'agree' range. In other words, generally, pre-service teachers in Malaysia also agreed that their TPACK mastery level before and after field experience was above average regarding the effective integration of ICT in teaching. Table 5.12 presents the mean scores and standard deviations of TPACK domains for the pre- and post-survey (n = 99) distributed in Malaysia. Pre-service teachers in Malaysia rated TPK as the highest domain before field experience and the lowest domain was TK. After field experience, the highest mean scores rated were for TPK and PK. TK remained as the lowest mean score. Although the mean score for TK was the lowest among the seven domains of perceptions of TPACK understanding, on average, it appears that the pre-service teachers have the necessary technological knowledge to be able to use ICT in teaching (see section 7.2 for further discussions).

Table 5.12: Mean scores and standard deviations of TPACK domains and differences between pre- and post-survey (n = 99) in Malaysia

Domain subscales	Pre-survey		Post-survey		Difference
	Mean	SD	Mean	SD	
TK	3.76	.51	3.78	.37	+ 0.02
CK	3.85	.49	3.98	.38	+ 0.13
PK	3.93	.49	4.06	.38	+ 0.13
PCK	3.84	.46	3.96	.34	+ 0.12
TCK	3.91	.41	3.97	.42	+ 0.06
TPK	4.02	.42	4.06	.35	+ 0.04
TPACK	3.91	.42	3.99	.41	+ 0.08

Further examination of the pre-service teachers' perceptions of their own TPACK level was undertaken to identify the specific skills/knowledge within each TPACK domain that pre-service teachers rated the highest and the lowest. The findings indicated that pre-service teachers rated the same items (TK2), (CK2), (PCK2), (TCK2) and (TPK3) in TK, CK, PCK, TCK and TPK domains respectively as the highest mean score in the pre-survey and the post-survey (see further descriptions of the items as presented in the following section). They also rated the same items (TK3), (CK6), (PK5) and (TPACK4) as the lowest mean scores in the pre- and post-survey. Details of these items are presented next. Table 5.13 gives an account of the highest and lowest mean scores of TPACK items by domain, rated before and after field experience in the Malaysian case study.

Table 5.13: The highest and lowest mean scores of TPACK items for each domain, rated before and after field experience for Malaysian pre-service teachers (n=99)

	TPACK Domains	Highest Mean Score			Lowest Mean Score		
		Item	M	SD	Item	M	SD
Pre-survey	TK	**TK2**	4.18	.63	**TK3**	3.58	.69
	CK	**CK2**	3.95	.61	**CK6**	3.75	.71
	PK	PK1	4.02	.59	**PK5**	3.79	.64
	PCK	**PCK2**	3.92	.62	PCK3	3.71	.59
	TCK	**TCK2**	3.99	.48	TCK1	3.81	.57
	TPK	**TPK3**	4.22	.66	TPK1	3.92	.53
	TPACK	TPACK2	4.00	.47	**TPACK4**	3.72	.66
Post-survey	TK	**TK2**	4.02	.55	**TK3**	3.64	.52
	CK	**CK2**	4.07	.44	**CK6**	3.85	.52
	PK	PK2	4.11	.51	**PK5**	4.01	.54
	PCK	**PCK2**	4.05	.41	PCK4	3.90	.46
	TCK	**TCK2**	4.04	.57	TCK5	3.92	.57
	TPK	**TPK3**	4.25	.63	TPK4	3.94	.49
	TPACK	TPACK1	4.03	.50	**TPACK4**	3.90	.61

Note: Items in bold text are those which were rated lowest and highest for each domain of TPACK in the pre- and post- survey to highlight that they were the same items.

Generally, pre-service teachers perceived that they can "keep up with important new technologies" (TK2) before and after completing their field experience. After field experience, pre-service teachers rated item TK3 "know about a lot of different technologies" as the lowest mean score in both surveys. This suggests that the lack of technologies exposure during field experience could also contribute to the low rating of TK (see section 6.3 for further clarification). Furthermore, item CK2 in CK domain which was rated as the highest in both surveys indicated that pre-service teachers agreed that they "had various ways and strategies of developing their understanding of subject matter" before field experience; and the level of particular knowledge had increased after field experience. However, the pre-service teachers agreed that they were unlikely to feel "comfortable in planning the sequence of concepts that need to be taught within their class" (CK6), this item having the lowest mean score in the pre-survey and the post survey. This could be explained by the level of support from cooperating teachers during their field experience (see section 7.2.8.3 for further discussion).

With regards to the Pedagogical Knowledge (PK) domain, the highest mean score before field experience (M = 4.02, SD = .59) was for item PK1, "I know how to assess student performance in a classroom"; after field experience it was for item PK2 (M = 4.11, SD = .51), "I can adapt my teaching based upon what students currently understand or do not understand". Although the different items rated as the highest mean score in PK domain, pre- and post-survey, the same item was rated as the lowest mean score. This item was PK5, "I know how to organize and maintain classroom management" which rated (M = 3.79, SD = .64) before field experience and (M = 4.01, SD = .54) after field experience. The challenges that pre-service teachers had experienced during their field experience may justify the lowest mean score of this item (see section 6.3 for further clarification).

In PCK domain, for example, the majority of pre-service teachers who had participated in both surveys agreed that they "could produce lesson plans with a good understanding of the topic in their subject matter that needed to be taught" (PCK2) before and after field experience. They also agreed that, to a certain extent, they "could anticipate student misconceptions within a particular topic" (PCK3) even though it was their lowest mean score in PCK domain prior to the field experience. After field experience, even though they agreed that they "could assist students in identifying connections between various concepts in the subject matter" (PCK4), yet the findings indicated that it was the lowest mean score. Presumably, pre-service teachers thought that they could assist the students in solving their misconceptions, however, to assist the student in recognizing a relationship between numerous concepts learnt was somehow more difficult to achieve and was necessary before they could assist the students in solving their misconceptions.

From pre-survey analysis, as shown in Table 5.13, item 2 in TCK domain was the highest mean score, whereby participants agreed that "I know how my subject matter can be represented by the application of technology". The lowest mean score was for item TCK1, "I know about technologies that I can use for teaching specific concepts in my subject matter". After ten weeks of teaching practice, again the pre-service teachers perceived that they "know how their subject matter can be

represented by the application of technology" (TCK2). Pre-service teachers also acknowledged that on average they had "developed the knowledge about technologies that they could use for teaching specific concepts in the subject" (TCK1) which previously they had rated as the lowest mean score in TCK domain. Consequently itemTCK5, "I use various types of technologies to deliver the content of my subject matter" was found to be the lowest mean score rated by pre-service teachers in the post-survey.

For TPK domain, on average, pre-service teachers in the Malaysian case study acknowledged that the "Teacher education programme has stimulated them to think more deeply about how technology could influence the teaching approaches used in the classroom" (TPK3). This rated as the highest mean score before and after field experience. Even though they rated item 1 in TPK domain, "I can choose technologies that enhance the teaching approaches for a lesson" as the lowest mean score before field experience, however, in the post-survey, they rated "thinking critically about how to use technology in the classroom" as the lowest mean score for items rated in TPK domain. For the intersection domain, TPACK, the highest mean score was for item TPACK2 as they perceived that they "can select technologies to use in the classroom that enhance what they teach, how they teach, and what students learn" before field experience. In contrast, after field experience, the post-survey findings showed that the highest mean score in the TPACK domain was for item TPACK1 which indicated that they "can teach lessons that appropriately combine their subject matter, technologies, and teaching approaches". Though it was the lowest mean score rated in TPACK domain before and after field experience, on average, pre-service teachers in Malaysia perceived that they "can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at the school" (TPACK4). (See section 6.3.1 on Ida's case story for further explanations).

5.3.3 Are there any significant differences in pre-service teachers' perceptions of all seven domains of TPACK level (TK, CK, PK, PCK, TPK, TCK, and TPACK) before and after completing field experience in a school?

Generally, there was a small improvement between pre- and post-survey mean scores on all seven TPACK constructs as presented in Table 5.14. In order to look for any significant differences among pre-service teachers, Malaysian data was analysed from 99 respondents who had participated in both surveys. Findings indicated that the only significant differences between the pre- and post-surveys were found in CK, PK and PCK domains. The findings also showed that the Cohen's d of .30 for CK, PK and PCK, indicated a small effect size (Cohen, 1988) of differences found in the three-mentioned domains (see details in section 7.3).

Table 5.14: Mean scores, standard deviations and effect size of TPACK domains for pre- and post-survey (n = 99) in Malaysia

Domain subscales	Pre-survey		Post-survey		T	Effect Size (Cohen's d)
	Mean	SD	Mean	SD		
TK	3.76	.52	3.78	.37		
CK	3.85	.49	3.98	.38	2.37*	.30
PK	3.93	.49	4.06	.38	2.21*	.30
PCK	3.84	.46	3.96	.34	2.37*	.30
TCK	3.91	.41	3.97	.42		
TPK	4.02	.42	4.06	.35		
TPACK	3.91	.42	3.99	.41		

Note: *. t-value is significant at p <.05; Cohen's d values were presented for TPACK domains with the significant difference

5.3.4 Further Analysis of Malaysian Data: CK and PK

Following further analysis conducted similarly to that of the New Zealand data, the Malaysian data was then analysed based on the subgroup major taken by the pre-service teachers. The analysis conducted with the TPACK domains showed significant differences between the pre-survey and post-survey in CK, PK and PCK levels. Though the TPACK domain did not show a significant difference, it was essential to include the TPACK domain in this analysis section because TPACK as a whole covers the necessary knowledge for pre-service teachers to effectively integrate ICT in teaching. Pre-service teachers in the Malaysian case study were grouped into four major courses taken in the teacher education programme,

namely, Information Technology (IT), Accounting, Business Management and Moral Education. The Malaysian data showed small differences in CK, PK and PCK. Thus, the researcher has decided to present and discuss the individual domains CK and PK, in this section, and the results of further analysis for PCK and TPACK are presented in section 5.3.5. Generally, the findings indicated that some students faced challenges during field experience which consequently influenced their perceptions of CK and PK level in the post-survey. As presented in Table 5.15, the number of students rating 'agree' increased in all groups of major courses, except for IT major group with two pre-service teachers rating neither 'agree' nor 'disagree' that they had developed their CK level after field experience. As for PK, more than half of the pre-service teachers from each major group rated 'agree' in the PK domain before and after field experience. A big positive difference was observed among Moral Education students; however, two students remained 'neutral' about their Pedagogical Knowledge after field experience.

Table 5.15: Distribution of participants' ratings for CK and PK by subgroup of major in pre- and post-survey (n = 99) in Malaysia

Domain			Group of major course (distribution of participants' ratings)			
			IT	Acc	BM	Moral
CK	Pre- Survey	Disagree	0	0	0	0
		Neutral	0	4	6	8
		Agree	21	18	15	27
	Post- Survey	Disagree	0	0	0	0
		Neutral	2	2	1	2
		Agree	19	20	20	33
Differences between pre- and post-survey		*Disagree*	*n.a*	*n.a*	*n.a*	*n.a*
		Neutral	*+2*	*-2*	*-5*	*-6*
		Agree	*-2*	*+2*	*+5*	*+6*
PK	Pre- Survey	Disagree	0	0	0	0
		Neutral	2	3	2	9
		Agree	19	19	19	26
	Post- Survey	Disagree	0	0	0	0
		Neutral	1	3	2	2
		Agree	20	19	19	33
Differences between pre- and post-survey		*Disagree*	*n.a*	*n.a*	*n.a*	*n.a*
		Neutral	*-1*	*0*	*0*	*-7*
		Agree	*+1*	*0*	*0*	*+7*

Note: 0 = no change of participants' ratings; n.a = none; + sign with figure = number of participants' ratings increased in the post-survey; - sign with figure = number of participants' ratings decreased in the post-survey; IT=Information Technology Major; Acc=Accounting Major; BM=Business Management Major; Moral=Moral Education Major

Close observation of the data found that there was a negative direction for changes in CK domain among Information Technology student teachers. Some examples of the cases are shown in Table 5.16. The two pre-service teachers who had changed their rating from 'agree' to 'neutral' were both from Moral Education (minor) with one of the two participants being Lynna who participated in the follow-up stages (interviews and classroom observation) in this study. Details of the negative direction are presented and discussed in section 6.3.1. Other cases also showed a similar pattern to that observed among IT major students.

Table 5.16: Changes of pre-service teachers' perception of CK level after field experience in Malaysia

Major	Rating of CK in the pre-survey		Rating towards CK in the post-survey	
Information Technology	Disagree	0	Disagree	0
			Neutral	0
			Agree	0
	Neutral	0	Disagree	0
			Neutral	0
			Agree	0
	Agree	21	Disagree	0
			Neutral	2
			Agree	19

Table 5.17 presents the changes of pre-service teachers' ratings of PK level after field experience for Accounting major students. These two majors were chosen because there were unexpected movements of pre-service teachers' rating of their PK. For example, though the number of Accounting pre-service teachers who had rated 'neutral' did not change (n=3), it was observed that they were different respondents who had rated 'neutral' in the pre-survey and post-survey. This indicated that all three respondents who had previously rated 'neutral' in the pre-survey moved to 'agree' in their rating of PK in the post-survey. However, the other three respondents who rated 'agree' in the pre-survey had changed their perceptions of PK to 'neutral' in the post-survey. Additionally, from the three

respondents, two of them (#48 and #49) also rated 'neutral' for CK in the post-survey. This could be due to the subject taught not being their content expertise area (refer section 7.2.8.3 for details).

Table 5.17: Changes of pre-service teachers' perception of PK level after field experience in Malaysia

Major	Rating of PK in the pre-survey		Rating towards PK in the post-survey	
Accounting	Disagree	0	Disagree Neutral Agree	0 0 0
	Neutral	3	Disagree Neutral Agree	0 0 3
	Agree	19	Disagree Neutral Agree	0 3 16

5.3.5   Further Analysis of Malaysian Data: PCK and TPACK

We could see that almost all pre-service teachers perceived that they had the knowledge of practising the PCK, yet some students still struggled to understand their PCK mastery level (see table 5.18). Only a few students from Information Technology and Mathematics majors had rated 'neutral' while half of the Accounting and Moral Education students rated 'neutral' for PCK in the pre-survey. However, the 'neutral' rating decreased to three students for both Accounting and Moral Education majors in the post-survey. For TPACK domain, there were minimal changes of participants' ratings from 'neutral' to 'agree' for Information Technology, Accounting and Business Management students. Moral Education students, on the other hand, showed negative changes in their TPACK rating with an increased number of students rating'neutral' in the post-survey.

Table 5.18: Distribution of participants' ratings for PCK and TPACK by subgroup of major in pre- and post-survey in Malaysia

Domain			Group of major course (distribution of participants' rating)			
			IT	Acc	BM	Moral
PCK	Pre-Survey	Disagree	0	0	0	0
		Neutral	1	8	5	12
		Agree	20	14	16	23
	Post-Survey	Disagree	0	0	0	0
		Neutral	1	3	2	3
		Agree	20	19	19	32
Differences between pre- and post-survey		*Disagree*	*n.a*	*n.a*	*n.a*	*n.a*
		Neutral	*0*	*-5*	*-3*	*-9*
		Agree	*0*	*+5*	*+3*	*+9*
TPACK	Pre-	Disagree	0	0	0	0
		Neutral	1	5	4	4
		Agree	20	17	17	31
	Post-	Disagree	0	0	0	0
		Neutral	0	4	2	6
		Agree	21	18	19	29
Differences between pre- and post-survey		*Disagree*	*n.a*	*n.a*	*n.a*	*n.a*
		Neutral	*-1*	*-1*	*-2*	*+2*
		Agree	*+1*	*+1*	*+2*	*-2*

Note: 0 = no change of participants' ratings; n.a = none; + sign with figure = number of participants' ratings increased in the post-survey; - sign with figure = number of participants' ratings decreased in the post-survey; IT=Information Technology Major; Acc=Accounting Major; BM=Business Management Major; Moral=Moral Education Major;

Table 5.19 shows the changes of pre-service teachers' ratings of PCK in the post-survey. The findings did not indicate any unusual cases, with the movement of the pre-service teachers' rating in a positive direction. Additionally, as expected, it was observed that pre-service teachers changed their rating from high to low and vice versa as they proceeded with their field experience. Similar situations were also observed with students from other majors.

Table 5.19: Changes in pre-service teachers' perception of PCK level after field experience in Malaysia

Major	Rating of PCK in the pre-survey		Rating towards PCK in the post-survey	
Information Technology	Disagree	0	Disagree Neutral Agree	0 0 0
	Neutral	1	Disagree Neutral Agree	0 0 1
	Agree	20	Disagree Neutral Agree	0 1 19

There were not many unusual changes of movement observed in the TPACK domain in the Malaysian context. An in-depth inspection of the TPACK domain among Moral Education students, for example, showed that four participants had rated 'neutral' for TPACK in the pre-survey (see Table 5.20). From those four students, one student (#41) remained 'neutral' in the post-survey, whereas the other three participants had changed their perceptions of TPACK level to 'agree'. Moreover, the increasing number of participants rating 'neutral' in the post-survey was observed with another five students who originally rated 'agree' in the pre-survey but changed to 'neutral' in the post-survey (see details in section 7.3).

Table 5.20: Changes in pre-service teachers' perception of TPACK level after field experience in Malaysia

Major	Rating of TPACK in the pre-survey		Rating towards TPACK in the post-survey	
Moral Education	Disagree	0	Disagree Neutral Agree	0 0 0
	Neutral	4	Disagree Neutral Agree	0 1 3
	Agree	31	Disagree Neutral Agree	0 5 26

5.4 Chapter Summary

To summarize, pre-service teachers in New Zealand rated their CK as the highest mean score before and after field experience, whereas, Malaysian students rated

their TPK as the highest mean score before and after field experience. Additionally, pre-service teachers from both case studies rated their TK as the lowest mean score in the pre- and post-surveys. Both New Zealand and Malaysian participants showed improvements in a positive and predicted direction. New Zealand and Malaysian pre-service teachers had puzzling findings on the TPACK survey, although they did improve significantly in some of the TPACK domains. There was a medium effect size in PK and TPACK and a small effect size in TK, PCK and TCK for the New Zealand data. As for the Malaysian data, there was a small effect size for CK, PK and PCK. Further analysis of the New Zealand and Malaysian data indicated that some cases changed in an unexpected direction. Clearly, as indicated in the earlier chapter on the survey itself, there were measurement difficulties with this instrument. Furthermore, there was a question as to whether we should expect the pre-service teachers' perception of their TPACK levels to be an accurate measure of their actual development of TPACK (see section 7.2 for further discussion). Thus, the next chapter uses some case studies to delve further into these puzzling findings. The following chapter, Chapter 6, mainly discusses pre-service teachers' concerns about ICT integration and their development of TPACK and experience of ICT practice in schools from a qualitative perspective. In-depth stories are presented based on three pre-service teachers' data in New Zealand and seven pre-service teachers in the Malaysian context. It is expected that pre-service teachers would change in a positive direction after completing field experience. However, some pre-service teachers who participated in the follow-up study remained the same or changed in a negative direction in some of the TPACK domains.

CHAPTER 6: PARTICIPANTS' CASE STORIES

6.1   Introduction

This chapter presents a rich description of participants' data gathered in the two case study contexts: New Zealand and Malaysia. The chapter begins with a presentation of the context of Case Study 1 in New Zealand which focuses on how ICT knowledge and skills were developed during field experience, and the development of pre-service teachers' TPACK level. A description is provided of the participants' backgrounds structured in the context of the three schools in which they undertook their field experience. Then, two participants' case stories are presented. This structure is also used for the second part of the chapter which deals with Case Study 2: Malaysia. In presenting the case stories, theme-based narrative style (Yin, 2009) was chosen which was guided by the research questions in this study and then was later used to form a basis for cross-case analysis. Chapter 6 uses case stories to delve further into those unusual findings discussed in the previous chapter.

This chapter mainly discusses pre-service teachers' concerns about ICT integration, their development of TPACK and their experience of ICT practice in schools from a qualitative perspective. Two in-depth stories are presented, the first based on three pre-service teachers' data in New Zealand and the second based on seven pre-service teachers in the Malaysian context. The first part of Chapter 6 covers the case stories of Vanessa, who completed her field experience at Secondary School A (SSA) and Paige at Secondary School B (SSB). Data from Melinda, who had her field experience at Secondary School C (SSC) was used to triangulate the case story of Vanessa because they were in the same major and perceived their TPACK level as being 'good'. The second part of Chapter 6 maps out the case story of Ida, who completed her field experience at Secondary School D (SSD) and Zaman at Secondary School F (SSF). Data from other pre-service teachers are triangulated within Ida's and Zaman's case stories.

The three research questions used to structure the case stories are:

1) What concerns do pre-service teachers have about integration of ICT in schools and do they change with field experience?

2) What do pre-service teachers understand about the TPACK mastery levels needed to effectively integrate ICT in teaching?

3) How do these pre-service teachers develop their TPACK levels and their practice with ICT in schools?

6.2   Case Study 1: New Zealand

There were three pre-service teachers who participated in this aspect of the study. They were continuing graduate professionals who had previous qualifications and differed in age and courses taken. Table 6.1 presents an overview of the three case participants. For the purposes of this study, in order to ensure participants' anonymity, the participating students were given the pseudonyms: Vanessa, Paige and Melinda (as agreed by them). The researcher commences this section with a description of the three secondary schools in which the three pre-service teachers completed their field experience: Secondary School A (SSA), Secondary School B (SSB) and Secondary School C (SSC) (see Table 6.1). Each part includes a reconstruction of the background of the pre-service teacher placed in that particular school. This section is followed by two case stories of Vanessa and Paige to further describe their experiences and development of ICT knowledge and skill, and TPACK level during field experience.

Participants' stories are presented thematically based on the research questions, and on themes which emerged from the data. Several themes emerged in relation to the pre-service teachers' concerns about integration of ICT during their field experience, namely, ICT access, technical issues, school procedure, support and classroom management. Participants' TPACK level was described and structured according to the individual domains: TK, CK and PK, and the combination domains: PCK, TCK, TPK and TPACK. To answer how pre-service teachers can develop TPACK and their practice with ICT in schools, the case stories were structured into three themes: teacher preparation programme, field experience and support. Participant's actual words are written in italics.

Table 6.1: Overview of three participants in New Zealand

School	n	Participant	Associate Teacher (AT)	Visiting Lecturer (VL)
SSA	1	Vanessa	ATA1 ATA2 ATA3	VLA
SSB	1	Paige	ATB1 ATB2 ATB3 ATB4	VLB
SSC	1	Melinda	ATC1 ATC2 ATC3	VLC

Secondary School A (SSA)

Vanessa completed her seven-week field experience at Secondary School A (SSA) which is a secondary school in a suburb of Christchurch, New Zealand. SSA became one of New Zealand's larger secondary schools during the 1970s, with a roll of over 1600 pupils. SSA also serves a relatively low socio-economic area of industrial southeast Christchurch, and promotes sporting achievement alongside academic achievement. Vanessa, with a major in ICT and minor in Economics, had more advanced use of ICT because of her advanced knowledge and her participation as a volunteer in an ICT project led by New Zealand Association for Computing, Digital and Information Technology Teachers. During the period of field experience, Vanessa was assigned to three associate teachers: one in Economics and two in ICT, as well as one visiting lecturer, VLA.

Secondary School B (SSB)

Paige completed her seven-week field experience at Secondary School B (SSB), a single sex state secondary school in Christchurch, New Zealand. SSB is well provided with excellent facilities and equipment. Paige observed that there was a projector in every classroom and the computers were also networked. Paige was majoring in Social Studies with a minor in Geography. During her seven-week field experience, Paige was guided by one associate teacher for her Social Studies, two associates for History and one associate for the Year 9 Mathematics classes, as well as one visiting lecturer, VLB.

Secondary School C (SSC)

Secondary School C (SSC) is one of the largest secondary schools in New Zealand with more than 2000 students and 200 staff. Melinda took ICT as her major and a minor in Mathematics. She was guided by three associate teachers; two in Mathematics and one in ICT during her field experience at SSC, as well as one visiting lecturer, VLC.

6.2.1   Case Story One:Vanessa's Story

The researcher chose to present Vanessa's story of her experiences and development of ICT knowledge and TPACK during field experience because Vanessa took an ICT major, and perceived that she had a good TPACK level; however she completed her field experience at SSA which had limited ICT facilities. Melinda's story was incorporated within Vanessa's story because they took the same major and were well-versed in ICT. They had relatively similar backgrounds and perceptions, however, the different contexts in which they had their field experience indirectly influenced their use of ICT in teaching. Vanessa's story demonstrates how she developed her confidence, ICT knowledge and skills and understanding of TPACK level.

6.2.1.1   What concerns do pre-service teachers have about integration of ICT in schools and do they change with field experience?

Vanessa viewed ICT use as important in classroom instruction, although she also noted some concerns which included accessibility, stating that "*having access to computers is a bit of a problem*". She realized the need to plan ahead for ICT access because that accessibility required "*you to book in the time*" for the students to use the computers. She felt that since technology was limited at the school, it was a challenge getting the students excited and interested. She was also concerned that the students would get bored. For instance, in her Economics class, there were different ways to teach the class that might include the use of word-based puzzles to reinforce definitions, because Economics relies so much upon definitions. For example, the students could build a crossword, but there was not enough access to technology to do these sorts of activities. The class could only get over to the computer lab about once a week or even as little as twice in a six-week period, and

130

the rest of the time they were reliant upon worksheets, activities and so on. Therefore, Vanessa's concern was that in her Economics class, which some may regard as a boring subject, the students were relegated to learning in a way that was not motivating or interesting to them as individual students.

Furthermore, Vanessa felt that the biggest problem was that the Internet would '*go down*' and that it was unreliable. She felt that she was always teaching in a computer lab for her ICT subject and having the Internet being unreliable was a challenge. The students needed to have access to their documents on the server, and with the network always 'going down' it made the hardware issues more of a problem. In her Economics classes she did not have access to any kinds of technology. She found that trying to teach without technology was also very challenging. Teaching was reliant upon her spoken instruction, the whiteboard and handouts. Additionally, because it was close to exam time, there was so much competition between all the other classes for rooms, and limited resources and Vanessa was low on the priority list in this regard.

In relation to teaching the ICT subject, this was not a concern for Vanessa and Melinda because it was their major. However, a bigger challenge for Vanessa was "*to integrate non-ICT into the lesson*" because she did not want the students simply sitting in front of a computer. The students were boisterous and excited so they got easily bored doing the same things. For example, the spreadsheet unit was organised to be taught for four weeks, so Vanessa did not want the students getting bored and feeling that they were learning the same thing repeatedly. Therefore, even when ICT was integrated in teaching, it was a challenge for Vanessa to keep the students interested and involved. Moreover, Vanessa noted that it was important for her to know what was allowed in the classrooms at any given time. The policies regarding the usage of iPods and cell phones was different for every school and students would say that they were allowed to use an item, but this had to be verified by the teacher first.

Melinda also agreed that ICT use could enhance her teaching and motivate students' learning, however, that would depend upon the school. She noted that if the school finances were healthy, they could provide good ICT facilities to teachers and students. As Melinda was placed at a school with very good ICT facilities, she did not have any major issues regarding ICT use in teaching. However, as with Vanessa's concerns about classroom management, Melinda also had concerns about the same issue. This was also emphasized by her visiting lecturer after his first school visit at SSC. Furthermore, Melinda stated that she felt overwhelmed about having her field experience at SSC as she noted that the school was a large and successful school.

6.2.1.2   What do pre-service teachers understand about the TPACK mastery levels needed to effectively integrate ICT in teaching?

From the quantitative finding, it was noted that Vanessa and Melinda perceived that they had 'good' TPACK levels. Furthermore, from the interview findings, Vanessa and Melinda showed that they understood about TPACK and that their knowledge developed during their field experience.

Vanessa rated 'agree' in all TPACK domains. However, after field experience, whilst TK, PK, PCK, TPK and TPACK remained at the same level, she rated a negative change in her CK and a positive change of her TCK. The negative change in her CK in the survey was supported in the third interview session after field experience, "*because I don't use Economics every day it's quite rusty*". Thus Vanessa needed to revise the work before continuing her teaching. In contrast with her ICT subject, "*all of the content is not a problem for me at all, but there is still so much more that needs to be maintained and upgraded*" (Vanessa, 3rd interview, 2010).

Melinda rated 'agree' for all TPACK domains before and after field experience. She further articulated that there was not much teaching involved during her field experience as the students had a group discussion about the project on which they were working. Thus, "*ICT use was not really there*" which explains why her TK

remained at the same level as rated in the pre-survey. However, in the third interview session after field experience, Melinda agreed that she had improved her CK when there was discussion of the students' projects, and during their revision period. She added that she was not able to enhance her content knowledge during her field experience perhaps because "*student teachers have already done a degree (in most cases) on the subject they taught, thus they knew a lot about the content of that subject and they may just pick up new bits and pieces during field experience*" (Melinda, 3rd interview, 2012).

Vanessa and Melinda were very confident with their CK, specifically their ICT content knowledge. As both of them were majoring in ICT, they had few problems concerning ICT use in teaching. Vanessa had CK and TK that helped her to integrate ICT in the classroom. She had completed her diploma in ICT, so she noted that her content area was not a concern for her teaching. That said, she knew that she always needs to keep updated in her subject area, because it changes so quickly and is always being upgraded, and she always has to keep up with 'new ICT stuff'. But she was passionate and interested in the 'new stuff', so it was not a problem for her to do this. She was always happy to spend time learning new tools and new teaching materials. The same could be said for Melinda. When she described her experience during teaching practice at SSC, she was comfortable with her CK and her visiting lecturer also commented that her CK was very good. She was competent in her computer programming and, as a teacher trainee at SSC, her field experience helped her towards developing more of her CK and TK.

In relation to Vanessa's PK, she noted that her "*PK is improving all the time*", (Vanessa, 3rd interview, 2010). She knew that she needed to keep learning in this area as well, because there was so much to learn and seven weeks of field experience was not enough for her to cover everything that she needs to know. She believed that, in teaching, she has to be constantly learning, constantly looking at what works and what does not work, and be willing to try different things. She also noted that if she was being assessed, observed and recorded, she wanted to stay 'a

little bit in the safe zone'. She commented that if she were not being assessed, she would be willing to try different things and see what works.

It was a challenge for Vanessa to teach the Economics subject without using ICT, so she tried to be creative with her word puzzles and pen and paper activities. She also made templates for the students that were like a puzzle which the students had to put together to make the model, and she was teaching the concepts of the model as part of this exercise. When teaching the ICT class, Vanessa did not want the students simply sitting in front of the computers. According to her, students need a variety of learning modes to effectively absorb what is being taught. So, for instance, she might tell the students to pretend that one of the students was a robot, and another student was a programmer, and that student had to write code to tell the robot what to do. Vanessa believed that it was a good way to get ICT concepts into her ICT class without actually having to use a computer.

> "*One student is the programmer, the other student is the robot and you have to get your robot to the door. And so you have to write a code and tell your robot what to do, and so you're getting the idea of programming concepts without using a computer*" (Vanessa, 3rd interview, 2010).

In her ICT classes, she implemented ICT as a part of the daily lesson plans, so that the students were doing the ICT for themselves. She found it easy to incorporate, because this was the overall subject matter. In her Economics class, she did not have access to technology, so she obviously did not integrate ICT into this classroom. She did attempt to book an ICT room for her Economics students, and scheduled them to look at the Reserve Bank website, which would be like a field trip for the students. This would be a computer-based lesson and would take place only in the ICT room and they would have to stay in that room. She felt that using ICT in her Economics class would be 'a good thing', because it would break up the monotony of the daily lessons. Furthermore, in Economics, she did a lot of "chalk and talk," and the lessons became boring for this reason. Economics is 'dry and not

fun' if there are no experiments or field trips, so integrating ICT is the best way to teach this particular subject, in Vanessa's opinion.

In relation to TPACK development, Vanessa felt that her TPACK knowledge was "*getting there*", (Vanessa, 3rd interview, 2010) but admitted that she needed some more work. Vanessa and Melinda stated that they had TPACK sessions in Education Studies and Vanessa felt that the concepts came naturally to her and had developed during field experience. While Melinda stated in her first interview session that she did not remember that she had learnt about TPACK, however, she felt that she was comfortable with TPACK and it had developed during field experience.

> "*I kinda looked at it...sort of know what it is, in theory and they are helping us through that, but not referring to that every time so I kind of see that Education Studies was the technology side and how to teach*" (Vanessa, 3rd interview, 2010).

> "*I'm sure I've heard about it [TPACK] but I did not know where it came from*" (Melinda, 1st interview, 2012) and "*I think you have got to learn it [TPACK]*" (Melinda, 3rd interview, 2012).

6.2.1.3 How do these pre-service teachers develop their TPACK levels and their practice with ICT in schools?

Teacher Preparation Programme

Vanessa felt that her college training prepared her for field experience; that it was a 'good start' because she noted that she needs 'some good grounding' regarding basic behaviour management. Furthermore, Vanessa stated that the Initial Teacher Education programme was the most valuable part of the learning process, and that the mix of 20 weeks at university and 14 weeks of teaching practice was a good mix for this. She felt that the preparation programme needs more than one field experience to achieve mastery, and that two might be sufficient for some people, although some pre-service teachers need more teaching experience.

Vanessa felt that she was well prepared going into the first teaching practice, and felt that, in the first teaching practice, she and the other students were expected just to 'know' some behavioural management, some lesson planning, and some types of technology. The second teaching practice was much more advanced, and built upon what was learned in the first teaching practice. In the second teaching practice, she had to construct a unit plan, had to incorporate Māori language into it, had to show specific behavioural management techniques and reflective practice. She felt that, therefore, there was much more expectation that was built into her second practice.

Melinda also agreed that the teacher preparation programme had helped her in understanding more about teaching. "*I learnt about PK here [ITE]*" (Melinda, 1st interview, 2012). Furthermore, she noted that the curriculum classes were 'really helpful' in preparing her for the field experienceby understanding more about the curriculum.

Field Experience
Both Vanessa and Melinda agreed that the best way to integrate ICT in teaching is to use it, but it depends on the school as well. The Initial Teacher Education programme was based more upon theory and techniques, but putting these into practice was what made it 'come together' for Melinda and she felt that 'on the job' training had helped her even more.Vanessa admitted that she was nervous and spoke very quickly with a lot of nervous energy during her first field experience but after her second field experience, she felt that she had improved a lot. She felt much more relaxed in her second field experience and noted that her teaching style was more 'laid back' than in the first field experience. Vanessa agreed that it was best to do more practice, as opposed to continually learning new theory.

Although the peer teaching method used in ITE could assist pre-service teachers to gain confidence in teaching, Vanessa commented that she was more nervous teaching in front of her peers. She stated that there was a lot more pressure in that teaching situation because of the fact that teaching sessions were being marked for

136

'pass or fail', but, in a regular classroom, the teacher does not feel as judged because the students trust the teacher more than the teacher's peers might trust them. She asserted that the more she taught, the more she learnt, and this was especially true with her Economics subject. Moreover, Vanessa stated that she had the confidence to teach because she had completed several classes in Teacher Education and had developed her knowledge through field experience. In addition, she had two teaching practices, thus after her second teaching practice, she had more confidence in teaching. "*Yes, I felt much more comfortable and confident knowing what to expect*".

Vanessa also believed that developing ICT integration in the classroom would get easier with practice. Moreover, Vanessa believed that the teacher preparation programme was a good start, however, most of the learning occurred in the classroom itself. Vanessa further added that,

> "*they [PK] look good theoretically, but whether they worked in the classroom, you would not know until you got there [classroom]… so I think the practice has been really vital where we learn more*" (Vanessa, 3rd interview, 2010).

Vanessa stated that her TK and CK were at the top of the scale, and that her PK would rank slightly below that, but that she had improved a lot since her first practice.

As for Melinda, she stated that having field experience was "*fabulous*" and further commented that her understanding of TPACK had increased during her field experience. Melinda confidently stated that after field experience she learnt that she could teach Computer Science because the field experience was "*giving her a great basis*" for teaching.

Support

Furthermore, support from the associate teachers also played an important role in assisting pre-service teachers to develop more of their teaching and TPACK. Vanessa and Melinda stated that they had good support from their associates. Vanessa stated that she expected her associates to stay in the class to give feedback on how was she doing, "*rather than going off to do other stuff*". For example, if the class was getting 'out of control', then Vanessa hoped that the associate would be there to help her to gain some kind of control. Furthermore, Vanessa agreed that learning from the associate teachers was the best approach in developing her knowledge. They could assist with different ways of teaching as they had more teaching experience so if necessary Vanessa could apply their teaching strategies in her teaching.

However, it would be difficult if the associate expected the pre-service teacher to be like her. Vanessa stated that one of her associates commented on a specific point that she would be doing if she was teaching. The associate might think that she was helping Vanessa but "*I felt like I had to do exactly the way she would do it without having a chance to come up with my own style*". However, Vanessa also had a very understanding associate teacher, who was also willing to learn new things. According to Vanessa, this associate had been teaching Computing for 15 years, but had never used any teaching materials from the Web. Thus, when Vanessa had to teach about the Robotics topic, she used a three minute YouTube video in her teaching, and the associate commented that "*Oh, that was so cool*". Indirectly, Vanessa had inspired her associate to do things a little bit differently than she was used to and that benefited both of them. "*Yeah exactly, sharing from each other so it's a kind of win-win situation*" (Vanessa, 3rd interview, 2010).

As for Melinda, her associate was really supportive and always in the class during her teaching sessions. Melinda stated that her associate had 'so much knowledge' and helped her with the teaching resources too.

Vanessa also found that she was using technology more in her second field experience, but her use of technology depended upon the school. For instance, she said that the 'setup' in the school where she had her first teaching practice was not as good at SSA; everything was on a white board or an overhead projector. However, she admitted that the white board actually had its good points, because just the act of writing on the board while the students were watching had more impact than if the students were simply looking at a PowerPoint. She felt that using the overhead projector was kind of a novelty for the students, gave them something different to look at, and captured their interest. If the information was displayed all the time, the students might become bored. Vanessa felt that the low-tech methods of teaching with the white board and overhead projector actually had advantages over some of the more high-tech methods of teaching, including the use of PowerPoint. She noted that using PowerPoint once in every two lessons gives more impact than using it all the time, and could give more of the "*wow*" factor for the students. She felt that the same thing would happen if she had the students watch a YouTube clip every day. Using YouTube once a week would be much more effective and would give the students a great deal more novelty.

Vanessa also had a lot of interaction with the ICT technical staff and she noted that she could build up her skills in that area. Furthermore, the external ICT community was very strong as Vanessa had participated in the New Zealand Association of Computing and Information Technology Teachers (NZACDITT) and volunteered to help them to write resources for the new Digital Technology standards. Similarly, Melinda also had participated in the Multimedia Training and agreed that she had developed her knowledge from the training.

Vanessa stated that she could develop more knowledge regarding her TK, CK and PK, but also noted that there was not enough time to develop herself in these areas. Thus, she looked for another opportunity that she could have in order to help her develop her knowledge. She was informed about a CISCO course that could help her develop in these areas, which focused upon digital infrastructure and was online and the equivalent of Year 11 or 12.

6.2.2   Case Story Two:Paige's Story

The researcher chose to present Paige's story of experiences and development of ICT knowledge and skills during her field experience for several reasons. Although Paige was not majoring in ICT nor studying ICT as an additional Teaching Study, she had the confidence to use ICT in her teaching classroom during her field experience. During her field experience, she supported ICT use in classroom instruction and she also stated that the SSB *"has more tools available to use".* Additionally, Paige was one of the two pre-service teachers who participated in the follow-up study during the first stage of data collection. Thus, both Vanessa and Paige had experienced a similar situation, being unable to participate in the classroom observation due to the Christchurch earthquake. Paige's story also demonstrates how her confidence in ICT use and TPACK developed. Furthermore, support and training were important for her to develop her knowledge and skill in teaching.

6.2.2.1   What concerns do pre-service teachers have about integration of ICT in schools and do they change with field experience?

Paige stated that she had a concern with integrating ICT in her teaching practice, because her laptop did not connect to the data projectors in the classroom. (Or, rather, it did connect, but the image did not come from the screen to the data projector). Therefore, she put everything on a memory stick and used her associate's computers in her teaching. Paige noted that ICT use could be a *"bit of a hassle".* This had happened in one of her classes, and she did not see that there was a solution. She could not print from her computer, and this had been a problem that she was not able to fix. In relation to the use of computer software, she noted that she could only use PowerPoint because she had not learned other tools. She had tried to use Prezi but did not really know much about Prezi, so she simply used PowerPoint. Paige admitted that she *"needed more time to actually learn how to use them properly to be able to integrate them [ICT]".*

Paige also experienced some technical problems when she tried to integrate ICT. The problems that she had involved attempting to embed a YouTube video in her

PowerPoint presentation which was unsuccessful. On another day, her associate was not present, so she could not use his laptop, and although there was a spare laptop, it was old and slow and would not load pages properly. She finally gave up and taught the lesson without the computer at all.

Since Paige was not an ICT major, she did not really know how her school was implementing ICT in the curriculum. But what she observed was that teachers had their own laptops to use to support their teaching and students were using all the library computers. Although Paige experienced some issues using ICT in teaching, at the end of the field experience, she could see specific reasons for integrating ICT in her teaching classroom which included that ICT "*was more enjoyable*" and "*it motivated the students to learn*". She further commented that "*all the feedback from students that I've received said that using technology in class makes it much more interesting*". Overall, she felt that her integration of ICT was 'pretty good' although she used ICT at the minimum level.

6.2.2.2   What do pre-service teachers understand about the TPACK mastery levels needed to effectively integrate ICT in teaching?

Paige rated 'agree' in all TPACK domains before field experience and remained 'agree' in all domains except for TCK and TPK which were rated as 'strongly agree' in the post-survey. This could be justified when she said that "*We won't be an effective teacher if we were lacking in one of those areas*". As described earlier in the participant's background, Paige perceived that she had a good TPACK level. She further commented that "*I don't think there was one more important than the other*" (Paige, 3rd interview, 2010). Paige continued that "*I guess you could teach without technology if you had the other two, but the lessons would be probably more boring*".

In relation to her TK, Paige agreed that she was well prepared for her field experience. She learned more about the Web 2.0 tool in the Technology course. Paige stated that she has more tools available to use, but she found that she did not have the time to actually learn how to integrate them. Furthermore, she stated that

she could develop her TK just by being exposed to the tools that she needed, along with having the time to learn them practically and work on them more. She did not have much confidence with her CK because she felt that she was not taught much about her CK during her training programme. Furthermore, she believed that whatever it was that she was teaching, she was learning them from a basic level, along with her students. This was because what she had learned at university with regards to History was not the same as what she was teaching her students. Therefore, Paige stated that her content knowledge was not adequate. Moreover, History was not even her main focus at the university as she was majoring in Social Studies, along with a minor in Geography, which complicated matters still further. However, after completing her field experience, she noted that she had developed her CK. She stated that she looked at what the schools were teaching in different year levels, and made sure that she understood the topic before she had to teach it in class and she felt that she was learning as her field experience progressed. Paige stated that her PKwas good as she had the confidence to deliver the lesson although she stated earlier that her CK was not strong enough. However, Paige agreed that she just needed to put her CK into practice, and noted that she had learnt what she needed from her associates by having them in the classroom during her teaching sessions.

As for TPACK, in general, Paige commented that she did not necessarily think about it in her teaching. She just prepared the lesson with the resources she already had. However, she still believed that she had to know the meaning of the TPACK concepts in order to make her lesson planning more successful and her teaching with ICT effective. She stated that a good teacher should have a mixture of CK, PK and TK because teachers would "*not be as effective if they were lacking in any of these three areas*". Furthermore, Paige believed that there was not one knowledge domain that was more important than another. She also agreed that it was not necessary to teach using ICT, but that, without technology, the lessons would be more boring and would not motivate the students to learn; as the students were bored in her teaching during her field experience at SSB.

6.2.2.3 How do these pre-service teachers develop their TPACK levels and their practice with ICT in schools?

Teacher Preparation Programme

Paige noted that her TK, CK and PK gained at the College of Education were adequate, and that she learned a lot about these. Her knowledge of TK was also based on what she knew prior to coming to the teacher's college. She agreed that the knowledge from the teacher preparation programme was very important; if she did not go through the teacher preparation programme she would know less than what she currently knows. She clearly articulated that she had the confidence to teach and use ICT in the classroom after she "*had done the courses*" in the teacher preparation programme.

Field Experience

Paige stated that she had developed the knowledge that she gained at the teacher's college during her field experience. She asserted that the knowledge gained during the teacher preparation programme was a foundation for her to build upon through experience. That said, she commented that the practical knowledge had been more helpful to her than the theoretical knowledge. She believed that field experience was important for pre-service teachers to practise and develop their confidence because "*the best way I'm finding to learn it is to put it into practice while I'm on placement*". Furthermore, Paige noted that "*if you have learnt what they [TPACK] were, then, you can develop it during teaching practice*". Though Paige found that most of the time during her field experience she was unfamiliar with the topic, she tried to find out what was taught in school in the different year levels in that subject and to make sure that she had learnt the topic before she got to teach the class. She was then able to teach the topic. She stated in relation to TK that "*I have been exposed to ICT tools, and then I need to just have some time actually working on them and learning them practically*" (Paige, 3rd interview, 2010). She stated earlier that she had the confidence to teach and use ICT in the classroom and that this knowledge developed through field experience.

Support

Paige stated that her associate teachers were very committed to giving her support and feedback. "*I'm just learning so much from my associates and from actually having to take a classroom and teach*" (Paige, 3rd interview, 2011), but did not really help her with integrating ICT into teaching. She also noticed that many of her associates were not well-versed in using ICT, and that, actually, she used more ICT than her associates. Perhaps, this was the reason why they were not helping her with ICT use in teaching. Moreover, Paige stated that she had the CK, but did not have as adequate TK as she would have liked, experiencing constraint of time to really learn and develop the TK. Thus, she thought that if there was someone around who had good TK, and could help her to integrate it in her teaching, then this would be a good way for her, and others like her, to integrate ICT into teaching. During field experience, Paige tried to learn more about using ICT in teaching by asking the teachers around her, in the Social Studies and History departments, with whom she shared a room. Paige stated that "*there was an IT technician who was employed by the school*" but integrating the ICT in teaching is a different knowledge than knowing how to use ICT.

6.2.2.4   Summary of Case Study 1

From the case stories presented earlier, it was found that pre-service teachers' concerns relating to ICT integration in teaching were varied depending on the school context, support and the pre-service teacher's knowledge. Specifically, their concerns were about the availability of ICT, technical issues and classroom management. Vanessa and Melinda had a good basic TK, as ICT was also their CK. They had advanced knowledge on ICT matters, so integrating the technology for them was just a matter of having access. What they wanted to know was different ways to let the students have some creativity in their learning processes. Both Vanessa and Melinda showed that their level of TPACK understanding was increased during field experience and both quantitative and qualitative data supported these findings. Paige might be more typical of many of the students in placement. She did not have much knowledge of ICT to begin with, so integrating ICT in teaching would be a challenging task for her. Additionally, she had a

difficult time trying to enhance her content knowledge. This would have taken up much of her time, as she indicated that she was learning her content alongside her students. So, it seems that there were many different ways that a school could accommodate somebody like Paige, who needs basic ICT knowledge in order to be able to use ICT in teaching.

All three pre-service teachers had something in common and it was probably something that most teachers feel – they agreed that the best way to learn was by doing. The best way to develop PK was not by theory or even by being given practical tips, but by actually teaching a class, finding out what works and how it works. Furthermore, the preparation during the Initial Teacher Education programme and support during field experience were important for them to develop more ICT skill and knowledge, and their TPACK.

6.3   Case Study 2: Malaysia

There were seven pre-service teachers who participated in Case Study 2. For the purposes of this study, in order to ensure participants' anonymity, the pre-service teachers agreed with the given pseudonyms of Ida, Adys, Lynna, Zaman, Ayu, Suria and Ramli. The following section is structured in three parts based upon the three secondary schools in which the seven pre-service teachers completed their field experience: Secondary School D (SSD), Secondary School E (SSE) and Secondary School F (SSF) (see Table 6.2). Each part includes the reconstruction of the backgrounds of the pre-service teachers placed in that particular school and their perceptions of their own TPACK mastery level, as indicated in the pre- and post-surveys. This section is followed by two case stories of Ida and Zaman to further describe their experiences and development of ICT knowledge and skill, and TPACK mastery level during field experience, triangulated with other pre-service teachers' stories.

In describing pre-service teachers' concerns about integration of ICT during their field experience, there were several themes which emerged from the data: ICT access, technical issues, student's attitude, classroom management and support

from the cooperating teacher. Participants' TPACK level was described and structured according to the individual domains: TK, CK and PK, and the combination domains: PCK, TCK, TPK and TPACK. To answer how pre-service teachers can develop TPACK and their practice with ICT in schools, the case story was structured into three themes: preparation prior to field experience, field experience and support. Participants' actual words are written in italics. Participants' stories are presented in themes based on the research questions and other themes which emerged from the data.

Table 6.2: Pre-service teachers' placement at three different schools in Malaysia

School	n	Participant	Cooperating Teacher (CT)	Visiting Lecturer (VL)
SSD	1	Ida	CTD	VLD
SSE	2	Adys	CTE	VLE
		Lynna	CTE	VLE
SSF	4	Zaman	CTF1	VLF
		Ramli	CTF2	VLF
		Ayu	CTF3	VLF
		Suria	CTF4	VLF

The seven participants involved in this study were not English first language speakers. Thus, the participants' actual words have been translated into English and the quotations are in italics. The interview participants were allowed to communicate either in the Malay language (Malaysian national language) or in the English language or a combination of the two. However, for the purpose of analysing and reporting the results, comments offered in the Malay language were carefully translated by the researcher.

Secondary School D (SSD)

Ida's teaching practice at Secondary School D (SSD) was for ten weeks from May 2011 until August 2011. SSD is a secondary school located in a rural area in Kedah. The school has approximately 800 students. In SSD, Ida was guided by her kind, helpful and cooperative cooperating teacher, CTD. CTD teaches Business to students in Form four classes and Accounting to Form five students. She was a

senior teacher with a background of vocational skills. Ida was also supervised by a visiting lecturer, VLD, who specialises in ICT in Educational Studies at one of the public universities in the northern part of Malaysia. Currently, at the time of writing her story, Ida is a pre-service teacher with a major in Business and a minor in Multimedia Interactive. At 24 years old, she is in her final year of a four-year course at the teacher education programme which she started in 2008, after completing her matriculation programme.

Secondary School E (SSE)

Adys and Lynna completed their ten-weeks of field experience at Secondary School E (SSE) from May 2011 until August 2011. SSE was established in 1999 and located in an urban area in Kedah. The school has approximately 1522 students and 93 teachers. In SSE, they were guided by a cooperating teacher, CTE. CTE teaches ICT to form four students. He has good knowledge about using ICT and is responsible for maintaining the ICT facilities at SSE. They were also supervised by a visiting lecturer, VLE, who specialises in Educational Studies at one of the public universities in Malaysia. Adys and Lynna took ICT as their major and Moral Education as their minor course. Coming from Sarawak with similar cultural backgrounds, their different personalities made their stories even more interesting. As they were guided by the same cooperating teacher and visiting lecturer, and provided with good ICT facilities to teach Computer Literacy, they were expected to integrate ICT into their teaching.

Secondary School F (SSF)

Similarly, four pre-service teachers: Zaman, Ramli, Suria and Ayu undertook their teaching practice at Secondary School F (SSF) for ten weeks from May 2011 until August 2011. SSF was located in a rural area in Penang and categorized as School Category Type B with the number of students not more than 1000 and very limited ICT facilities. At 24 years old, Ramli, Suria and Ayu were in their final year of a four-year course at the teacher education programme which they started in 2008, after completing the matriculation programme. Zaman, 25 years old, took a Diploma Programme in Accounting at one of the public universities in Malaysia

prior to the teacher education programme. All four pre-service teachers were guided by the same visiting lecturer, VLF, who specialises in Educational Studies at their public university in Malaysia. From the observation made by the researcher, SSF had no specific room for ICT purposes. They have a 'computer laboratory' without computers, while the other computer room, which was fully equipped with ICT hardware and software for teaching and learning purposes, was specifically designed for multimedia productions and for Multimedia majoring students only. The projector that could be used for teaching needed to be reserved beforehand and most of the time, the pre-service teachers conducted the session without using the projector (Ramli, 1st interview, 2011).

During their field experience at SSF, Zaman was guided by cooperating teacher, CTF1. CTF1 teaches ICT to Form two students and is responsible for handling the computer laboratory at SSF. Zaman was interested in using and teaching ICT as a student with an Information Technology Education major, and his minor was in Moral Education. At the time of data collection, he was in his final year and would be posted to the new school after completing the field experience. Ramli was a pre-service teacher with a major in Business Management and minor in Multimedia Interactive. In SSF, Ramli was guided by a cooperating teacher, CTF2. CTF2 teaches Business to students in Form four classes and Accounting to Form five students.

Ayu and Suria came from the same hometown and took the same major, Moral Education and minor, Malay Language at the Initial Teacher Education programme. Prior to the field experience, they had completed their major subjects in Moral Education and had more subjects from their minor course, Malay Language, to be completed after field experience. Ayu and Suria were guided by two different cooperating teachers: CTF3 and CTF4 respectively. Both cooperating teachers teach Malay Language at SSF. Further description of their case stories which were triangulated within Zaman's case story are in section 6.3.2: Case Story Four.

6.3.1 Case StoryThree: Ida's Story

The researcher chose to present Ida's story of experiences and development of ICT knowledge and skills during her field experience, for several reasons. First, Ida took a non-ICT major and chose Secondary School D (SSD) to complete her field experience for ten weeks. From researcher's observation and Ida's description of SSD, the school was categorized as School Category Type B, with the number of students of not more than 1000. Ida had the opportunity to use ICT during her field experience as SSD has one room designed for Technology-related classes, equipped with a liquid crystal display (lcd) projector, laptop, printer, television, whiteboard, and access to the Internet, though it was limited to the teachers' room area. The school also has one computer laboratory equipped with several computers which could be allocated for students in one classroom. Thus, it could be said that the school is well-resourced with ICT facilities. Adys and Lynna's stories were incorporated within Ida's story because they were placed in a similar school context, well-equipped with ICT facilities. Ida's story demonstrates how she developed her confidence, knowledge and skills and strove to overcome her concerns.

6.3.1.1 What concerns do pre-service teachers have about integration of ICT in schools and do they change with field experience?

From the compilation of Ida, Adys and Lynna's data, they outlined several concerns about integration of ICT in schools which include students' attitude, technical issues, students' ability to learn, and medium of instruction. Ida was worried about the ICT availability in the school, whether she was able to use ICT in her class and if it would be in good working orderprior to starting her field experience at SSD. "*From what I can see, the school does not have a projector in every class and the teacher normally uses a blackboard*". SSD had one dedicated room equipped with ICT hardware and software to be used in teaching and learning but according to Ida, the room was "*never used by any teacher in that school*" thus "t*hey need to go to the technology room if they would like to use ICT in their teaching*". Therefore, with this ICT facility, Ida did not face any problem using ICT in her teaching. Wireless internet connection was also available in SSD.

149

However, the coverage area was limited to the teachers' room only. Thus, she borrowed a broadband device from her sister for internet access at school during her field experience since the wireless connection at the school could sometimes not be accessed.

Ida felt very motivated to use ICT in her classroom even though she had experienced teaching ICT in pair work only during her micro teaching session. Ida had to teach Business to two Form four classes (aged 16 in secondary schools in Malaysia), Forms 4B and 4C. She planned to teach the rest of the subject using ICT because currently the students were taught in their classroom, teachers wrote on the blackboard and the students then copied the work into their workbooks. Consequently, Ida planned to change the routine of the classroom schedule by taking the students to the Technology room. However, the students took too much time to get to the Technology room which then prevented Ida from starting her class on time. Ida was given a list of topics to be covered during her teaching practice which pressured her to finish the topics as planned. Even though Ida perceived that her TK was at an average level prior to the field experience, Ida believed that ICT usage is very important in teaching and learning. *"We can use different types of ICT such as multimedia presentation where graphics, video and audio are all integrated"* (Ida, 3rd interview, 2011).

However, Ida faced challenges in using ICT. *"For my first classroom observation, the projector could not be switched on and the laptop could not be connected to the projector"*, thus, *"the class had to start at 9.20 am instead of 9.00 am"*. Fortunately, Ida had an alternative plan, and continued the class using the whiteboard. *"I can start the class without the ICT as all students were in the classroom but since I planned to show a video, I was trying to show the video, but I could not"* (Ida, 3rd interview, 2011).

As explained, Ida had some issues regarding ICT use at SSD. Although the situation with Adys and Lynna was different at SSE, with a fully equipped computer laboratory, they still had problems when it came to use of ICT in their

teaching. Access to the ICT facilities was not a problem for Adys and Lynna, yet the integration of ICT in teaching and learning was under-utilised. Adys and Lynna were aware that delivering only the theoretical topics to the students could make the subject less interesting and more difficult to understand. Thus, in order to teach their subjects, especially Computer Literacy, Adys and Lynna needed to be able to demonstrate the practical part as the students needed to "*see it*" in order "*to learn more*". But they were afraid of taking responsibility for handling the computer parts, and demonstrating the 'how' part to the students.

> "*I couldn't open the hardware easily because I only learn the theories and have lack of practical knowledge about hardware. I'm afraid if these things get broken down, it's the school's properties and we have to be responsible for it*" (Adys, 1st interview, 2011).

When Ida described her field experience at SSD, she also pointed out that students' attitudes were one of her major concerns. She felt that she could not handle the classes well enough to proceed with the use of ICT in her teaching. Students did not have the interest to learn when she started her first introduction class. They always had an excuse to leave the class. One of the big challenges to her was having all boys in her class because the students had options to choose between Business or Home Economics and usually, the girls chose Home Economics. Ida did not have a problem with time management but she was worried about the students who could not read. "*I am really worried with the students' attitude especially because for the Business subject, students are from the last class, some students cannot read and are naughty*". Another two pre-service teachers at SSE: Adys and Lynna, were also stressed by the students' attitudes. Adys in her third interview stated that,

> "*sometimes they don't even have their respect for me, not to mention that I have to waste ten minutes to calm the class down before I start teaching. There's a few students who did not show interest in the lesson and some of them didn't even bring the books for study*".

The pre-service teachers noted that there were more challenges when dealing with students in a classroom than in front of their peers as students in the micro teaching class. "*I told them[my friends] to support me during the micro teaching session but it was different when you're faced with real students*" (Lynna, 1st interview, 2011).

Ida also faced a problem when her class was scheduled before recess break. The students would not pay attention 30 minutes before the recess break because they were eager to leave the class and go for a morning break. She commented that the students did not have interest in learning and they wrote whatever the teacher asked them to write even though they did not understand the content. Ida planned to use ICT to solve the problem of students who did not have the interest to learn. Ida was worried that the students would leave the class especially during the time when her visiting lecturer came by to observe her teaching. She was informed that this also happened to a previous trainee teacher where there were no students in the class when the visiting lecturer turned up. In addition, different languages used by different cultures also influenced the pre-service teachers' and students' abilities to communicate as well as their teaching and learning process. "*I have an Indian student who didn't understand the language at all and her friend would always translate it for her before I can proceed to my teaching*" (Adys, 3rd interview, 2011).

6.3.1.2   What do pre-service teachers understand about the TPACK mastery levels needed to effectively integrate ICT in teaching?

From the pre-survey findings, Ida appeared to show that she had a good understanding of most TPACK domains except for technology knowledge with an average level of understanding. She claimed herself as a moderate user of ICT even though she took five ICT classes in the Educational Studies course. After field experience, Ida's responses showed a negative direction in her CK and PCK. However, she perceived that she had slight improvement in her TK, PK and TCK. She remained at the same level for TPK and TPACK. Ida had completed all her major courses in Business, a foundation course in Educational Technology and ICT

courses as a preparation to undergo the teaching practice. Ida took Educational Technology in the third semester in which she learned how to use a video camera, the techniques involved, how to create Powerpoint slides and ways of choosing colours. Ida also indicated that she has learnt pedagogy approaches in the Teaching Methodology course; "*we have learnt the art of preparing a syllabus at school, teaching strategies, preparing lesson plans and the skills of using Powerpoint to teach the Business subject*".

For Ida, TK was "*important for the teacher*" and "*the teacher must be aware of the changes in ICT*". TK was especially important for practising and having good ICT skills. Ida explained that if a teacher knew how to prepare Powerpoint slides but the technical skills were low, that would slow down the process of integrating ICT. Thus she believed that a teacher must have good TK because students are now becoming more interested in technology. Ida's improvement in terms of her TK was also supported when she commented that, "*at first, I asked other teachers to help me but now I feel confident to use it and help other teachers to use it*".

Ida observed that "*teaching the content using appropriate strategies with the support of technology could enhance teacher's lesson preparation and implementation*". She also noted the positive changes in her students' reactions and also their participation in the class.

Ida described her CK as "*knowledge of what to teach*" and "*a teacher must fully understand the content so that they are ready to answer any questions or queries from the students*". After four weeks in the field, Ida became more confident to talk about her content knowledge when she further commented that, "*I was a student who took Business Management and now I am a teacher who teaches Business Management*" and "*my content knowledge has increased and I understand the content more*". Ida stated that the Business subject was not too difficult to teach as she could find more materials from the Internet and relate the concepts she taught to daily live. For example, "*I gave them an example of a purchasing process which the students could relate to their daily routines, something close to them... So, they*

could remember that". Ida talked confidently about her content knowledge, *"I used to have notes when I started my field experience but now I can explain more on the topic discussed"*.

Ida rated herself at a low level for PK when she stated that *"my pedagogy knowledge is still low and I do not know much about teaching strategies"*. Ida defined pedagogy knowledge as a communication skill to be mastered. Ida stated that PK is knowledge about how to deliver the content and how to make the lesson more interesting. *"I think pedagogy knowledge is when a teacher knows how to teach the subject matter"* and *"I know how to attract students' attention in my class and use a variety of teaching strategies"* (Ida, 1st interview, 2011).

Ida also showed improvement in her PCK as rated in the surveys. *"I know for this topic, I could use this kind of teaching technique to deliver and to attract students' attention"* (Ida, 3rd interview, 2011). Ida added that she had to prepare herself before, during and after the lesson was completed. Furthermore, Ida agreed that *"the teacher needs to work on connecting all techniques with technology,"* so that *"the teaching would be more interesting"*. For Ida, communication skills are important for a teacher in order to be able to deliver the content. Otherwise, a teacher could not transfer the information to the students. Additionally, having a balance of content knowledge, communication skills, ICT and ways of delivering the content to the students was important in making the lesson more effective.

> *"When we have the content and know how to teach, then ICT is integrated to develop both content knowledge and pedagogy knowledge to support the teaching process because they are somehow interrelated in the process of creating and implementing the lesson plan"* (Ida, 3rd interview, 2011).

Ida looked for other materials from the Internet to be used in the class. She clearly defined her CK and PK. When she tried to understand Pedagogical Content Knowledge (PCK), she talked about *"the skills to teach the content"*. She was

sometimes confused between general Pedagogical Knowledge and Pedagogical Content Knowledge.

Ida stated that TK and CK were important to know and described Technological Content Knowledge as "*the skills to use ICT and deliver the content*" with an example of TCK, "*using video to show the content*". When Ida described her teaching lesson on a specific topic with the use of ICT, she explained that,

> "*I searched for related videos and used the video together with the images on a related topic and asked them to think of the topic to be learnt. Then, I used Powerpoint for the notes, did an assessment for the students with the use of ICT. I asked them to get involved during the assessment by participating in using ICT*" (Ida, 3rd interview, 2011).

Ida admitted that it was hard to understand Technological Pedagogical Knowledge (TPK). Ida stated that during her teacher education programme, she only understood Content Knowledge and Pedagogical Knowledge separately. She also added that she only had basic ICT skills. Ida agreed that she was confused about TPACK before. Even now, she could not define clearly her understanding of TPACK when she described TPACK as more about technology skills used to deliver lessons. However, she believed that "*knowing TPACK could give more benefits to teachers*" in order to effectively integrate ICT in teaching. Ida further suggested that they could use ICT in any subtopic in the subject to deliver the content. For example*, "we can use video when we teach about love and caring... the students could not imagine the love and care when they could only see the text"*. However, Ida also agreed that there are topics that are not suitable to use ICT. For example,"*if we teach calculation in Business subject, we cannot simply show Powerpoint slides*". She suggested using "*non-digital tools to show the ways of solving it."*

From Ida's statement, she strongly agreed that pre-service teachers must have the CK and PK, and by using ICT in a classroom, the learning process would be

interesting and meaningful. Ida might not know the right definition of the terms but the researcher believed that for Ida, understanding the meaning of terms would be difficult without having the opportunity to practice. She agreed that, *"TPACK was important and a 'must know' because it makes the teaching process more effective and the teaching concepts would be easier"*. Ida further commented that,

> *"I think, I use the term without even knowing about it, however, it is important for teachers to get to know the concept as they have the pedagogical knowledge, content knowledge and perhaps basic technological knowledge too and if they know what the concepts are and their purpose, I believe it would strengthen their lesson"* (Ida, 3rd interview, 2011).

Two classroom observations were conducted with Ida in order to observe her ICT use in teaching. The first classroom observation was conducted in week four, started at 9am and took place at the Technology room. For her first classroom observation, Ida had a class with Form 4B, with 26 students, 23 boys and 3 girls. The second classroom observation was held at the same room, with Form 4B students. It was observed that Ida was a bit nervous because her previous class did not proceed well during her first observation with the visiting lecturer. Students came to the Technology room twenty minutes after class started. Furthermore, her planning to use ICT failed as her laptop could not successfully connect with the projector. Ida had checked everything before the lesson, and everything seemed to be in working order. However, the class finally continued without the use of ICT. Even though Ida had experienced failure in her ICT use, she kept trying to use ICT in her class even when she was being observed and evaluated by her cooperating teacher and visiting lecturer.

Ida reflected that she had completed and achieved the learning objectives. Her visiting lecturer was very committed to support Ida in improving her teaching. VLD was satisfied with her overall performance despite his comments on her writing of lesson plans. The comments were also on the varied use of student-

centered activities and pedagogy advice. Her visiting lecturer also noted that the students showed more confidence and were committed in the class. However, he did not discuss much about the use of ICT in Ida's class.

> *"It should be stated clearer in order to measure whether the learning objectives have been achieved… The use of teaching aid was interesting and suitable. However, for induction set, it could be improved. Teaching steps need to be improved so that the content activities are in sequence"*(VLD, 1st classroom observation, 2011).

Ida faced quite a challenge with her second classroom observation when the class started 20 minutes late due to the morning assembly held every morning before the class started. However, Ida was able to start her class when all students came to the Technology room immediately after they finished the assembly. VLD commented on her successful planning for the class lesson. He rated Ida's teaching performance with a four score out of five for almost all indicators in the observation assessment form.

> *"I can see how Ida was so motivated and confident to successfully complete the class. I also noticed that the students actively participated throughout the class.Was it because other people were there in the class or they really enjoyed the class"(Researcher's Journal, 2011).*

Results of the pre-survey analysis for Adys showed that she perceived a good understanding of most TPACK domains with TK the highest score. This could be explained by her major course in ICT that contributed to her level of confidence in using ICT prior to the field experience. Additionally, similar results were observed from the post-survey analysis. Lynna, in the pre-survey, appeared to show that she had a good understanding of most TPACK domains except for technology knowledge with an average level of understanding. However, a negative change in her CK and PCK was observed in the post-survey findings. It appeared that Adys

and Lynna became more realistic in their understanding of all TPACK domains after going through the ten-week field experience.

As for Adys, in terms of delivering the content, she stated that she did better in the Moral Education class than in the ICT class. Adys was able to define her PK when she talked about "*how am I going to deliver the content accordingly suited with my students' learning level*". Lynna also explained that PK was more about controlling students and classes and how we should attract the students and manage them if they do not behave well in class.

Similarly, Adys and Lynna could not clearly define what TPACK and each of the combinations of CK, TK and PK were, but from the description of their teaching process, they showed their understanding. Adys noted that, "*the combination of content, pedagogy and technology knowledge made me a better teacher*". Mentioned earlier in her first interview, Adys was afraid to demonstrate the 'how' knowledge to the students, but, after a few weeks in the field, learning and getting to know the concepts better, Adys was able to justify the steps she made to explain the 'how' part. For instance, Adys started the lesson for a Computer Hardware topic with the theoretical part, then proceeded with the ICT use and the practical session. "*I will let them watch a video that gives more explanation about the topic and an example of how to install or configure it*" (Adys, 3rd interview, 2011). According to Adys, the students did not understand English well, thus she decided to use a video with subtitles before she further explained about the concepts being taught. "*When using a video, it was a bit easier for them [students] to understand the whole substance*" (Adys, 3rd interview, 2011).

The researcher also got the opportunity to observe Adys and Lynna at SSE twice during their field experience. Adys and Lynna had access to the computer during their teaching class of Moral Education on Human Rights. The languages used in the class were mixed as they had a number of races and some of them used their own language to communicate, thus it was hard for the teacher to understand. Some students did not understand the language of instruction: Malay language and "*it*

158

makes it hard for them to interact with the teacher". Adys had to teach the same subject to Form 2 students and she showed her capacity of understanding and teaching the subject, however, she had to develop more of her PK in order to attract students' attention. Even though she used the computer to teach the subject, she only used it for displaying the content.

For the classroom observation with Lynna when she taught the topic: Creating a Database for Information Communication Technology Literacy to Form 2 students, she used a computer laboratory which was equipped with 20 computers arranged in a four by five layout. The class had 39 students, thus one computer was assigned for two students. She used English as the language of instruction as it is necessary to use English in teaching ICT. This made the teaching and learning harder for the students to participate and limited Lynna from elaborating further about the topic taught. It was observed that Lynna showed an average level in her CK, PK and TK. It was also observed that Lynna struggled to understand and deliver her content as she gave erroneous information to the students. For the second observation, Adys and Lynna were observed for the same topic in ICT. Lynna showed less confidence compared to Adys in delivering the content.This explained the negative changes in Lynna's CK after field experience.

> *"I believed that she was too nervous having two people watching her teaching when later she came and told me that she was wrong with the information given and she will explain about the topic again in her next class"* (Researcher's Journal, 2011).

6.3.1.3   How do these pre-service teachers develop their TPACK levels and their practice with ICT in schools?

There were three main themes which emerged from the compilation of Ida, Adys and Lynna's data: preparation, field experience and support.

Teacher Preparation Programme

At the start of field experience, Ida felt that she did not have enough preparation and knowledge to start field experience because she felt that the content of the subject taught in the Teaching Methodology course was not fully explored in her programme especially for the Business subject for Form 4 and 5, "*We had to choose any topic to teach in our micro teaching session, but the teaching itself was not modeled by the lecturer and it was not enough*". So, she felt that she was not prepared to teach the subject. She needed to learn more about the teaching strategies used to deliver her subject during field experience. However, Adys and Lynna stated that the teacher preparation programme had helped them a lot especially building up the confidence for teaching. Furthermore, the programme taught them the PK to prepare them for field experience.

Field Experience

ICT was important for the pre-service teachers and Ida suggested that pre-service teachers would use ICT more often in their teaching and learning. Thus, Ida believed that field experience could assist her to enhance her knowledge and skills. For Ida, field experience was very important for pre-service teachers to get to know the school environment and students' characteristics before they go into the field for their real teaching experience. This would help her to learn about students and how students learn their subjects. Ida asserted that field experience was a training session for her because field experience provided a context "*to know how to use ICT and be proficient in doing my job*". She believed that she would need to practice the knowledge that she gained because according to her, "*if we learn but we cannot practice and transfer the knowledge, it will not do any good for the students and teachers*".

Field experience also provides pre-service teachers with an opportunity to face the school environment from day one until the end of their field experience. Ida believed that she could understand more about the TPACK concepts during her field experience. Adys and Lynna also agreed that the field experience helped them to understand and develop their CK, PK, TK and the combination of those. Ida added if they could have two practicums that would add more opportunities

because she could communicate and learn more during field experience. For example, if the school had limited classes for the Business subject, it could not have pre-service teachers to teach that subject. Thus, Ida chose to go to the school (SSD) which could offer a place for her to teach her major subject: Business Management. In order to take the opportunity to learn and develop more during field experience, Ida decided to go to that school even though she would be the only student teacher there.

> "*If my friend and I go to the same school together, the principal would not let both of us teach the same subject even though we are from the same major. One of us will need to teach other than our major subject matter and this will not give us a chance to develop the content knowledge and the teaching skills in our subject matter. Thus, we decided to go to a different school*" (Ida, 1st interview, 2011).

For Ida, another good thing about being the only teacher trainee at the school was she would have the opportunity to mix with other teachers and she stated that it was "*a good opportunity because I hope to learn more from other teachers about teaching*". However, a different approach was taken by both Adys and Lynna, as they applied for the teaching practice at the same school. They thought it would be a good opportunity for them to cooperate and help each other during field experience. On top of that, the school could offer them enough classes to teach for their ICT major and Moral Education minor.

With regards to teaching strategies, Ida noted that she had learnt about how to pose questions to students in a classroom but during field experience "*it was not as easy doing it*". During field experience, Ida could practise the stages involved in questioning skills and could also connect the implementation with her previous knowledge and experience it herself. Furthermore, she felt more confident using ICT. She had rated herself at an average level in the pre-survey but improved after field experience. Ida stated that, "*field experience really helps me to develop my ICT skills and given the school had good ICT access too*" and her visiting lecturer

also believed that, "*the school environment supported her to successfully complete her field experience*" (VLD, 3rd interview, 2011). Ida was actually prepared with ICT or without ICT during her field experience, because some schools do not have ICT infrastructure. Therefore, as a new teacher, she suggested one should be prepared to teach with and without ICT in the classroom.

Ida also stressed the importance of field experience to assist pre-service teachers in practising the knowledge and skills in a classroom environment and also in integrating ICT in teaching. Initially, Ida felt that completing field experience was really challenging with the various backgrounds of the students. However, once she got to know them, they were more approachable. Students were used to learn in a traditional setting of learning instruction, but, "*when I brought them to the technology room, they asked me whether they were going to the technology room for their next class*". Her students could adapt to her teaching style and "*they were also interested to learn using ICT because they could create mind maps with the Powerpoint, note making using Powerpoint*". According to Ida, her cooperating teacher was surprised when "*the students did not sleep in my class, whilst, they were always sleeping in her class*".

Support

Ida would seek help from her mentor regarding teaching strategies and motivating the students to learn. "*I will try to create ways for them to learn and understand*" because for her, "*It was not only to pass the practicum but also the ability to make the students learn and understand what they have learnt*". She would also like her visiting lecturer to guide her to develop more skills especially in using ICT during field experience.

Ida was grateful to complete her field experience at SSD because she had an opportunity to use ICT during her field experience. In addition to that, Ida believed that because she was the only student teacher at SSD, she could learn more and be trusted by other teachers to fully utilise the technology room, in fact, they gave her the room key to be able to use the room at any time she wanted to. "*After I started*

to use the technology room, other teachers were also using it and the room was complete with ICT tools and all were in working order" (Ida, 3rd interview, 2011).

Ida mentioned that she had good support from her helpful mentor and other teachers as well. The cooperating teacher was very helpful and assisted Ida in materials preparations as well as advising her on students' attitudes. *"My cooperating teacher was very supportive. However, my cooperating teacher could not model the use of ICT in class as she was not good in ICT"* (Ida, 3rd interview, 2011). Furthermore, she got support to use ICT from the teacher of Computer Literacy and learnt from him. *"Now I know how to use it...and it was an interesting experience when we can share the knowledge that we have with others"*. As for Adys and Lynna, their cooperating teacher was helpful and guided Adys and Lynna in materials preparations as well as setting up the computer laboratory for teaching.

6.3.2 Case Story Four: Zaman's Story

The researcher chose to present Zaman's story of experiences and development of ICT knowledge and skills during his field experience because Zaman was an ICT major student who had completed his teaching practice at Secondary School F (SSF). Zaman perceived that his CK, PK and PCK were slightly above average in the pre- and post-survey. He showed good mastery level in all technology-related domains: TK, TCK, TPK and TPACK. He perceived that he was good at using ICT, assembling computer components since primary school and fixing computers. It was his interest to teach ICT because *"it is one of my areas of expertise"*. The main case story of Zaman is also triangulated with other participants' stories to create a more interesting and meaningful story. The other three pre-service teachers's data: Suria, Ayu and Ramli were incorporated in Zaman's case story as they had completed their field experience at the same school. Participants' actual words are written in italics. Zaman's story is presented in themes based on the research questions and other themes which emerged from the data.

6.3.2.1 What concerns do pre-service teachers have about integration of ICT in schools and do they change with field experience?

From the compilation of Zaman, Ramli, Suria and Ayu's data, several concerns were identified about integration of ICT in schools which included students' attitudes, ICT availability and access and support.

Zaman was lucky enough to be able to use ICT in his teaching, as he taught Information and Computer Technology Literacy (ICTL) during his field experience at SSF. According to Zaman, mostly people who were involved in the ICTL subject have full access to the computer laboratory. Zaman was able to use the computer lab because teachers at SSF recognized him as an ICTL teacher, "*so they always gave me permission to use the lab. But for other people, it's difficult*". However, for other student teachers, such as Suria, they could use the lab "*if there's no ICTL subject at that time... but the problem was to find the right time when there was no ICTL*". According to Ramli in his first interview, one of the reasons was, "*the school wanted to protect the LCD and projector, because it was old and they didn't want to break it*".

However, for Zaman, even though he used to teach ICTL in a computer lab, his cooperating teacher, CTF1, did not allow him to use the lab for other subjects - for example, teaching Moral Education (his minor). It was what Ayu also faced when she wanted to use the computer lab for teaching. She taught Moral Education and Malay Language subjects, thus preventing her from using ICT in her teaching. Even though Ayu did not have the opportunity to use ICT in her classes, she had the chance to use ICT during classroom observation. Ayu's statement confirmed what the researcher thought about why some teachers at SSF were hesitant to allow the use of the projector because "*teachers here had the assumption that practicum teachers could not manage the students, and they were afraid that we will break the tools in the lab*" (Ayu, 3rd interview, 2011). From the observation made, "*the projector in SSF can only be set up in the computer lab*" (Ramli, follow-up interview, 2011), as the classroom did not have the equipment for setting up the projector. Ayu and Suria were motivated to use the ICT if there was an opportunity

for them to do that because "*it makes the teaching job easier to provide the teaching aids*" (Ayu, 1ˢᵗ interview, 2011).

Concerning the use of ICT in the classroom at SSF, Zaman was able to use ICT even if only for ICTL, unlike the other student teachers, for example, Suria. They raised the issue of "*first come, first serve*" when it comes to the use of ICT because "*there were other teachers who wanted to use it*", (Suria, follow-up interview, 2011). Despite the trust that the teachers gave, Zaman, however felt stressed by his cooperating teacher, CTF4. Zaman stated that his preparation for teaching was not enough for his cooperating teacher. CTF4 commented that Zaman either did not elaborate in detail or over elaborated or even was not suitable with Form 1 level.

> "*I didn't elaborate my points in details to the students and sometimes when I tried to explain, she told me my explanation didn't suit Form one students' level of intelligence. She marked my report badly, with her red color pen*" (Zaman, follow-up interview, 2011).

Zaman's cooperating teacher always had to be in the classroom every time he had his lesson. His cooperating teacher ensured that he followed exactly what he had in his lesson plan, even the questions to be asked. If the questions asked were not included in the lesson plan, she would give him a comment of "*where is the question?*" in his daily lesson plan. In addition to that, she always gave a very long comment with her red pen. Each time he finished the class, the CT would comment and emphasize that she had 21 years of experience. Zaman, though, had tremendous hope that the students and teachers here would help him during his field experience, but, unfortunately, it did not work as he had hoped as the students in SSF had little respect for teachers. This was aligned with his score of an average level of PK in the pre- and post-survey.

> "*Mostly students who were spelled out from their school will come to this school so there were lots of problems in this school, lots of challenges, in terms of discipline even if they were in first rank class... I was hoping that I*

can get some knowledge in this school, in terms of how to teach the students. I can learn when I'm observing the senior teachers teaching their students" (Zaman, 1ˢᵗ interview, 2011).

However, in completing his field experience, Zaman felt more confidence to teach in a school with those challenges that he had mentioned earlier. Concerning students' attitude, he initially felt that it would be hard to teach in that school. Zaman further explained that,

"The school was a daily secondary school, not like the elite schools, for example the boarding school... The kids were too naughty. I've never seen such a school as this, some of them consumed alcohol and had several problems" (Zaman, 3ʳᵈ interview, 2011).

However, with an appropriate approach, Zaman was able to get along with the students and made them feel comfortable to be around him. Though he did not get to teach the lower class students, he suggested that he could use several strategies to approach the students, like talk to them and be their friend.

Apart from Zaman's concerns about students' attitudes, the other three pre-service teachers also pointed out issues that they thought centered on the school itself. Students' attitudes were one of the major concerns raised by them. Ayu pointed out that *"it's involving lots of discipline, mostly when the students are learning the Moral subject. We try not to lose our control over them..."*.Suria also agreed with Ayu regarding students' attitudes. The problems were about the students themselves. Thus, in order to overcome the problem, Ayu tried several strategies in class. For example,

"I explained the topic in a small group because if we are talking there in front of them they do not pay attention to us, they will not understand what we are teaching them. So it is far easier if we try to explain this by group, to make them understand better" (Ayu, 3ʳᵈ interview, 2011).

166

6.3.2.2 What do pre-service teachers understand about the TPACK mastery levels needed to effectively integrate ICT in teaching?

In all, the four pre-service teachers perceived that they had adequate knowledge of TPACK before and after field experience. Zaman perceived that his CK, PK and PCK were above average in the pre- and post-survey. He showed good mastery level in all technology-related domains: TK, TCK, TPK and TPACK, before and after field experience with TCK as the highest mean score rated in both surveys. When the first interview was conducted, Zaman perceived that he lacked PK, and he needed more practice to develop this knowledge, because it was not sufficient for him to practise during his micro teaching. "*We can concentrate on major subjects and focus more on the microteaching of major subjects. Before this I didn't really know how to speak in public, but now I have improved the skills*" (Zaman, 3rd interview, 2011).

Although Zaman was unsure about his PK, because he was new to the school environment, he asserted that he could teach the ICT subject well, but not the Moral Education subject. He explained that he was not able to elaborate and explain enough about the subjects to the students, but he believed that he could master the content and develop the teaching skills during teaching practice. Zaman, first, stated that PK was more important than CK, because with that he would know how to control the class and the students, how to attract them and to make them understand what he was trying to teach them. For his ICT subject, he stated that his CK was the most important, apart from PK.

As for content knowledge, he felt that he needed to fully understand his subject before he could teach it to his students. Zaman showed his confidence in his CK when he asked for an additional ICT subject. However, the principal told him that "*they only have multimedia production class but they couldn't give it to me*". Zaman strongly believed that he could teach the subject, so he applied and they gave him the opportunity.

167

As for TK, Zaman felt that TK was about technologies that he used for teaching purposes. Additionally, he felt that a teacher should know about technology because they can use this to help the students. He could be the referral source if students wanted to ask anything about technology. When they did not know how to operate LCD or the projector, they could always ask him. In addition, the other three pre-service teachers also agreed that they had basic knowledge of technology.

Zaman, perceived that he had a high level of TPACK and developed his understanding progressively throughout his field experience. He took the challenge to teach an additional subject in order to enhance his CK, which indirectly influenced his PCK for the subject. Even though Zaman had several problems with the supervision of his cooperating teacher, the other three student teachers, on the other hand, collaborated well with their cooperating teachers.

Two classroom observations were conducted with Zaman for two different subjects: Information and Communication Technology Literacy (ICTL) and Multmedia Production. The first classroom observation was for ICTL. Zaman taught about five input devices to a Form one class with 26 students. From the observation which was made in a computer laboratory, he used a projector, paper, Powerpoint, and a video. No computers were allocated for the students. Thus, it would be difficult for student teachers to teach ICTwithout using computers when they were teaching the practical topics. The class had mixed races with the majority of them Malaysian, and a balanced number of each gender. Zaman faced language challenges where he needed to teach in English. The second classroom observation was conducted in the multimedia production lab. It was very convenient, as all students were able to use a computer. Zaman showed that he had good CK and TK. However, he would need to develop more of his TPACK. The students had the learning module that would be used throughout this session, but, since there were no specific instructions posed to the students, the students asked their friends for assistance.

To help develop their understanding of TPACK, Zaman further suggested that the TPACK concepts should be introduced in the Initial Teacher Education programme, generally, and before their first field experience, specifically. The researcher believed that his experience in teaching multimedia production also influenced his perceptions about TPACK. Thus, in Zaman's case, the use of ICT in teaching during field experience helped him in enhancing his TPACK knowledge level. Ramli also agreed that he had what he needed in order to start his teaching practicum at SSF. All four pre-service teachers noted that they had been introduced to TK in their ICT courses, CK in their major courses and PK in the Teaching Methodology course. They all demonstrated the development of their PCK. Ayu, for instance, created several activities and strategies for students to develop their understanding of the content being taught. However, all four pre-service teachers did not clearly identify their TPACKunderstanding after almost nine weeks of field experience. This could be explained by the lack of ICT access and support to use ICT in teaching during their field experience.

From the pre-survey findings, Ramli appeared to show that he had a good understanding of most TPACK domains and rated the same level of TPACK mastery in the post-survey. Ramli appeared to have a preconception that he could understand the TPACK concepts before field experience started. When Ayu was asked to describe her technological knowledge, she stated that she knew how to set up the projector and create powerpoint slides for teaching purposes. However, for further use of the ICT tools, she still needed to learn more. This might be the reason why she rated her TK as the lowest mean score in the pre-survey. After field experience, she perceived that her TK, PK, PCK and TPACK had improved. Additionally, Ayu rated her CK as the highest mean score in the pre-survey but remained at the same level in the post-survey and she also showed a negative change in her TPK after field experience. Suria, on the other hand, showed her TK as the highest and PK as the lowest mean score rated in the pre-survey. Suria perceived that she had developed her CK, PK and PCK after her ten-week field experience at SSF. Suria also rated all technology-related knowledge as having increased in the post-survey.

6.3.2.3 How do these pre-service teachers develop their TPACK levels and their practice with ICT in schools?

Zaman, Ramli, Suria and Ayuall agreed that preparation, field experience and support were very important in assisting them to develop more of their knowledge.

Teacher Preparation Programme

Zaman felt that the subjects that are pure IT, such as Java and Database are not really being taught in schools. Zaman also suggested that the university should consider teaching them the subjects that are being taught at schools. Pre-service teachers could not link the theory and practice when they faced challenges in teaching. *"What I learnt in here [ITE] was far more advanced than the syllabus for the school's students, so I did not see how it's going to help me teaching at school soon"* (Zaman, 3rd inerview, 2011). This statement also supported the reason why Zaman rated his TK high prior to the field experience. Furthermore, Zaman stated that the Initial Teacher Education programme had built their personality as a future teacher. Zaman stated that he had learnt more of his CK and TK during the teaching preparation programme. The other three pre-service teachers also stated that the teacher preparation programme had prepared them adequately to start their field experience.

Field Experience

Field experience had helped Zaman to gain confidence and it was very important because *"we would get the real situation before we go to school, it helped us to overcome our fear"*. As Zaman stated, during his first and second week of field experience, *"I was acting that I was not afraid… but now I have the confidence"*.

Zaman felt that he was exposed to the methods of teaching during microteaching. However, these methods were different, so to use these methods in school was very challenging. He also felt that field experience helped him a lot, as he gained more confidence when he taught in the classroom.

"When I did my micro teaching, there was not much improvement. I kept repeating the same thing every day. I used slide shows to present my material. But it's different in the school, because you face real students. In the university, it's not the high school students that I'm facing during micro teaching" (Zaman, 3rd interview, 2011).

Zaman agreed that the practical experience was vital for him to develop his skills as a teacher. Additionally, the other three pre-service teachers also agreed that field experience was good exposure for them, and it was very important as well to develop their confidence in teaching and developed more of their knowledge of TPACK as well.

"When I first started my practicum, I did not feel confident with the way I was teaching them… but when it's already in week two or three it has become our routine. I can teach and at the same time I understand what I have taught them too" (Ayu, 3rd interview, 2011).

Support

Zaman agreed that in order to enhance his PK and CK, it also required support from teachers. "*I have always communicated with other teachers and asked other teachers in school for help*". Despite Zaman's cooperating teacher's harsh attitude, she still acknowledged Zaman's development/improvement in teaching. It was noted that teachers at SSF were not giving full support to the pre-service teachers whilst they were in that school. Most of the pre-service teachers commented that they did not have trust from the teachers. Furthermore, it was observed that the cooperating teachers were most of the time not in the class during the pre-service teachers' teaching sessions. This situation could contribute to the pre-service teachers' level of confidence and development of their knowledge.

6.3.2.4   Summary of Case Study 2

In summary, all seven pre-service teachers perceived that they had good levels of TPACK understanding prior to their field experience. However, when they went

into the field, they faced unexpected realities. Theoretically, they could say that they understood about TPACK, but they did not really know how to use it in their teaching. Furthermore, all seven pre-service teachers had developed more practicality in their teaching. The pre-service teachers were very motivated to use ICT in teaching. They also agreed that field experience was very important for beginning teachers to put into practice their TK, CK and PK in a situated context. However, due to circumstances in relation to ICT availability, some of the pre-service teachers were not able to integrate ICT in their teaching and this indirectly influenced their development of TPACK. However, some students failed to utilize what they had around them, especially in Adys and Lynna's cases. They might not be fully trained to be creative and innovative enough in teaching, and they were confined to only certain ways of teaching. Additionally, preparation and support also played a role in assisting pre-service teachers during field experience.

6.4 Chapter Summary

This chapter reports the results of data analyses which were conducted to give an overview of two case studies in New Zealand and Malaysia. In describing pre-service teachers' concerns about integration of ICT during their field experience, a few themes emerged from the data: ICT access and technical issues. Despite their concerns about ICT use during field experience, there were other issues found in the data: students' attitudes, classroom management and support. To answer how pre-service teachers can develop TPACK and their practice with ICT in schools, the case story was structured into three themes: preparation prior to field experience, field experience and support. The next chapter proceeds with discussion of the findings of cross-case analysis of Case Study 1 and Case Study 2.

CHAPTER 7: DISCUSSION

7.1   Introduction

"Teacher education is beginning to be better recognized and valued as an object of academic research" (Korthagen, Loughran & Russell, 2006, p. 1020). Initial teacher education is essential because preparation of teachers "requires the right conditions to support teacher development" (Cameron & Baker, 2004, p. 63). However, initial teacher education programmes vary enormously within and between countries (Darling-Hammond & Baratz-Snowden, 2005; Kane, 2005), including ICT practices in teacher education (Kirschner & Davis, 2003; Law & Plomp, 2003). Furthermore, cultural diversity and languages of a nation and region impact educational systems (Wubbels, 2010) and influence how pre-service teachers use and think about learning with technologies (Chin, Chang & Bauer, 2000; Bing & Ai-Ping, 2008). Thus, it is valuable to provide a comparative review of the two case studies in this research. The findings of comparative analysis between New Zealand and Malaysia indicate some limited similarities but considerable differences between the two Initial Teacher Educations (ITEs). These findings show variations regarding the interpretation of the data in the two different contexts. Therefore, the results of this comparison provide important evidence about the limitations and generalizations that can be made in interpreting the results of the research findings.

The chapter begins with the rationale for conducting the cross-case analysis by looking at the similarities and differences between the two ITEs and their national contexts. Similarities observed between the two contexts include the preparation of secondary school teachers by ITEs and the provision of two school placements at one or more secondary schools during the teacher education programme. In addition, varying extents of a knowledge base of TK, CK and PK are provided by both teacher preparation programmes. Contrasts include the language of instruction, school curriculum, ICT policy and practice in education, pre-service teachers' knowledge of culture and diversity, pre-service teachers' teaching competencies and provision of TPACK knowledge base. These similarities and

contrasts are then used to provide a frame of reference for interpreting and presenting the comparative findings of the two contexts in a detailed account structured around the research questions. The chapter ends with a summary of the contextual variations between the two contexts and the researcher's interpretation of the findings incorporated in the final discussion section.

7.2   Contrasts between New Zealand and Malaysia

This section presents the similarities and differences between the New Zealand and Malaysian Initial Teacher Education programmes and the national contexts. The aim of this contextualisation is to 'set the scene' for a comparative review of the cross-case analysis. The context of the Graduate Diploma in Teaching and Learning (Secondary) at University of Canterbury and the Bachelor of Education (Hons) at Universiti Utara Malaysia has been described previously in section 1.4 and 1.5. The variations of contextual aspects that are presented and discussed in this chapter are educational systems, school curriculum, cultural diversity, ICT policy and practice in education, programmes of Initial Teacher Education (ITE) and ITE curriculum.

7.2.1   Educational Systems: New Zealand

The New Zealand education system has three major levels: early childhood education, primary and secondary schooling, and tertiary education (Ministry of Education New Zealand,2008). The education system for schools comprises 13 Year levels (see figure 7.1 for a view of students' learning pathways). At present, schools in New Zealand include state schools, private schools, state integrated schools and home-schooling. The primary schooling comprises Year 1 to Year 8 (ages 5 to 12) which then continues to the secondary level from Year 9 to Year 13 (ages 13 to 17). Students in Year 7 and Year 8 may also attend the intermediate schools which provide a transition from primary schooling to secondary schooling. In 2011, New Zealand schools were influenced by the 'Leading learning in 21st century schools' initiative (Bull & Gilbert, 2012). The initiative aims to understand how teachers "shift their paradigm" and how the experiences assist them in their transition into 21st century teaching.
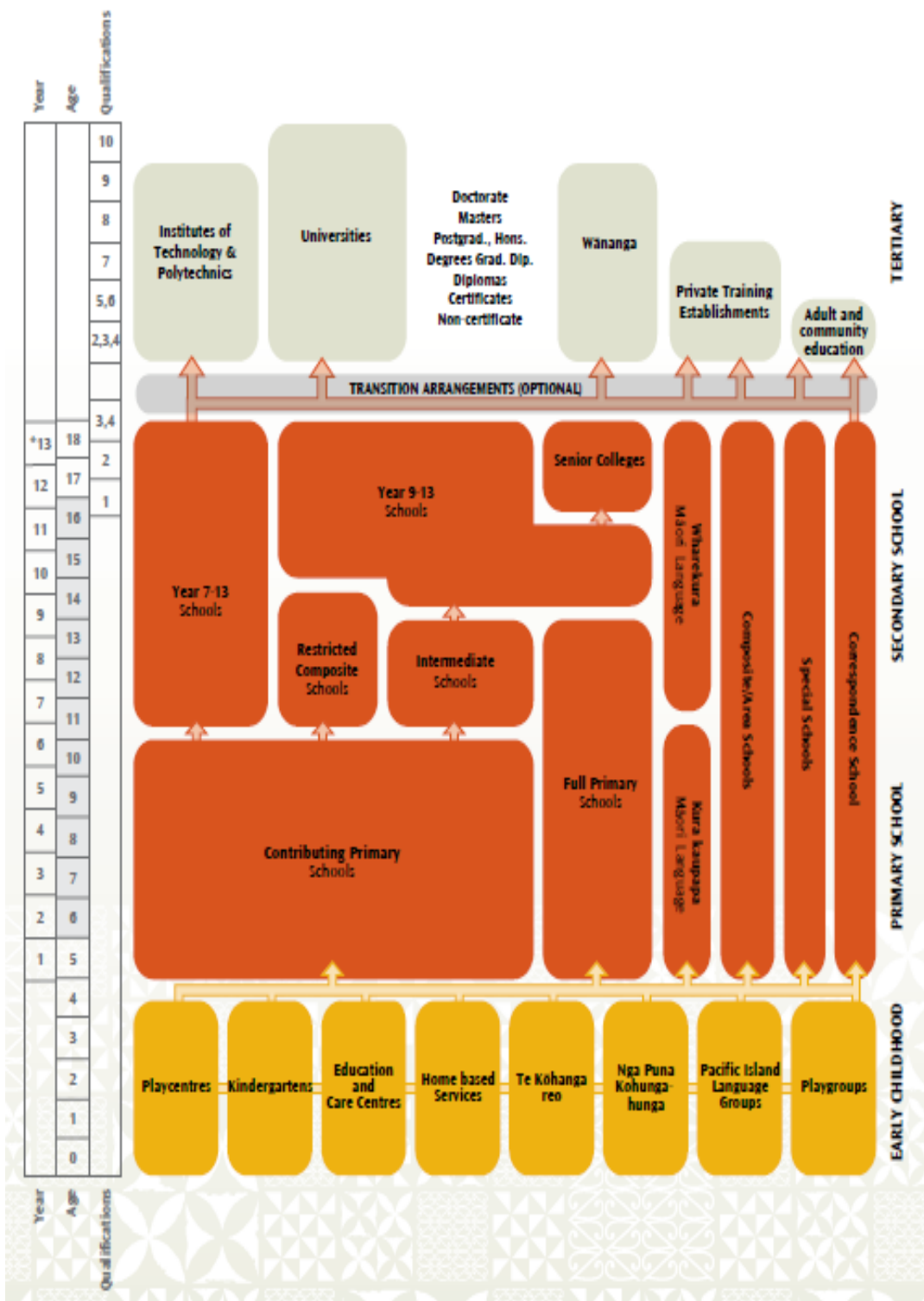
Figure 7.1: Learning Pathway in New Zealand Compulsory Schooling.Retrieved from www.moe.co.nz

The three embedded case studies (schools) included in the New Zealand case study were state schools, fully funded by the government (Ministry of Education New Zealand, 2008). The New Zealand schools are self governed by locally elected Boards of Trustees. The principal and teaching staff are the education experts who are employed by the Board of Trustees. The Board of Trustees also appoints school administration staff. Each school sets its own school rules, school policies and develops learning programmes based on the New Zealand Curriculum to provide teachers with the flexibility of teaching and managing the classroom activities in relation to the cultural diversity in their classes, the needs of their learners and the educational requirements relevant to their local community. Individual schools and college level institutions have the responsibility of managing and governing their facilities within the regulations set for the education system by government agencies. The quality of education is ensured through regulation by government agencies such as the Ministry of Education, the Education Review Office, the New Zealand Qualifications Authority, the New Zealand Teachers Council (Ministry of Education New Zealand, 2008).

In relation to national assessment, New Zealand's secondary schools offer national qualifications that are recognised by tertiary institutions in New Zealand and internationally: the three levels of National Certificates of Educational Achievement (NCEA) which correspond to the final three years of secondary school (Year 11, aged fifteen to Year 13, aged seventeen). The New Zealand qualifications are acceptable as entry to tertiary education and employment in USA. The NCEA Level 3 is recognised by the Australasian Conference of Tertiary Admissions Centres and equivalent to the Malaysian Higher School Certificate (*Sijil Tinggi Persekolahan Malaysia*, *STPM*). There are also schools offering the Cambridge International Examinations, the International Baccalaureate or an Accelerated Christian Education programme and vocational qualifications, for example, the National Certificate in Computing. In the New Zealand context, the school environment encourages the concept that at some point "everyone is a teacher and everyone is a student". Students are supported to learn and share their learning experiences (Donn & Schick, 1995).

7.2.2   Educational Systems: Malaysia

Similar to the New Zealand education system, the Malaysian education system has three levels of education that include pre-school, primary and secondary schooling, and tertiary education (Ministry of Education Malaysia,2012). There are three types of school in Malaysia: national schools, Chinese national-type schools and Tamil national-type schools. Malaysian students in the national system have 12 to 13 years of formal schooling (primary and secondary) prior to entering tertiary education (see figure 7.2 for learning pathway in Malaysian schooling). The primary schooling starts at Standard 1 to Standard 6 (ages 7 to 12) which then continues to the secondary level: lower secondary from Form 1 to Form 3 (ages 13 to 15) and upper secondary from Form 4 to Form 5 (ages 16 to 17). Within the Malaysian context, the three schools which participated in the Malaysian case study were national schools with the Malay language as their medium of instruction. In contrast to New Zealand's school management, Malaysia is highly centralized. The school curriculum is managed with a 'top-down' approach in which each school follows the same curriculum, policies and teaching programmes. The principal, teaching staff and school administrator are employed by the government. In Malaysia, emphasis on the school curriculum and high achievement in the national exams results in teachers' primary focus on teaching being to complete the syllabus of the subject, rather than sharing knowledge towards improving student learning.

National assessment in Malaysia includes the public common examination *Sijil Pelajaran Malaysia*, *SPM* (also known as the Malaysian Certificate of Education and *Sijil Tinggi Pelajaran Malaysia*, *STPM* (known as Malaysian Higher School Certificate). The Malaysian Certificate of Education is equivalent to the UK's General Certificate of Education (GCE) 'O' level, and roughly similar to NCEA level 2 in New Zealand) whilst the Malaysian Higher School Certificateis equivalent to the GCE 'A' level and similar to the NCEA level 3 in New Zealand. In Malaysian society, most learners are known to be passive learners, who do not ask any questions and always wait for the teacher to give instructions. That is, the students feel more comfortable with the teacher-centered approach, where they see
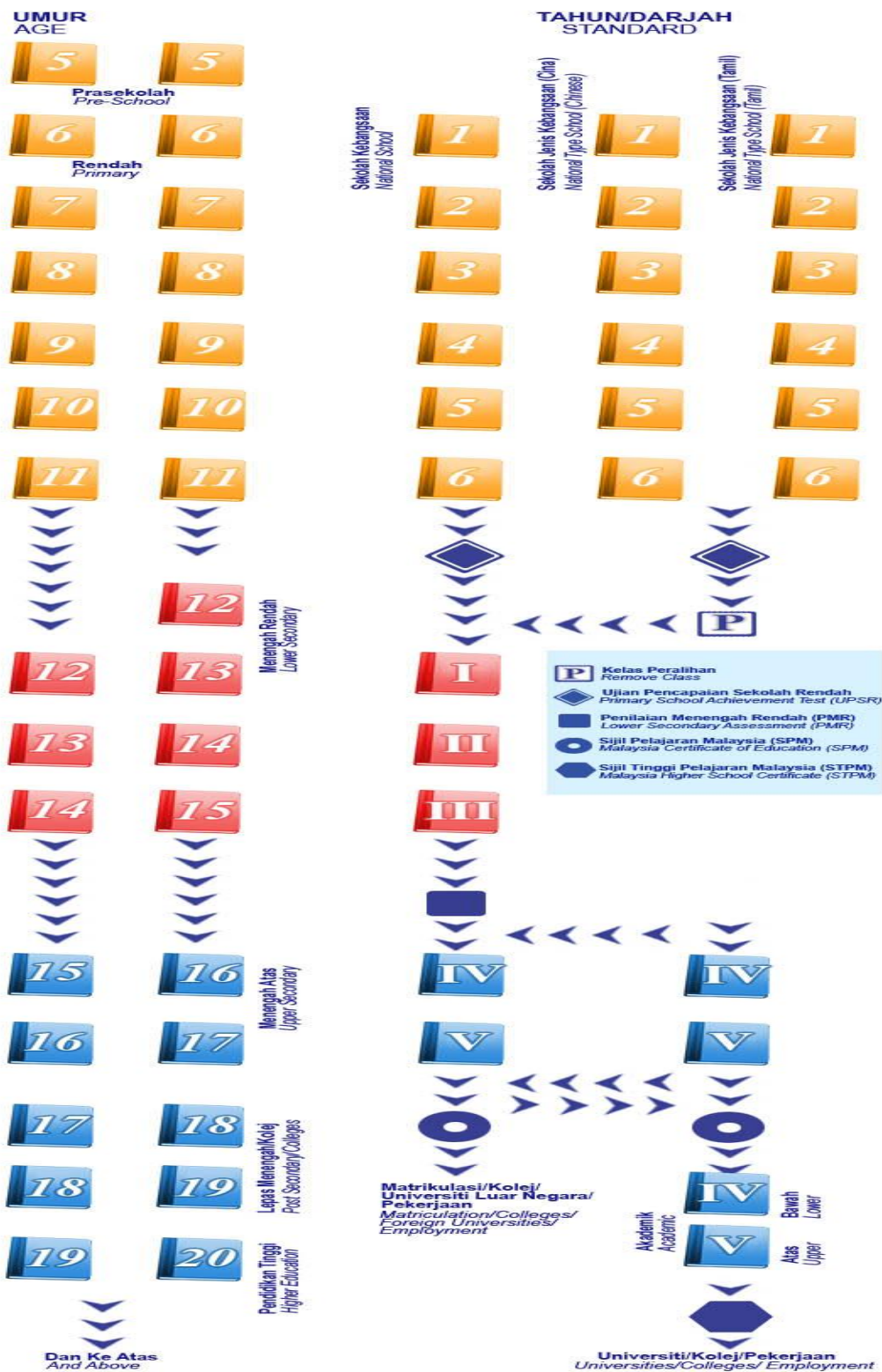
Figure 7.2: Learning Pathway in Malaysian Schooling. Retrieved from http://www.moe.gov.my/v/carta-sistem-pendidikan

178

the teacher as the person who directs the learning and assesses them using the formal paper and pencil examinations. This is often not the practice in New Zealand classrooms (Donn & Schick, 1995).

7.2.3   School Curriculum: New Zealand

The National Curriculum in New Zealand is designed and interpreted in a three-stage process: as the national curriculum, the school curriculum, and the classroom curriculum (Ministry of Education New Zealand, 2008). New Zealand schools follow a national curriculum which provides the framework and common direction for schools, identifying the values, key competencies, and learning areas which students should be taught; and the expected standards of students' performance (Ministry of Education New Zealand, 2008). The national curriculum gives schools the scope, flexibility, and authority to design and shape their curriculum so that teaching and learning is meaningful and beneficial to their students.

The New Zealand National Curriculum published in 2008 was set out in two documents: 1) The New Zealand Curriculum for English-medium schools, and 2) Te Marautanga o Aotearoa for Māori-medium schools (Ministry of Education New Zealand, 2008). This New Zealand Curriculum has eight learning areas: English, The Arts, Health and Physical Education (PE), Learning Languages, Mathematics and Statistics, Science, Social Sciences and Technology. The document also describes the vision, principles, values and key competencies to develop students' confidence, knowledge and skills in each area by learning how to apply them in their lives. The Te Marautanga o Aotearoa curriculum for Māori-medium schools has nine learning areas: Te Reo Māori, Pāngarau (Maths), Pūtaiao (Science), Hangarau (Technology), Tikanga-ā Iwi (Social Sciences), Ngā Toi (Arts), Hauora (Health and Physical Education), Ngā Reo (Languages) and Te Reo Pākehā (English). The aim is to develop competent and confident learners, effective communicators to participate and contribute to Māori society, specifically, and to the wider society, generally.

7.2.4   School Curriculum: Malaysia

As stated in the Education (National Curriculum) Regulations (1997), The Malaysian National Curriculum emphasizes "*...* an educational programme that includes curriculum and co-curricular activities which encompasses all the knowledge, skills, norms, values, cultural elements and beliefs to help develop a pupil fully with respect to the physical, spiritual, mental and emotional aspects as well as to inculcate and develop desirable moral values and to transmit knowledge". The Malaysian National Curriculum is intended to develop the intellectual, spiritual, emotional, and physical dimensions in learners (Ministry of Education Malaysia, 2012) to align with the National Education Philosophy. The National Education Philosophy for Malaysia, written in 1988 and revised in 1996, stated that "Education in Malaysia is an on-going effort towards further developing the potential of individuals in a holistic and integrated manner, so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious, based on a firm belief in and devotion to God. Such an effort is designed to produce Malaysian citizens who are knowledgeable and competent, who possess high moral standards, and who are responsible and capable of achieving a high level of personal well-being as well as being able to contribute to the harmony and betterment of the family, the society and the nation at large" (Ministry of Education Malaysia, 2012). Furthermore, students are required to take part in at least one sport, one club, and one uniformed body activity to encourage their talents and interests and to develop their leadership skills (Ministry of Education Malaysia, 2012).

7.2.5   Cultural Diversity

Wubbels (2010) stated that pre-service teachers' attitude and knowledge of culture and diversity are important for teaching a diverse student population. This includes pre-service teachers knowing their self-identity and the learners' background. Students from different cultural backgrounds perform in different ways in school (Wubbels, 2010). National culture can be broadly defined to include the language, beliefs, and practices shared by a group of people in a particular country. New Zealand and Malaysia are complex, multiracial societies including many cultural groups with different customs and traditions.

In New Zealand, English language is the official language of the country and the medium of instruction at English-medium schools and higher institutions while Māori language is used for teaching most of the time at Māori-medium schools. In Malaysia, with the three major ethnic groups, namely Malay, Chinese and Indian, the Malay language or *Bahasa Malaysia* is the official language of the country and the medium of instruction at National schools and public universities. The Chinese national-type school and Tamil national-type school use Chinese and Tamil languages respectively. However, English is used as the primary medium of instruction at most private higher educational institutions.

In multiracial societies, there is a concern to establish the main medium of instruction in the education system so as to best contribute to economic development. Thus, with respect to cultural diversity, the ITE programme in New Zealand consists of a mix of curriculum, learning and pedagogical theory, professional studies, practicum experiences and cultural studies (Ministry of Education New Zealand, 2007). Similarly, the Malaysian government has restructured the education system to educate all students to achieve the knowledge and skills needed to function in a multi-ethnic world. Furthermore, in a recent preliminary report of Malaysian Education Blueprint (MEB) 2013-2025, the Ministry of Education has supported the concept of unity through the *Rancangan Integrasi Murid untuk Perpaduan* (RIMUP) or Student Integration Plan for Unity to foster interaction between different schools and encourage students to learn an additional language other than Malay and English (Ministry of Education Malaysia, 2012).

7.2.6   ICT Policy and Practice in Education

Most countries are moving towards using ICT to teach students the knowledge and skills they need in the 21st century (UNESCO, 2002; Law & Plomp, 2003). The objectives of such policies are generally to promote connectivity and access to ICT for students in schools. Several conditions have been outlined as a guide for teacher educators, administrators and policy-makers to integrate ICT into education which include: 1) Students and teachers must have sufficient access to digital technologies

and the Internet in their classrooms, schools, and teacher education institutions; 2) High quality, meaningful, and culturally responsive digital content must be available for teachers and learners; and 3) Teachers must have the knowledge and skills to use the new digital tools and resources to help all students achieve high academic standards (UNESCO, 2002; Law, et al., 2008). However, the way in which countries are focusing on developing and practising the ICT use in education varies greatly between developed and developing countries, depending on how established ICT is in their education systems.

In New Zealand, the ICT policy of "Digital Horizons-Learning through ICT" (Ministry of Education New Zealand, 2002) and "Enabling the 21st century learner" (Ministry of Education New Zealand, 2006), were developed to look at how ICT can be extended into the classroom from the perspective of the 21st century learner and the associated learner centred approaches. These policies initiated several ICT projects by the Ministry of Education (Parr & Ward, 2010) including the Information and Communication Technologies Professional Development (ICT PD) school cluster programme and Laptop for Teachers (TELA) scheme (Cowie, et al., 2010; Parr & Ward, 2010). The New Zealand Curriculum also introduced the FFI (Future-Focused Issues in Education), namely, enterprise, sustainability, globalisation and citizenship (Ministry of Education, 2007) in preparing the future of schooling and the teaching curriculum to better meet the opportunities and challenges of 21st century learning environments. Furthermore, the integration of ICT in education in New Zealand schools and universities has increased and is moving towards 21st century learning environments which include virtual schooling and blended online learning, and aims to implement Ultra-fast Broadband in Schools (UFBiS) and a Network for Learning (N4L) for all schools by 2016 (Davis, 2012). The collaboration between the secondary school and teacher education is required to maximise the initiatives implemented (Davis, 2012). By 2016, tertiary education in New Zealand is expected to make full use of augmented reality, gesture-based computing, the next-generation batteries, and smart objectives (Johnson, Adams, & Cummins, 2011).

In contrast, the Ministry of Education in Malaysia has formulated the vision for ICT in education which focuses on three major areas: 1) ICT provided to all students so that it is used as an enabler to reduce the digital gap between schools; 2) ICT used in education as a teaching and learning tool, as part of a subject and as a subject by itself; 3) ICT used to increase productivity, efficiency and effectiveness of the management system (Isa, 2006). Although the government has placed emphasis on the integration of ICT in teaching and learning, the use of ICT in the actual practice of teaching and learning has some way to go before it is reflected in the practice of most schools (Hoque, Abdul Razak & Mosa, 2012). Malaysia is moving towards becoming a developed nation by the year 2020, when the use of ICT should be expanded to all local schools (Ismail, Azizan, & Azman, 2011). Furthermore, in line with the Vision 2020 which was introduced by the former Prime Minister of Malaysia, Tun Dr. Mahathir bin Mohamad in 1991 (Prime Minister's Office of Malaysia, 2010), the Malaysian government initiated the 'Smart school' project to increase productivity and sustainable development which can be achieved through a technologically literate workforce in the global economy of the 21st century (Ministry of Education Malaysia, 1998). The 'Smart school' project was one of the flagship projects under the Multimedia Super Corridor (MSC) with several IT projects in Malaysia that aim to transform key sectors such as trade, governance through the use of IT, including education. Implementation of best practices in technology-supported teaching and learning is emphasized in all aspects of education including curriculum, pedagogy, assessment and teaching and learning resources (Ya'acob, Mohd Nor & Azman, 2005).

To further contextualise the ICT practice in education in New Zealand and Malaysian schools, this study revealed that ICT use in participant schools varied enormously. Within the New Zealand case study, one of the three secondary schools had minimal ICT access for pre-service teachers. In relation to the use of ICT for teaching and learning, the three New Zealand schools had good resources for ICT. By contrast, in the Malaysian case study, only one out of the three schools had good ICT facilities and the other two schools had very limited access and moderate use of ICT for pre-service teachers. Moreover, the use of ICT for

teaching and learning was also limited due to the structure of the education system in Malaysia.

7.2.7   Programmes of Initial Teacher Education (ITE)

The development of quality teachers begins with the effectiveness of ITE programmes (Darling-Hammond & Baratz-Snowden, 2005). Furthermore, the effectiveness of ITE depends on the characteristics of pre-service teachers, the structure and content of the ITE programme, and the schools within which field experience is completed (Zeichner &Conklin, 2005). There is a wide range in the structure of teacher education programmes. In some programmes, preparation for subject-specific courses and teaching is completed simultaneously with an undergraduate degree programme while in other programmes, subject-specific study occurs first, and the subsequent teaching professional preparation is completed in a different programme. In the USA, for example, teacher preparation is completed in a one or two year post-baccalaureate programme which leads to a teaching certificate or master's degree (Ben-Peretz & Lotan, 2010). In addition, there is also an alternative route to teaching in which candidates are not required to complete the programme in preparation for employment due to lack of teachers (Ben-Peretz & Lotan, 2010).

Initial Teacher Education qualifications in New Zealand are offered by a variety of providers. Universities, Institutes of Technology and Polytechnics (ITPs), Private Training Establishments (PTEs) and Industry Training Organisations (ITOs) deliver a variety of educational options, often in flexible ways to meet the needs of adult learners (Ministry of Education New Zealand, 2008). Before entry into a programme, pre-service teachers are assessed on their ability for effective communication with learners and their whānau (family), and the selection process must involve a visual interview which may include the use of visual technologies. Pre-service teachers in New Zealand can choose the approved ITE programmes which include the undergraduate degrees of three or four years, undergraduate diplomas of three years (in early childhood education) and a one-year graduate diploma if they already have a relevant qualification at Level 7 or above (New Zealand Teachers Council, 2009). The ITE programmes prepare the pre-service

teachers for a teaching qualification at Level 7 on the NZQA Register of Quality Assured Qualifications, which allows them to teach in New Zealand early childhood education centres, schools (primary, intermediate and secondary) or kura (Māori medium or immersion). Secondary pre-service teachers are generally required to complete a subject-based degree with a mix of subjects relevant to their chosen teaching subjects followed by a Graduate Diploma of Teaching (New Zealand Teachers Council, 2009). The most common route for candidates who have completed the degrees to teach at the secondary school is the one-year programme (Cameron & Baker, 2004). After completing the initial teacher education programmes, teachers can submit the registration application for the practising certificate which allows them to teach for three years under provisional registration. Moving from provisional to full registration requires at least a two-year induction and mentoring period under the supervision of a fully registered teacher. To ensure the high quality of education for students, teachers need to maintain their full registration by renewing the teaching license every three years, which involves several steps, as outlined by the New Zealand Teachers Council (New Zealand Teachers Council, 2012) and shown in Figure 7.3.

Figure 7.3: Steps towards full registration for New Zealand pre-service teachers. Retrieved from http://www.teacherscouncil.govt.nz.

In the New Zealand context, the university is required by the funding agency and the New Zealand Teachers Council (NZTC) to maintain effective partnerships with the schools and their collaborating teachers. The NZTC's current role is to maintain the professional standards of teachers, including accreditation of ITE programmes (the NZTC is under review in 2013). It registers teachers, renews their practising certificates, defines standards, and jointly approves teacher education programmes that lead to registration (New Zealand Teachers Council, 2012). Every school teacher must be registered by the NZTC. Given the ICT focus of this research it is also useful to note that the NZTC provided guidance to teachers in 2013 regarding the use of social media (New Zealand Teachers Council, 2013), which is possibly the first time it engaged directly in ICT-related issues.

Similarly, the implementation of teacher training programmes in Malaysia is also divided into two groups: (i) undergraduate degree for primary pre service teachers offered by the Institute of Teacher Education (*Institut Pendidikan Guru, IPG*) and secondary pre service teachers offered by the Institute of Public Higher Education (*Institut Pendidikan Tinggi Awam, IPTA*) and (ii) a one-year Post-Graduate Diploma in Teaching (*Kursus Diploma Perguruan Lepasan Ijazah, DPLI* for teaching at secondary school or *Kursus Perguruan Lepasan Ijazah, KPLI* for teaching at primary school). In Malaysia, secondary school pre-service teachers begin the ITE qualifications with the Matriculation or Diploma certificate and a psychometric test, the Malaysian Educators' Selection Inventory (MEdSI). MEdSI is a paper-and-pencil multiple-choice of 300-items test with a time-limit of 60 minutes designed to capture four intrinsic qualities: Personality, Career Interest, Integrity and Emotional Quotient. The objective of MEdSI is to better select qualified and suitable student teachers for entering Malaysian public universities (Othman, et. al., 2008). Successful candidates are called for an interview.

In contrast to New Zealand's teaching registration process, after completing the ITE qualifications, the employment in the permanent service is dependent on the candidates' academic achievements and their performance in the interviews conducted by the Education Service Commission (ESC), which is called

Suruhanjaya Perkhidmatan Pelajaran (SPP). In Malaysia, the ESC serves as the authority in the education service regarding appointment of teachers, confirmation of the services that have been appointed on a regular basis, approval of pension status, promotion of educational services, approval of the appointment of exchange / fixed exchange services. It also plays a role in disciplinary matters in educational services (Education Service Commission, 2013).

In contrast to New Zealand, there is no collaboration or formal partnership between ESC and ITEs with regard to the preparation of pre-service teachers. In the past, almost all graduates from the ITE programmes were employed after graduation because teaching is a highly secure job which also gives an option for the graduates without education certificates to choose teaching as their career. However, from 2007, in order to improve the standard of the teaching profession, only those sponsored by MOE who achieved cumulative GPA greater than or equal to 2.75 were employed and placed at schools. Meanwhile, those who have a cumulative GPA below 2.75 must pass another qualifying examination, followed by an interview before being posted (Mokshein, Ahmad & Vongalis-Macrow, 2009). For the school placement, the Ministry of Education assigns the newly qualified teachers for teaching roles based on their chosen states to either primary or secondary schools in Malaysia. However, that will depend on the availability of the chosen school. A beginning teacher has to serve for three years in order to be confirmed as a fully qualified teacher, which includes completing the Malaysian Remuneration System Induction Course, also called *Kursus Induksi Sistem Saraan Malaysia (KISSM)* (Ministry of Education Malaysia, 2012). They must also get the approval from the principal (see Figure 7.4 for the researcher's and also a teacher educator's view of the pathways for teaching, and see section 1.5 for details). The aim of KISSM is to produce government officers who are committed to performing their duties in order to provide good quality service and be able to adapt to the organization and work culture in their work place. Finally, in contrast to the New Zealand renewing teaching license procedures, teachers in Malaysia do not need to renew their teaching license.

ITE qualification completion	To be employed as a teacher	Appointed as a fully qualified teacher
• Undergraduate programmes • Post-Graduate Diploma	• sponsored by MOE • achieve CGPA greater than or equal to 2.75. • CGPA less than 2.75, to attend an interview	• Service for three years • induction course (KISSM) • Approval from the principal

Figure 7.4: Malaysian pre-service teachers' pathways to teaching

7.2.8 The ITE curriculum

The framework of ICT in the teacher education curriculum comprises four groups of competencies: Content and Pedagogy, Technical Issues, Social Issues and Collaboration and Networking which are supported by the four themes: Context and Culture, Leadership and Vision, Lifelong Learning; and Planning and Management of Change (UNESCO, 2002). The teacher preparation programme is a key element to enhance the quality of education in all aspects including the structure and curriculum and training programmes that focus on classroom practice (Bransford, Darling-Hammond & LePage, 2005). According to Darling-Hammond and Baratz-Snowden (2005), the ITE curriculum includes the provision of knowledge about students, content and teaching.

Training and development of teachers is one of the major concerns for improvement of education by both the New Zealand and Malaysian governments. Colleges and universities offering initial teacher training are supervised and approved by both Ministries of Education in addition to the accreditation of the student teacher educators. ITE in New Zealand provides curriculum knowledge, subject-matter knowledge, pedagogical content knowledge, and knowledge of child development, aspects of psychology, sociology and professional practice (Conner, McGrath & Lancaster, 2008). For the case study in New Zealand, the ITE

programme structure includes three parts: the Professional and Educational Studies, Teaching Studies and Teaching Practice programme structure (see section 1.3 for details). Similarly, the ITE curriculum in Malaysia provides the specialist subject component, teaching component and school experience. The Bachelor of Education (Hons) programme in the Malaysian case study can be summarized to include subject specialization, professional competence and a practical component (Lee, 2000) during the four-year programme (details in section 1.4).

The following section contrasts these three components provided in the New Zealand and Malaysian context, starting with the subject specialization component which discusses the subjects chosen by the pre-service teachers in New Zealand and Malaysia as their major and minor. The professional competence component discusses the pedagogy-related courses, education courses and the provision of TPACK in ITE curriculum nationally and within the New Zealand and Malaysian contexts. This section ends with the practical component which presents the structure of the field experience, the requirement for the field experience and the role of the associate / cooperating teacher nationally, followed by the New Zealand and Malaysian contexts.

7.2.8.1 Subject Specialization Component

In the subject specialization component, the pre-service secondary teachers are required to come with the content knowledge in one or two school subjects that they plan to teach in schools, based on their previous qualifications. For example, in the New Zealand case study, the pre-service teachers may choose ICT as their major subject and Mathematics as their minor. In Malaysia, the pre-service teachers also have options to choose such as, for example, Business Management as their subject major and Multimedia Interactive as their minor. Furthermore, it is also expected that all pre-service teachers in New Zealand and Malaysia have, to a certain extent, been exposed to a similar level of individual domains within the TPACK, namely, TK, CK and PK during their initial teacher education. The ITE qualifications in both contexts are designed to equip pre-service teachers with sufficient CK and PK. To a certain extent, the pre-service teachers are also

prepared with the basics of TK. In contrast to the Malaysian context, pre-service teachers in New Zealand have completed their specialised content knowledge (major and minor) prior to the graduate diploma programme. Thus, the completion of content courses is likely to have contributed to the high mean score of CK rated by New Zealand pre-service teachers in comparison with other domains (see section 5.3 for details).

7.2.8.2 Professional Competence Component

The professional competence component includes the foundation courses in education and pedagogy-related courses (peer teaching, micro teaching and method class). Furthermore, TPACK and the need for the TPACK capabilities by teachers in the 21st century (Jamieson-Proctor, Finger & Albion, 2010) is also an important component in ITE. The provision of TPACK in ITE has resulted in the model being introduced in some of the teacher preparation programmes in curriculum in some countries. For example, in USA, TPACK was addressed in a 3-credit Introduction to Instructional Technology course at a Midwestern university (Schmidt, et. al., 2009), introduced in an "Integrating Technology in Education" course in a mid-Atlantic university in the United States (Shinas, Yilmaz-Ozden, Mouza, Karchmer-Klein & Glutting, 2013), and emphasized in a core ICT module entitled "ICT for Meaningful Learning" during the semester of July 2009 in Singapore (Chai, Koh, Tsai & Tan, 2011). In developing the three individual domains of TPACK, it could be said that they require more practice and support to better understand and enhance the knowledge level. In addition, the combined domains are unique and more complex to understand which requires a deeper understanding of the interaction between the three individual domains (Mishra & Koehler, 2006; Niess, 2005). Furthermore, teachers may face difficulties in the classroom with students from diverse backgrounds. Previous studies showed inconsistent findings of the TPACK model structure. For example, there were seven-factor (Schmidt, et. al., 2009) and eight-factor models (Shinas et. al., 2013) while some reported a four-factor model (Chai, et. al., 2010) and a five-factor model (Koh, et. al., 2010) of TPACK.

In the New Zealand context, the TPACK was introduced in the Educational Studies course in a Graduate Diploma Teaching and Learning (Secondary) at University of Canterbury in 2007 (McGrath & Morrow, 2009). During the session, TPACK was incorporated into the pre-service teachers' learning activities. However, this did not occur for the Malaysian pre-service teachers who were only informally introduced to the TPACK during their field experience.

The comparative findings of this study also confirmed the mixed results in relation to the TPACK model structure. The results for the measurement model showed an acceptable fit of the seven-factor TPACK model in New Zealand and Malaysia (see details in section 4.6 and 4.10 for New Zealand and Malaysia respectively). The findings indicate that New Zealand pre-service teachers perceived that they could differentiate each TPACK domain. However, Malaysian pre-service teachers could not clearly differentiate between the PCK and TPACK; TPK and TPACK; and TCK and TPACK as separate factors and they tended to put all the domains together. The explanation for this could be that the teacher preparation programme in Malaysia was slightly different from the New Zealand context. That is, during the New Zealand teacher preparation programme the pre-service teachers were formally introduced to the TPACK which emphasizes the interaction between technology, content and pedagogy as a means for technology-integrated lessons, whereas this did not occur in Malaysia. Furthermore, the reduced experience of being present in and teaching in the school may also explain why the pre-service teachers in Malaysia failed to distinguish between PCK, TCK, TPK and TPACK domains because it was their first teaching experience, whereas for the New Zealand pre-service teachers it was their second teaching experience.

Furthermore, with regards to TPACK domain, Malaysian pre-service teachers rated their TPACK level higher than the New Zealand pre-service teachers before field experience. However, New Zealand pre-service teachers were more realistic in their perceptions towards TPACK as they rated TPACK the lowest compared to other combined domains. Perhaps, because they had been introduced to the TPACK prior to the field experience, they knew the complex interaction between

the three individual domains. Pre-service teachers in New Zealand showed significant medium improvement of TPACK after field experience. For Malaysian participants, they showed non-significant improvement of TK. Thus, it would be less likely for them to show significant improvement in technology-related domains, as was confirmed in the findings of TCK, TPK and TPACK differences after completing field experience (see section 5.5 for details).

7.2.8.3 Practical Component

Most if not all pre-service teacher education programmes include field experience in schools to provide a hands-on opportunity for pre-service teachers to put what they have learned into practice in the classroom (Darling-Hammond & Baratz-Snowden, 2005; Smith & Lev-Ari, 2005). Darling-Hammond and Baratz-Snowden (2005) further described that the variety of field experience structures implies different benefits and limitations for pre-service teachers. They stated that multiple field experiences give opportunities for pre-service teachers to think of how different strategies apply in a different placement setting while the short length of field experience may inhibit pre-service teachers to develop their understanding about school, learners and teaching. For example in the USA, the 30 weeks of field experience for four-year programmes is necessary for pre-service teachers to be able to teach the content of the courses that they have been taught (Darling-Hammond, 2006). Furthermore, visiting lecturers and the associate teachers have different but important roles in supervising the pre-service teachers (Timperley, 2001). The visiting lecturers and associate teachers involved during the field experience need to understand their purpose and roles (Haigh & Ward, 2004). Typically, associate (cooperating) teachers are appointed by the school principal based on who would be competent to mentor the student teachers within their subject matter knowledge. Generally, the role of associate (cooperating) teachers is subject competence so as to provide significant guidance and support to pre-service teachers and partnership for pre-service teachers during their field experience (Haigh & Ward, 2004).

The required practical component in New Zealand ITE consists of a minimum of 20 weeks of field experience across the three- or four academic year programmes and a minimum of two seven-weekperiods of field experience across the one academic year programme (New Zealand Teachers Council, 2009). For example, pre-service teachers in the New Zealand case study were enrolled in a one-year Graduate Diploma Programme (Secondary) Teaching and Learning and they were required to complete the two seven-week field experiences. The first seven week field experience was completed after five weeks of course delivery and the second field experience was done after a further ten weeks of course delivery and five weeks before completing the programme (details in section 1.3). Furthermore, they were required to teach their major subject during their first field experience and both major and minor during their second field experience.

By contrast, in Malaysia, the length of field experience required is not less than three months (Ministry of Higher Education, 2010). However the requirement for field experience varies between ITEs starting with a shorter period (two to three weeks) of school observation and a longer period (seven to ten weeks) of field experience. Furthermore, pre-service teachers in Malaysia had a limited practical component to practice and transfer what they had learnt with the guidance and support from teachers and teacher educators (Ministry of Education Malaysia, 2012). For the Malaysian case study, the pre-service teachers enrolled in a four-year Bachelor of Education programme had their first three-weeks of school observation and seven-weeks of field experience (details in section 1.2.2). However, pre-service teachers in Malaysia were not required to teach their major subject during field experience. They might be assigned with other subjects that are similar to their major subject due to the limited number of classes for that subject. During the process of supervision of pre-service teachers in 2007 and 2008, the researcher also acknowledged the deficiencies in ensuring the pre-service teachers were able to teach their major subjects and observed the same situation in 2011 as written in the researcher's journal.

Pre-service teachers are not obliged to teach their major or minor subject, all are depending on the subject availability. For example, pre-service teachers with Accounting major were asked to teach Integrated Living Skills subject and the reason for this was pre-service teachers in the same school but from different universities were teaching the subject. Furthermore, it was not their chosen subject area. In Malaysia, Integrated Living Skills (ILS) is a practical study which draws on technology and is offered to all students in lower secondary school (Form 1 to Form 3). This subject is designed as an effort to increase the technological skills and entrepreneurship among the students (Researcher's Journal Entry, May/2011).

Another contrast of findings between New Zealand and Malaysia was observed in relation to the role of associate/cooperating teachers during field experience.

According to the three pre-service teachers in New Zealand, the associate teachers were in the class during their [pre-service teachers] teaching period. However, in Malaysia, during my observation and as commented on by six pre-service teachers, some teachers left the class to the pre-service teacher except for the classroom observation assessment when the cooperating teacher was there [only] twice to do the evaluation (Researcher's Journal Entry, May/2011).

In summary, the comparative findings showed the existence of several commonalities among teacher education programmes within and between countries. However, the contrasted findings within and between ITEs in different countries certainly reflected the differences in relation to the cultural, school curriculum, the ICT use in education and the structure of ITE programmes in the two countries. Particularly, the strong focus of the Malaysian education system on exams and achieving results may partly explain the various concerns of student teachers in integrating ICT during field experience which will be discussed in the following section. Moreover, most of the school teachers in Malaysia have no time

to create a new strategy on how they can effectively incorporate the use of ICTs within the school curriculum (Afshari, et al., 2009). Malaysian teachers may lack ICT knowledge and confidence (Hosseini & Tee, 2012) to provide support for pre-service teachers in integrating ICT into the classroom. Hosseini and Tee (2012) acknowledged the advantage of having an experienced teacher to assist the pre-service teachers to use ICT in teaching during their study. However, only one teacher was able to guide one group of participants in making decisions to integrate ICT in teaching, whilst the other groups were lacking in confidence to proceed with their decisions (Hosseini & Tee, 2012). For this reason, providing support for pre-service teachers is essential to enhance their TPACK development and practice with ICT in school. Furthermore, it is difficult to "establish a strong all-inclusive education system, based on the best ideas from other parts of the world but still maintaining the cultural integrity of the people" (Townsend & Bates, 2007, p.8).

7.3   Pre-service teachers' ICT skills and knowledge and their TPACK

Given the contrasts provided so far in this chapter, it is now time to revisit the two case studies drawing on the analysis above to give a better focused lens reflecting the cultural diversity in the two countries, language used in the countries, school curriculums that are implemented in the two countries, ICT policies and practices and ITE curriculum that have been implemented in the two countries. In addition, the discussions of the two different contexts describe the factors that represent barriers and opportunities for pre-service teachers in both countries to develop the Technological Pedagogical Content Knowledge (TPACK) and their ICT skills and knowledge in schools, which are interpreted and incorporated within the discussions. These discussions are valuable in the sense that, firstly, they will highlight the factors that help to explain the causes of the difference between New Zealand and Malaysian opportunities for pre-service teachers to develop TPACK, ICT skills and knowledge in school. Secondly, the discussion aims to identify the level and the perception of pre-service teachers about their preparation for teachingin the two countries, which will reflect on the technological level as well as applicability of the technology in the teaching practice of each country. Lastly, discussion identifies the support level that is available during the pre-service

teachers' preparation for developing TPACK and their ICT skills and knowledge in school in these two countries, and even the level of ICT access that is available during the pre-service teachers' preparation.

The goals of integrating ICT in teacher education have been shared in this present research study of which the focus of this chapter is to discuss the comparative findings between New Zealand and Malaysia in regards to the opportunities available in the two countries for pre-service teachers' preparation to develop TPACK and ICT skill and knowledge in schools. Three key objectives for integrating ICT in teacher education are now applied for this analysis. There are the need to: 1) renew school education and teachers' education in order to ensure that they are in tandem with the changes taking place in the external environment; 2) integrate ICT into teacher education and equip pre-service teachers with ICT skills which are essential in preparing them to apply ICT effectively in their teaching practice; and 3) integrate ICT studies in teacher education in order to prepare K-12 teachers to teach ICT-related content and apply the ICT in education (Davis, 2010).

In both contexts, the university evaluation of the practicum performance also contributed to the level of ICT integration in teaching. These evaluations related to the ICT policies for teaching and learning that were available in both countries. In addition, the evaluations were aligned with the requirements of each certification body for initial teacher education in both countries. Although pre-service teachers in New Zealand did not clearly identify their concern in relation to teaching assessment, feedback from the teacher educator provides support for this. For example, the Science Programme Coordinator (SPC) in ITE, an expert in the field of Science at a New Zealand University, asserted that,

> *"Having another adult (associate teacher) in the same class during the teaching period could possibly contribute to the minimum development of their ICT use in teaching".*

The Science Programme Coordinator made this assertion regarding the fact that there could be a negative perception/fear of having other people in the pre-service teacher's classroom.Teaching evaluation by associate teachers triggers anxiety among pre-service teachers because, in some cases, they feel uncomfortable when their teaching is observed by others because their teaching may not be what the supervisory teams expect (Rajab & Romly, 2010).

7.3.1   ICT Use

The ICT policies and practice in education vary considerably between countries (Anderson, 2003). New Zealand being a highly developed country has a wide implementation of ICT in its school systems whereby online learning has greatly taken off (Kidman & Stevens, 2011). As Paige, New Zealand pre-service teacher, said, "*They [schools] made ICT well available for me*".

Only one of three participants in New Zealand commented during the interview on the issue of limited ICT resources.

> *The limited resource is the biggest [and] trying to teach [Economics] without access to any technology is quite a challenge as well [as] there's competition between all the other classes for rooms (*Vanessa, New Zealand pre-service teacher*).*

Malaysia aims to be a developed country by 2020 which indicates that the ICT penetration is not high in schools and it can even be noted that schools in rural areas within the country have no ICT infrastructures for learning (Ismail, Azizan, & Azman, 2011; Mahmud & Ismail, 2010). School teachers in Malaysia have for a long time been required to use ICT in class activities, however, several studies suggest that not all teachers are able to maximize the use of these technologies in teaching despite its availability in schools (Abd Hamid, 2011; Lau & Sim, 2008) and to have access to ICT tools such as the Internet or personal computer, projectors, and laptops (ChanLin et al., 2006). The findings of this study further confirmed that the ICT access was a concern for all of the participants in Malaysia.

They stated that, *"The projector in SSF can only be set up in the computer lab"* (Ramli, Malaysian pre-service teacher), and *"They have a computer laboratory but without computers"* (Zaman, Malaysian pre-service teacher).

> *Although I was at a cluster school, the ICT was only available for form 5 students. The school has a computer laboratory but not all students have the opportunity to use it* (Firus, Malaysian pre-service teacher).

The lack of ICT access during field experience provides an explanation for why pre-service teachers in Malaysia did not show significant differences of their TK level after completing the field experience.

> *Even though I have made the booking, but I was late and somebody else [another teacher] took the lcd [liquid crystal display] earlier or used other facilities in the lab, I couldn't use it [lcd]* (Ayu, Malaysian pre-service teacher).

Furthermore, limited ICT facilities in school and the teachers' perceptions that pre-service teachers did not have much teaching experience could also encourage the teacher to strictly limit the access to the ICT facilities.

> *Teachers here had the assumption that practicum teachers could not manage the students, as they [teachers] were afraid that we [pre-service teachers] will break the [ICT] tools in the lab* (Ayu, Malaysian pre-service teacher).

In New Zealand, in some schools the same situation was also observed as pointed out by Vanessa in her first interview, where she stated *"having access to computers is a bit of a problem"* for her to teach Economics. Although most schools in New Zealand are equipped with technologies, which also supported the significant differences of TK level rated by New Zealand pre-service teachers, they still need

to keep practising using it in their teaching. As stated by Paige, "*I need to just have some time to actually work on them and learn them practically*".

The pre-service teachers agreed that TPACK is important in understanding the complex interaction between content, technology and pedagogy and necessary for teachers to effectively integrate ICT in teaching.

> *We won't be an effective teacher if we were lacking in one of those areas [and] I don't think there is one more important than the other* (Paige, New Zealand pre-service teacher).

> *TPACK is important and a must know to make the teaching process more effective and understanding of the teaching concepts would be easier [and] knowing TPACK could give more benefits to teachers* (Ida, Malaysian pre-service teacher).

Furthermore, the findings of this study (refer section 5.2.2 and 5.3.2 for details) indicate that there were differences between New Zealand and Malaysian pre-service teachers' understanding of TPACK before and after field experience. Similarly, pre-service teachers in New Zealand and Malaysia showed significant differences in PK and PCK mastery level between pre-survey and post-survey. Comparatively, pre-service teachers in New Zealand showed significant differences in most TPACK domains, namely, TK, PK, PCK, TCK and TPACK. The findings for New Zealand data showed that the differences for TK, PCK and TCK indicated a small effect size and a medium effect size for PK and TPACK. Additionally, the New Zealand pre-service teacher (Vanessa) asserted that her TPACK was "*getting there*" after completing the field experience but she admits that she needs some more practice to develop the knowledge. In contrast, respondents in Malaysia showed significant improvement with small differences in CK, PK and PCK. Moreover, during the third interview, the Malaysian pre-service teachers did not clearly articulate their understanding of TPACK. Most of them tried to define their TPACK based on the definition given in the TPACK notes. However, one of the

seven pre-service teachers, Ida, tried to explain even the understanding was too broad "*the TPACK concept is a combination of all domain of knowledge*". This suggests that, generally, pre-service teachers in New Zealand and Malaysia perceived that they have the essential knowledge prior to their field experience with regards to TPACK concepts and demonstrated a significant improvement in some of the TPACK domains.

Comparatively, participants from Malaysia scored their TK mastery level higher than the participants in New Zealand before and after field experience. However, participants in New Zealand showed significant differences in their TK mastery level which indicates that they have developed their TK mastery level from completing field experience. However, there was a small significant difference in New Zealand pre-service teachers' TK. The minimal use of ICT in teaching could be due to the number of teaching sessions that the pre-service teachers had during field experience. According to Melinda, "*there was not much teaching involved during my field experience, thus, ICT use was not really there*" (Melinda, 3rd interview, 2012). Additionally, the lowest score in TK and non-significant difference rated by pre-service teachers in Malaysia may also explain the non significant differences in other technology-related domains: TCK, TPK and TPACK. Pre-service teachers may have the confidence to integrate ICT into their lesson plans, however, when it came to the actual implementation, they faced issues, such as a lack of time and difficulties to reserve technology (Hur, Cullen & Brush, 2010) which inhibited them from continuing to use the ICT in teaching.

It would be impractical to try to equip pre-service teachers with TPACK and ICT skills without giving them access to ICT, more so during the field experience and therefore, for any effective initial teachers' education, ICT must be readily available to the teachers, as it was for Ida but not for Ayu:

> *Field experience really helps me to develop my ICT skills given the school had good ICT access too* (Ida, Malaysian pre-service teacher).

Teaching session involved using technology but the school's technology level is still at a minimum (Ayu, Malaysian pre-service teacher).

However, it is important to restate that the level of ICT access in New Zealand is much higher than in Malaysia and therefore, supporting access to ICT in field experience is more effective in New Zealand than in Malaysia. In line with the vision of 2020, the Malaysian government introduced a smart school which is one of the seven flagships applications that are part of Malaysia's Multimedia Super Corridor (MSC). The aim of the Malaysian smart school is to provide good ICT access for teaching and learning, however, the preparation of pre-service teachers at ITE does not align well with the structure of the smart school and there is lack of partnership collaboration between the school and ITE. For example, pre-service teachers (Adys and Lynna) first chose to have their field experience at one of the smart schools in the northern part of Malaysia; however, they finally decided not to have their field experience at the smart school.

We have changed the school [from smart school to national secondary school] for our field experience because we felt that we were not ready to practice at that kind of school (Adys and Lynna, Malaysian pre-service teachers).

In Malaysia, however, most pre-service teachers emphasize the teaching performance assessment in the classroom. Zaman, for example, suggested that the cooperating teacher was not supposed to set the teaching level of pre-service teachers as comparable to an experienced teacher especially during their field experience.

As an experienced teacher, it may be appropriate to guide and monitor the students [student teacher] without setting up the level of expertise (Zaman, Malaysian pre-service teacher).

Zaman's remarks suggested that pre-service teachers are unlikely to have mastered TPACK and ICT skills. This could mean that there is lack of emphasis on the early integration of ICT skills into the teaching practice, which could have seen Malaysian students who have enrolled for a teaching course take-up ICT training as early as their first year at the University.

As previously discussed in the different approaches to ICT use in education, the use of ICT in teaching was also affected by the education system. Furthermore, the availability of, and access to, the ICT facilities in schools also contributed to the integration of ICT in teaching. For example,

> *In Malaysia, schools are constrained by an exam-oriented curriculum, teachers faced the pressure of finishing the syllabus, which did not allow sufficient times for pre-service teachers to teach with ICT* (Researcher's Journal Entry, 2011).

The observations made during pre-service teachers' supervision and fieldwork showed that ICT training during field experience for pre-service teachers is not greatly emphasized in Malaysia and is more likely to be treated as a supplementary requirement that is not a 'must-have'. Greater emphasis is placed on finishing the syllabus which is mostly theoretical. These observations or findings about Malaysia can be related to the fact that Malaysia is a country that is projected to be developed by 2020, that the current ICT penetration is not as high as in New Zealand and most schools do not have ICT infrastructure (Ismail, Azizan, & Azman, 2011). Although there were ICT courses for teachers' professional development to prepare teachers with the ICT knowledge and skill, as a teacher educator in Malaysia, the researcher believed that the knowledge about how to integrate ICT within pre-service teachers' subject expertise was not greatly emphasised at the ITE (Hosseini & Kamal, 2013).

7.3.2   *Language of Instruction*
Returning to the medium of instruction in school, unlike New Zealand which mostly uses English as the medium of instruction, Malaysian pre-service teachers

faced challenges with the language used in the classroom. For example, using English to teach the ICT subject was a concern for Malaysian pre-service teachers. Although Malay language is the medium of instruction at national schools in Malaysia, the ICT subject requires teachers to teach using English.

> *In order to communicate with them [students], I used broken English [mix of both Malay and English languages] to communicate with them [students] because if I use the language in the book [English], they won't understand it* (Adys, Malaysian pre-service teacher).

> *Zaman struggled to explain more about the concepts taught during his ICT class, it was not because of the limited knowledge of his content. As ICT subject is delivered in class using English as the medium of instruction, thus, the [his student] language limitation hindered him to successfully deliver the content. The students' participation also was not good. However, when Zaman questioned the students using Malay language, they were able to participate in the class* (Researcher's Journal Entry, 2011).

This language barrier presented an additional challenge to the application of ICT in teaching as well as pre-service teacher development of TPACK. This drawback is further worsened by the fact that most ICT platforms are designed for use in the English language and, therefore, poor comprehension of the English language limits the understanding of the topic. Pre-service teachers seemingly overcome this challenge by using broken English in order to teach an ICT subject. However, this worsens the problem because it lowers and even distorts the students' mastery of English language, fluency in which is quite important because of the current trends in globalization. Additionally, a multiracial country with three major races and three different languages also gives the pre-service teachers a challenge to teach using the medium of instruction in national schools during their field experience. For example, pre-service teachers in Malaysia, Adys and Suria, commented that using Malay language to teach Moral Education was also a concern for them.

I have an Indian student who didn't understand the language at all and her [Indian student] friend would always translate it for her before I can proceed with my teaching (Adys, Malaysian pre-service teacher).

We [pre-service teachers] use Malay as our main communication language with the students and mostly students who did not use Malay in their daily communication were not able to understand the subject [Moral Education] well (Ayu, Malaysian pre-service teacher).

Thus, in order to overcome the language barrier during the field experience, Ayu further suggested that pre-service teachers, especially those who will be teaching the Moral Education subject, should learn an additional language. She suggested, for example, Chinese language, as an additional language course so that they could communicate well with the students.

Teachers [pre-service teachers] should take [learn] the foreign language subject [Chinese language], apart from Bahasa Melayu [Malay] (Ayu, Malaysian pre-service teacher).

7.3.3   Pre-service teachers' preparation

Generally, the pre-service teachers who participated in the research study stated that the teacher education programme ignited curiosity in them and they would seek to learn more about how technology can be used to improve the teaching approaches used in the classroom. The comment from one of the three participants in New Zealand commended the initial teachers' education thereby affirming that this approach is effective in imparting pre-service teachers with TPACK, ICT skills and knowledge, which they can employ in their teaching practices (Ben-Peretz, et. al., 2012).

Yeah, in fact the how to teach I think has come from professional studies, a lot of the ways, in the way of teaching questioning skills, getting group work sorted, education studies has been the technological knowledge, the course

work and the courses that we take [and] if you have learnt what they [TPACK] are, then, you can develop it during teaching practice (Vanessa, New Zealand pre-service teacher).

From Vanessa's statements, it seems that she is reflecting back on the earlier initial teacher education during the professional studies class and attributing the technological knowledge that teachers learn in order to apply to their teaching practice. Furthermore, Vanessa's statements provide explanation as to why there was a small improvement between the pre- and post-survey on the seven TPACK constructs. For instance, she talked confidently and gave examples of her teaching lessons. This is because she affirms the initial teachers' education is adequate in the sense that it equips teachers with the necessary content, pedagogical and technological knowledge, and ICT skills which they can further develop during their teaching practice.

Similarly, in the Malaysian context, the pre-service teachers' feedback supported that the ITE preparation is adequate in equipping teachers with the preparation for their teaching practice. For example, Malaysian pre-service teacher, Ayu, in her first interview session stated that "*The preparation is enough and I am quite confident to start my teaching practice*". Zaman in his first follow-up interview session also shared the opinion that the ITE was effective in preparing them as a teacher. "*This university [UUM] has built our [pre-service teachers] personality as a future teacher*".

7.3.4   Field Experience

In regard to ITE preparation, New Zealand offers flexible ITE preparation, which can be customized by a particular body that awards certification to pre-service teachers while in Malaysia the ITE preparation is uniform and centrally managed. Pre-service teachers stated that field experience provides them with an opportunity to practice and even gain more knowledge. It is expected that field experience provides support for pre-service teachers to develop the teaching strategies and incorporate a suitable approach with their content. Generally, pre-service teachers

in this study acknowledged that they have developed their PK and PCK during field experience (see section 5.2.3 and 5.3.3 for details). However, participants in New Zealand showed more significant differences in their PK mastery level compared to the Malaysian participants which points us to the activities occurring whilst the pre-service teachers were not teaching. Melinda, New Zealand pre-service teacher said "*The students had more group discussion on the project they were working on*". Vanessa added that her "*… PK is improving all the time*". This may also suggest that completion of the two seven-week teaching placements and support from teachers provide the opportunity for them to develop more of their PK.

> *We should already know the content ourselves, but it's about how … [my] pedagogical knowledge, it's getting there and I think that's to do with practice as well* (Vanessa, New Zealand pre-service teacher).

> *I think I've learnt a lot more on placement than at Teachers College* (Paige, New Zealand pre-service teacher).

In contrast, Malaysian participants rated higher PK before field experience than the New Zealand participants. However, they showed small improvement in their PK after field experience (see section 5.6 for details) which may suggest that there was insufficient field experience compared to other ITEs and a lack of immediate support from their cooperating teacher during their teaching sessions.

> *Field experience is helping me to gain confidence for myself and then, it teaches us to prepare our teaching plan* (Zaman, Malaysian pre-service teacher).

> *Other universities might have more than one practicum. Therefore, I think this would be an advantage for pre-service teachers to be more skilful* (Ida, Malaysian pre-service teacher).

Therefore, gaining a substantial knowledge of pedagogy is important for teachers because it will enable them to use several approaches in delivering the content to the students (Hinostroza et al., 2008). The above statements confirm that having teaching experience in practicums is more effective since it involves the practical application of theories, a principle of constructivist learning (Forlin, 2010).

In terms of developing pre-service teachers' CK during field experience, pre-service teachers in New Zealand rated their initial CK the highest among all domains in the pre-survey, thus, it became less likely that the trainees would show significant development of their CK during their field experience. Furthermore, the pre-service teachers in New Zealand had more experiences in relation to the CK prior to the ITE programme because they had learnt the subject-specific material before they started the ITE programme. This may contribute to the rating of CK before their field experience.

> *Student teachers have already done a degree (in most cases) on the subject they taught, thus they knew a lot about the content of that subject and they may just pick up new bits and pieces during field experience* (Melinda, New Zealand pre-service teacher, follow-up interview in November 2012).

Additionally, the non-significant difference in CK in the New Zealand findings pre- and post-survey was because "*there was not much [content] teaching involved*" (Melinda, New Zealand pre-service teacher) as "*they were getting in towards exam time*" (Vanessa, New Zealand pre-service teacher). In contrast, Malaysian pre-service teachers showed significant small improvement of their CK after field experience. The explanation for this could be that they had the opportunity to understand and develop more of their CK as it was their first teaching experience in ITE.

> *I thought that my CK was enough, but, during field experience, I found that my CK was not enough especially for my Moral Education subject because*

207

the topic I had learnt was quite different than the one in school (Lynna, Malaysian pre-service teacher).

Experiences during teaching practicum can enhance my content knowledge, and it can be improved more because I used to learn about theories and now I can transfer the knowledge (Ida, Malaysian pre-service teacher).

7.3.5   Support for pre-service teachers in the field

One of the most common challenges that can impede the success rate of ICT implementation is the support and knowledge of school teachers when it comes to the use of ICT in teaching which can also affect the success rate of ICT integration (Hew & Brush, 2007; Mishra & Koehler, 2006; Ertmer, 2005). Based on the literature, the role of associate teacher can be summarized as a "model teacher, observer / evaluator, planner of teaching experiences / demonstrator of planning processes related to teaching, conferencer, professional peer, counselor and friend" (Sanders, Dowson & Sinclair, 2005). However, the level of support given varied from the roles expected. Findings of this study also confirmed this with regard to the support needed from school. New Zealand pre-service teachers, Vanessa and Paige stated that,

... we [pre-service teacher] tended to be a little bit lower on the priority list [of using ICT] (Vanessa, New Zealand pre-service teacher).

Only one of them [associate teachers] modelled the use of ICT, but the other three [associate teachers] didn't really use much ICT (Paige, New Zealand pre-service teacher).

Similar to the lack of modelling in the New Zealand context, pre-service teachers in Malaysia commented that the support from teachers was very minimal. Generally, the role of associate / cooperating teachers is to guide and give feedback

on the pre-service teachers' performance during their field experience (Haigh & Ward, 2004).

> *The support from cooperating teacher and the school are both fundamental [and] I hope that we [pre-service teachers] would be given opportunity from the lecturer to demonstrate and train us about proper techniques for us to teach even better* (Ayu, Malaysian pre-service teacher).

However, teachers were not giving full support and guidance; some of them did not even feel comfortable with the pre-service teachers' dedication towards work (Hapidah, et. al., 2002). Other factors contributing to the minimum support from the teachers in school were time constraints, workloads and supervision skill (Zainudin, 2006). As observed during the fieldwork and as indicated by the Malaysian pre-service teachers' quotations in this study, the cooperating teacher was not in the classroom during their teaching sessions, thus it was uncertain how the assistance and assessment could be given. As Firus, Malaysian pre-service teacher, said "*My cooperating teacher was never in the class during my teaching sessions*".

Additionally, as a teacher educator in Malaysia, the researcher has observed pre-service teachers during their field experience. Although some schools are provided with the ICT facilities, teachers at school did not use the facilities in most of their classes. The reason for this was they found it difficult to cover the whole curriculum syllabus as teachers did not want to waste their time planning, fixing and implementing the new lesson with ICT use (Salehi & Salehi, 2012; Afshari et al., 2009).

The partnership collaboration between schools and teachers' education programme contributes to improving the competency levels amongst the pre-service teachers (Sanders, Dowson & Sinclair, 2005; Lange, 2011). Moreover, Conner, McGrath and Lancaster (2008) found that most teachers agreed that greater contact between ITE programmes and schools is important. More so because schools are able to

introduce relevant and tested teaching techniques that can further ensure the teachers are effective. The collaboration is more beneficial during the field experience since the schools can offer a more guided approach in the ways they apply TPACK and ICT skills and knowledge during the teaching process.

> *In those schools participating in the case study in Malaysia, ICT use was inconsistent, although some schools were provided with good ICT facilities, the support for use was generally thought to be inadequate by those interviewed. Furthermore, teachers do not actively model the use of ICT in teaching. Therefore, there would be less potential for ICT use in teaching* (Researcher's Journal Entry, 2011).

Paige, a New Zealand pre-service teacher, expressly stated the importance of support from the associate teacher during field experience.

> *While I'm on placement I'm just learning so much from my associates and from actually having to take a classroom and teach.… Watching my associates and other teachers helped me develop pedagogical knowledge* (Paige, New Zealand pre-service teacher).

Paige's statement shows that the associate teachers demonstrated their roles consistent with an educatively acceptable standard. This finding is similar to the findings from a study by Timperley, Black, Rubie, Stavert and Taylor-Patel (2000) in which they found three of the four mentors demonstrated the views and performed their roles aligned with the New Zealand university guidelines. Furthermore, the integration of ICT in teaching could also be modelled by their associate/cooperating teachers during field experience. Modelling the integration of ICT by teacher educators during teacher education programmes may also benefit the students by exposing them to ways of ICT use in teaching specifically in their subject matter knowledge. Similarly, the lack of modelling would be a challenge experienced in Malaysia. For example,

I found that my cooperating teachers did not use technology in their classroom (Ida, Malaysian pre-service teacher).

The cooperating teachers' roles were clearly outlined in the Industrial Training Policy (2010), however, they were not able to give good supervision experience to pre-service teachers due to heavy workloads (Md Yunus, et.al, 2010). Challenges faced by pre-service teachers during field experience, particularly related to classroom management and students' attitude, are difficult to cope with during the field experience (Abdul Majid, 2008; Reupert & Woodcock, 2010). These concerns can prevent the pre-service teachers from focusing entirely on the teaching and learning activities (Ong, Rose, Azlian, Sharnti, & Ho, 2004). Thus, it is suggested that the pre-service teachers build good relationships with the teachers in school (Reupert & Woodcock, 2011). In this regard, one of the three participants stated her concern to start the field experience,

Some of the concerns came like learning the students' names, getting to know where everything is in school, the policies, behaviour management policies (Vanessa, New Zealand pre-service teacher).

In contrast, all seven pre-service teachers in Malaysia agreed that classroom management was a concern regarding integrating ICT in teaching. Furthermore, in the pre-survey findings, pre-service teachers in Malaysia rated the item concerning organizing and maintaining the classroom management as their lowest mean score in the PK domain (see section 5.3.2 for details). Pre-service teachers' concerns were mainly linked to the students with poor attitude towards learning. Some of the students were of a low academic level, could not read and did not have an interest in learning. Furthermore, in one of the three schools participating in the study, some students just ignored teacher's instruction and even showed disrespect towards the teacher. For example,

I am really worried with the students' attitude especially because for business subject, students are from the lowest class, some students cannot read and are naughty (Ida, Malaysian pre-service teacher).

Sometimes they don't even have their respect for me, not to mention that I have to waste ten minutes to calm the class down before I start teaching. There's a few students who did not show their interest towards the lesson and some of them didn't even bring the books for study [to school] (Adys, Malaysian pre-service teacher).

If I asked them [the students] to do something, they will fight against it and if I became mad or angry towards them, they surely will fight back and make noise in the class, they were so disrespectful that they dared to throw papers in the class (Suria, Malaysian pre-service teacher).

Furthermore, the participation in the communities in which pre-service teachers are trained, not only in their individual schools, but also with families and community partners (Coffey, 2010) could also contribute to their teaching experience. For example, Vanessa, one of the participants in the New Zealand case study, stated that her participation as a volunteer in an ICT project that was led by the New Zealand Association for Computing, Digital and Information Technology Teachers also helped her in developing her knowledge and skills with ICT in teaching.

7.4   Chapter Summary

This chapter provides a description of contextual similarities and variations between the two ITEs in New Zealand and Malaysia. Both ITEs have similarities which include the preparation of secondary school teachers and provision of two school placements at one or more secondary schools during the teacher education programme. However, the earlier case studies could be misinterpreted without this wider contextual understanding of the two cases.

The contrasts between the two contexts include the education system, school curriculum, pre-service teachers' knowledge of culture and diversity, language of instruction, ICT policy and practice in education and ITE curriculum. These help to clarify interpretation of the extent of a knowledge base of TK, CK and PK; pre-service teachers' teaching competencies; and provision of TPACK knowledge by both teacher preparation programmes. Therefore, the findings of this study reveal variations in the level of pre-service teachers' TPACK before and after field experience in New Zealand and Malaysia are influenced by these contextual factors. It is important to note that the preparation of pre-service teachers includes the preparation and support from members involved in the education system. The support from school and the partnership collaboration between ITE and teachers councils is necessary to develop and produce well-prepared future teachers.

The following chapter will conclude this study by clarifying the contribution of these findings to the field of ICT in education and by making recommendations for a variety of stakeholders.

CHAPTER 8: CONCLUSION

8.1 Introduction

This concluding chapter aims to clarify the originality of the findings of this doctoral thesis along with recommendations that arise, while also identifying limitations. The chapter begins with a general overview of the current study by briefly reviewing the purpose and the research design followed by identifying the original contributions. The limitations in relation to the particularities of the research contexts and transferability of the findings are discussed. This chapter concludes with recommendations for the Initial Teacher Education programme, Ministry of Education and collaborating schools. Recommendations for further research are also identified.

8.2 Overview of the current study

The current study was informed by a number of studies researching TPACK which have demonstrated that effective technology integration requires teachers to acquire knowledge of technology, content, and pedagogy as well as knowledge of their intersections (Mishra & Koehler, 2005; Schmidt, et. al., 2009; Archambault & Crippen, 2009; Albion, Jamieson-Proctor & Finger, 2010; Lux, Bangert & Whittier, 2011). As an extension of Shulman's concept of Pedagogical Content Knowledge, the TPACK framework is more complex in the sense that the model is composed of seven constructs known as: (1) Content Knowledge (CK); (2) Technological Knowledge (TK); (3) Pedagogical Knowledge (PK); (4) Pedagogical Content Knowledge (PCK); (5) Technological Content Knowledge (TCK); (6) Technological Pedagogical Knowledge (TPK); and (7) Technological Pedagogical Content Knowledge (Mishra & Koehler, 2006).

This study is unusual in bringing together the concept of TPACK, ICT integration in schools with an investigation of pre-service teachers' experience and development of this knowledge during field experience in two countries that were then contrasted to understand the impact of differing curricula and contexts. The

aim of this study is to gain a better understanding of the impact of field experience by comparing the development of TPACK by future teachers situated in two contrasting programmes of ITE with field experience in secondary schools and to investigate ways that pre-service teachers understand TPACK. The research investigates the question "*Do pre-service teachers in New Zealand and Malaysia use their field experience to develop their potential to integrate ICT in schools*? One case study of a New Zealand Initial Teacher Education programme with embedded cases of three student teachers' field experiences in New Zealand schools was gathered and contrasted with a case study of a Malaysian Initial Teacher Education programme with seven embedded cases of student teachers' field experiences in Malaysian schools. The summary of findings clarifying the originality of the findings begins with the instruments used to measure TPACK.

8.2.1 *Overall TPACK Findings*

Several studies have acknowledged the need to develop more reliable and valid instruments when measuring pre-service teachers' TPACK (Mishra & Koehler, 2006; Schmidt et al., 2009; Albion, Jamieson-Proctor & Finger, 2010; Sahin, 2011; Lux, Bangert & Whittier, 2011; Chai, Koh, Tsai & Tan, 2011; Yurdakul et al., 2012). Several TPACK surveys that were developed and tested on teachers in the United States were reported to be of high internal reliability (Schmidt, et al., 2009; Archambault & Crippen, 2009). This study contributed to increased reliability of TPACK instrumentation as well as gathering a data set in New Zealand and Malaysia for the first time.

The differences found in pre-service teachers' perceptions of TPACK in this study reflect differences in the way New Zealand and Malaysian pre-service teachers conceptualize their understanding of TPACK. The original findings contributed by this study indicate that the New Zealand pre-service teachers' understanding of TPACK was complex, whereas the Malaysian pre-service teachers over generalised their understanding of TPACK (see section 4.6 and 4.10 for New Zealand Malaysian findings respectively).

The structure of the TPACK model had been found to be inconsistent in previous studies. For example, some identified all parts of the models: Schmidt et al. (2009) identified a seven-factor model and Shinas, Yilmaz-Ozden, Mouza, Karchmer-Klein & Glutting (2013) an eight-factor model; while others found aspects had been combined or confused: Chai et al. (2010) found a four-factor model and Koh, Chai & Tsai (2010) a five-factor model of TPACK. An explanation for these differences was sought.

As previously discussed (see 4.2 for details), Jamieson-Proctor, et. al., (2013) carried out parametric and rasch analysis to identify the structure of technology-related domains, namely TCK, TPK and TPACK for the data analysis of their study. The development of four-theorised factors; TCK/TPK Confidence, TCK/TPK Usefulness, TPACK Confidence and TPACK Usefulness were evident. However, the development of TTF TPACK survey was looking at a different perspective of using ICT for future teaching (TCK/TPK) and how ICT could support students' learning (TPACK). Although they preceeded their analysis with Rasch method, it is believed that the confirmatory factor analysis used in this study was sufficient for the purpose of confirming the TPACK structure (Raju, Laffitte & Byrne, 2002). Several similarities that were discussed include: 1) both perspectives examine the relationship between an underlying construct and a set of measured variables; 2) both approaches examine the degree to which item/subscale level true scores are similar for persons in the two different populations with the same level of satisfaction/attitude/ability score on the latent construct; 3) both definitions of measurement equivalence do not imply that the distributions of scores on the underlying constructs in the two populations of interest are identical; and 4) both approaches can be used to identify the extent and the source of problem when there is measurement nonequivalence (p. 523).

Explicit teaching about TPACK in ITE was identified as likely to be linked with more complete understanding of TPACK, which was indicated by the larger number of factors identified with inferential statistics. For example, in USA, the TPACK was reported as a seven-factor model after those students had been

introduced to TPACK in a 3-credit course that introduced ICT in learning and teaching at a Midwestern university (Schmidt et al., 2009), and a similar course in a mid-Atlantic university in the United States (Shinas et al., 2013). TPACK was also emphasized in Singapore in a 12-week compulsory ICT integration coursethat reported eight factors of TPACK (all seven TPACK factors but the CK factor was separated into two specific CK factors) (Chai, Koh & Tsai, 2011).

Where students had not been taught about TPACK the model had fewer factors; as in this Malaysian case study. Koh, Chai and Tsai (2010) administered their TPACK survey at the beginning of the programme to Singaporean pre-service teachers who interpreted the items in TCK, TPK and TPACK as being in a similar domain and interpreted the PK and PCK items as one factor. In this study, the Malaysian pre-service teachers did not clearly distinguish their PCK, TPK, TCK and TPACK, suggesting that these pre-service teachers could not distinguish between the technology-related domains and the PCK. This research therefore recommends, along with Koh et al. (2010) that the TPACK instrument include the phrase "without using technology…" at the beginning of the all PCK items in order to help pre-service teachers differentiate between PCK and the technology-related domains. Furthermore, both recommend using subject-based TPACK items in TPACK surveys to help pre-service teachers distinguish the different TPACK factors, especially in the case of secondary subject specialists as compared to primary or early childhood education generalists where content is more integrated.

A TPACK survey was used to measure pre-service teachers' perceptions of their TPACK before and after field experience for the first time in this study. These original findings showed that New Zealand pre-service teachers showed significant differences pre- and post-survey in most TPACK domains, namely, TK, PK, PCK, TCK, and TPACK. Such measurement of pre-service teachers' TPACK before and after field experience could help teacher educators and pre-service teachers to better understand the baseline of TPACK understanding before field experience, and the significant influence of field experience for their TPACK development, except where they already have high levels before the field experience. The New

Zealand pre-service teachers, who were graduates on their second field experience, rated their CK highly before field experience; so it was not surprising that no significant improvement was shown in their CK after field experience. In contrast the Malaysian pre-service teachers, who were undergraduates on their first field experience, significantly increased their CK, PK and PCK domains. The lack of a significant difference in technology-related domains is likely to be explained by the lack of ICT available to them during field experience (as discussed in section 7.2.4). These and other contrasts in the New Zealand and Malaysian case studies indicate the importance of a range of contextual factors, which suggest that the country, the Initial Teacher Education programme, school curriculum and ICT availability as well as student maturity contribute to the development of TPACK.

In addition to providing original evidence of the instruments (adapted from Schmidt et al., 2009 and Archambault & Crippen, 2009) accompanied by validation when measuring pre-service teachers' TPACK level, this study also confirms the importance of triangulating a self-report instrument with other data sources such as interviews and classroom observations to overcome the self-reported difficulties or bias, and to validate the findings (see also, Graham, Cox & Velasquez, 2009; Jamieson-Proctor, Finger & Albion, 2010). Perhaps most importantly, the design of the study enabled the researcher to clarify the importance of a range of contextual factors by contrasting two case studies to explore and explain the variances that could otherwise have been misinterpreted. The importance of such factors has not been clarified previously in the literature.

8.2.2   *Overall findings of Case 1 contrasted with Case 2*

Overall, the current findings confirmed existing literature. Participants in this study acknowledged a range of influences on the development of their ICT knowledge and skill and TPACK. However, unlike the previous research, the current study went further to understand the current findings from a comparative view. As compared and discussed in the previous chapter (see section 7.2 for details), it is important to interpret the findings of this study with care as there are large variances within and between countries.

The original findings of this study indicate that field experience, support from school, ICT access, technical issues and preparation are all important factors in developing pre-service teachers' knowledge and skill of ICT and TPACK. An in-depth account of pre-service teachers' TPACK development provided in this study (see section 6.2, 6.3, 7.2 and 7.3 for details) revealed the influence of a number of 'factors' on the development of TPACK. Easy access to the ICT facilities made a difference to the pre-service teachers' use of ICT in teaching. For example, those who had access to ICT facilities were more likely to use them in the classroom (see also Cowie, Jones & Harlow, 2006).This study confirms the positive influence of field experience on pre-service teachers' learning and self perception. Pre-service teachers are best prepared and supported during this learning cycle (Forlin, 2010); and it is important that the whole teaching team takes responsibility for educating the pre-service teachers by providing and supporting a positive learning context (more detail is presented later in section 8.2.5).

8.2.3   Language of Instruction and Cultural Diversity

Language is the basic ability and condition that makes identity and communication possible (Brown, Craven & McLean, 2012). Therefore, for full understanding of teaching or lessons, it is essential to ensure that the language used in class is understandable to every student. In the Malaysian case study (see section 7.3.2) it is noted that most ICT related issues and concepts are communicated using the English language. Although an international language because of its popularity across the world, the use of English was challenging for the students and their student teacher. Therefore, it is recommended that the communication of the ICT concepts in class to students uses language that all the students are able to understand, including techniques suited to second language learners.

This was not a problem in the New Zealand case study even though its original citizens have a distinctive Māori culture and language because 19th century migrants introduced a distinctiveBritish culture and schooling system (Singham, 2006) and none of the schools in the study taught in the Maori language. However, the existence of the Treaty of Waitangi has fostered a unique race relations environment in New Zealand, adopting te reo Māori as the national language along

219

with sign language (Singham, 2006). The Treaty of Waitangi is a founding document for New Zealand which provides a context for the relationship between the Crown, Māori, and their iwi (tribal groups) (see Orange, 2012). Furthermore, the Ministry of Education New Zealand has introduced the Māori Education Strategy and other policy frameworks including Kahikitia– Accelerating Success 2013-2017 (Ministry of Education New Zealand, 2013) to ensure the equal treatment of people. Therefore New Zealand pre-service teachers face different hurdles in relation to the language of instruction during teaching including when using ICT to teach. Māori-medium schools also have related problems with language, because relatively little English is used and yet English is the everyday language for most New Zealand people. Thus, it is important for the national curriculum to recognise the importance of the Māori language for all New Zealand schools and to increase the number of bilingual teachers (Ministry of Education New Zealand, 2013). For these reasons, although language did not emerge as an issue in the New Zealand case study, it does clarify that the overwhelming use of English when teaching ICT is a global issue that should be addressed.

Returning to the Malaysian case study, where it appeared to be necessary for pre-service teachers to use English when teaching ICT in a classroom, it would be preferable for the pre-service teachers to also use the Malay language for better understanding. Furthermore, the three different school systems in Malaysia encourage multiple languages to be used in school, which also creates additional concerns for pre-service teachers when communicating with the students. For example, Adys had a problem delivering computer literacy content and communicating with the students using only English, so she felt compelled to use both English and Malay languages during the teaching and learning session (see section 7.3.2 for details). It has been proposed in a recent Malaysian Education Blueprint that school children are required to learn an additional language as well as Malay and English (Ministry of Education Malaysia, 2012). Thus, it is also recommended for pre-service teachers to have knowledge of additional languages, including ICT terminology. Malaysia is a multiracial country with different races that include Malay, Chinese, Indian, and the indigenous people, so that the

Malaysian education system is required to reflect and respond to diverse races in the classrooms. To date, no TPACK literature has clarified the importance of language and cultural diversity in interpreting the TPACK and,this study did not aim to investigate the impact of language and cultural diversity on pre-service teachers' TPACK. However, the comparative findings of this study suggest that these factors may have an influence on the development of pre-service teachers' TPACK and ICT use in school and research is recommended to investigate the impact of language and cultural diversity on pre-service teachers' TPACK.

Differences in language and culture may be conceptualised as an additional layer when interpreting the TPACK. In particular, content knowledge should always be structured in a manner that is not racially degrading to any culture. For example, in New Zealand, Māori culture is becoming better embedded within the CK domain as part of the recent Māori Education Strategy, Kahikitia – Accelerating Success. In relation to PK, the Māori Education Strategy also recommends the indigenous two-way teaching and learning process called Ako (the same word in Māori language for both teacher and learner) that suggests that the teacher is also learning from the student. Ako also acknowledges that students should not be seen as independent of their whānau (extended family), thus all stakeholders must establish 'productive partnerships' with iwi, whānau (Ministry of Education New Zealand, 2013). This adds to the complexity of applying TPACK within New Zealand.

Returning to the use of ICT in field experience in New Zealand and Malaysia, the ICT can be used to find and present relevant resources in the classroom to fit the diversity of cultural needs with the teacher learning about additional cultures from his or her students. For example, ICT awareness can be increased by providing better access to interfaces in Māori language including accents and basic ICT vocabulary in te reo. The same recommendation also applies in the Malaysian context with its range of languages in its multiracial society. Therefore, drawing on the findings of this comparative study, a recommendation is made to include language and cultural interpretation when teaching TPACK and using ICT in teaching. It is also recommended that ITEs prepare pre-service teachers with

knowledge of an additional language and culturally responsive pedagogies to help them in communicating with the students (see section 8.3.1 for recommendations to the ITE).

8.2.4 Local vs central school curriculum and school management

While analyzing and discussing the New Zealand and Malaysian contexts it was noted that the two countries have different sets of curriculum for their school systems. In New Zealand they have two sets of national curriculum: one is the New Zealand curriculum for English-medium schools while the other is Te Marautanga o Aotearoa which has been developed for the Māori-medium schools. However, Kidman and Stevens (2011) noted that despite having two sets of national curriculum, the New Zealand Ministry of Education has allowed for schools to restructure or personalize the curriculum in order to suit the needs of their learners and address challenges that are only prevalent in a particular local region. Consequently, school management in New Zealand is decentralized and each school has autonomy to enable schools to adjust to local needs and reflect local capabilities.

In contrast, the Malaysian curriculum is centralized with the management of schools largely under the control of the national Ministry of Education that supervises all public schools. The main disadvantage of this 'top down' approach is that the curriculum may at times fail to address the needs of each school and community, since it is designed from the national perspective. Furthermore, the responsibility of the teachers towards teaching is more focused on covering the syllabus for each subject that is set by the Ministry. These educational context differences explain some of the differences in the findings in this study.

8.2.5 Diversity of Initial Teacher Education Programmes

It is important to note that the findings required careful interpretation because of the variations of the ITE programmes (Darling-Hammond & Baratz-Snowden, 2005) which include the implementation of field experience, the role of associate (cooperating) teachers and the use of ICT.

Field experience

Based on the current findings and literature on field experience, it is evident that field experience has an important role in developing pre-service teacher's teaching competencies both in general and in relation to TPACK. The findings of this study indicate that field experience offers pre-service teachers the opportunity to practise and gain more knowledge about teaching as well as TPACK and ICT skill and knowledge. New Zealand pre-service teachers showed more progress when compared to their Malaysian counterparts. It was noted that this difference may have resulted from the multiple teaching practices completed by the New Zealand pre-service teachers and greater access to ICT and modelling of teaching with ICT.

Although the common conception is that pre-service teachers are supported to shift from 'novice' to 'routine expert', Timperley (2012) suggests that pre-service teachers need to shift from a 'novice' to an 'adaptive expert'. According to Timperley, being an 'adaptive expert', the pre-service teacher is "responsive to learners through challenging their own assumptions, checking relationships with target student learners and identifying what needs to be learned next" (p. 15). The original findings of this study confirm and added to Timperley's conceptby identifying the importance of understanding the various contexts in which pre-service teachers develop and build adaptive expertise. This includes the diversity of culture, languages and the curriculum. In addition, this study indicates that the ITE programmes should draw attention to improving the access to ICT during field experience, which was not noted in Timperley's work. (see section 8.3.2 for the recommendations towards improvement of field experience).

Role of Associate / Cooperating teacher

Associate or cooperating teachers have important roles in supervising pre-service teachers (Timperley, 2001) and such teachers need to understand their purpose and roles during the field experience (Haigh & Ward, 2004). Generally, the role of associate/cooperating teachers is to guide and give feedback on pre-service teachers' performance during their field experience (Haigh & Ward, 2004). The original findings in the New Zealand case study indicate that the pre-service

teachers attributed their improved mastery on TPACK and ICT skill and knowledge in schools to the persistent assistance of their associate teachers. This could also be attributed to a close cooperation between ITEs and regulatory support of the Teachers Council in New Zealand. The establishment of partnership between ITEs and schools requires a clear understanding of the supervision requirements and acknowledgment for the job (Timperley, 2012).

In contrast, the Malaysian student teachers observed that there was no or minimal support from their cooperating teachers specifically in relation to ICT use in teaching. Generally, the teaching practicum regulations clearly state the roles of the cooperating teacher (see Ministry of Higher Education, 2010) and that support from the cooperating teacher has the most significant influence on the development of pre-service teachers during field experience (Killian & Wilkins, 2009; Haigh & Ward, 2004). However, four pre-service teachers in Malaysia did not observe their cooperating teachers teach with ICT (see details in section 7.3.5). This suggests that the cooperating teacher was not helpful to the pre-service teacher's development of TPACK and ICT skills. This could be attributed to the teaching workload, administrative work, co-curricular duties and examinations (Thang et al., 2010). Although this may consequently hold some back from using ICT in the classroom, all pre-service teachers who had been exposed to the use of ICT were eager to incorporate ICT in their future practice. One student commented, "*Technology [ICT] offers so many advances for students and can relate to many different learning styles*". Another student commented, "*I will definitely want to use technology*". In addition, one of the student teachers encouraged greater use of the 'computer room' (the only classroom with a computer and projector) and also helped teachers in the school use that ICT.

Thus, an original finding of this study is to confirm the importance of the associate teacher's role in supporting and guiding pre-service teachers during field experience including their use of ICT and development of TPACK (see section 8.3.4 for recommendations for school).

ICT use in school

Many variations in the ICT practices in teacher education are reported in the literature (Kirschner & Davis, 2003; Law & Plomp, 2003). Similarly there are many variations in ICT in school systems worldwide as shown in the SITES international study by the IEA (Pelgrum, 2008) and the SITES II case studies of innovative schools (Law, 2008). The case studies in this research were set in a developed and a developing country and thus the ICT infrastructure and resourcing in schools and home were much richer in New Zealand than in Malaysia. ICT infrastructures in New Zealand schools continue to increase with the implementation of Ultra-fast Broadband in Schools (UFBiS) and a Network for Learning (N4L) for all schools by 2016 (Davis, 2012). In addition, ICT policies for schools are well developed in New Zealand, unlike in Malaysia. Thus ICT is widely deployed and applied in teaching and learning in schools and initial teacher education in New Zealand.

In contrast, in Malaysia ICT is only utilized in some schools, often those with substantial financial resources or in urban areas that are able to utilize ICT for teaching and learning purposes or part of the Government Smart School project (Wan Ali & Mohd Nor, 2010; Awang, Ismail, Flett & Curry, 2011). Problems exist such as the provision of notebooks for school students when the school was not provided with the technical support and ICT facilities for teachers. Furthermore, there was only one computer in a computer laboratory for teaching and learning in one of the three embedded cases in Malaysian context. Additionally, the pre-service teachers in this study did not seek to complete their field experience at the Smart School although such a school has very good ICT facilities (see details in 7.3: ICT Access section). Thus, the potential for TPACK development in Malaysia is rather low. Therefore, it is recommended that increasing the ICT use in all schools impacts the opportunity and development of pre-service teachers' knowledge and skill of ICT including TPACK (further recommendations in section 8.3.1).

8.3 Recommendations

This section provides recommendations to the three stakeholders, namely, the Ministry of Education, the Initial Teacher Education providers, and to schools. First, the recommendations are presented for the teacher educators and the University in which the researcher is employed, before presenting recommendations to improve field experience. The recommendations for the Ministry of Education and schools are also presented before ending with recommendations for further research.

This study was limited in that it was designed as two case studies situated within particular contexts in different countries, and this, therefore, limits the generalizability of the findings to other contexts. However, the case study methodology employed in this study provided an opportunity to conduct the research within authentic natural environments. This approach allowed the researcher to make an in-depth investigation of the phenomenon as well as to contribute to the research field. No previous studies have investigated pre-service teachers' TPACK in New Zealand and Malaysian secondary schools during field experience. Furthermore, case study combined with theory and literature allows theoretical generalization that enables readers cautiously interpret the findings from their own perspectives (Yin, 2009). Within these limitations the following recommendations are made.

8.3.1 *Recommendations to the ITE Educator*

My academic experiences as a teacher educator prior to undertaking this research were focussed on preparing graduates in the field of ICT in education. As part of my role as a teacher educator I had a supervision role insupervising and observing pre-service teachers and collaborating with teachers at secondary schools. Drawing on the literature and the findings of this research, now that I have returned to this role, I can see that more research is needed to better understand and develop pre-service teachers' TPACK and to establish a stronger partnership with pre-service teachers and teachers at schools. I have evidence of the benefit of exposing current and future teachers to research findings and also to knowledge that can help to shape their own conceptual understanding of integrating ICT in teaching.

226

Improved collaboration is recommended between the three key stakeholders for ITE, namely the ITE, the schools, and the Ministry of Education. Furthermore, ITE colleagues are encouraged to ensure that teacher educators and cooperating teachers in schools share a more collaborative partnership towards the practicum supervision and classroom observation. This will help to ensure that the pre-service teachers receive adequate support during their field experience. For instance, in Malaysia, to provide opportunities and encourage pre-service teachers to undertake their school placement at a smart school where the schools may also benefit from the professional development reciprocated by outstanding student teachers who can support teachers to develop more ICT skills, as shown by Ida in this research (see section 6.3.1).

8.3.2 *Recommendations for the field experience implementation*

My interactions during this study, both with pre-service teachers and their associate/cooperating teachers, reinforced my belief that educating and supporting students to be active in their selection of teaching placements is an effective educational strategy. Improvements are recommended for the processes of choosing teaching placements, especially in the Malaysian context, to encourage pre-service teachers to select schools that can offer more practice to develop their content and pedagogical knowledge of their major and minor subjects. In addition, choosing a school with ICT facilities is important for pre-service teachers to develop more of their ICT knowledge and skills. Additionally, greater understanding of TPACK may be required for pre-service teachers before adequate gains in using ICT in teaching can be achieved. This study found that introduction of TPACK in the New Zealand case enabled the pre-service teachers to develop their understanding of integrating ICT within their subject. Thus, the promotion of TPACK in Initial Teacher Education programmes can expose pre-service teachers to the complexity of knowledge interaction, to further their knowledge and skills through practise while teaching during field experience. This approach can help pre-service teachers develop the knowledge and skills required to effectively integrate ICT in teaching. However, in realising the potential of integrating ICT in teaching, especially during pre-service teachers' field experience, the schools have

to be well equipped with ICT facilities and support. It is recommended that in New Zealand, the TPACK development should be expanded to a wider context. In Malaysia, this knowledge should be integrated in the Initial Teacher Education curriculum with more attention to improving access to ICT in Initial Teacher Education and the schools.

The disparity of field experiences in which pre-service teachers had participated also contributed to differences in the findings in this study. The New Zealand pre-service teachers had two seven-week teaching placements, whereas, the Malaysian pre-service teachers had only one ten-week teaching placement in their ITE programme (see details of field experience structure in section 1.3). It is recommended that field experience in Malaysia be increased to provide more teaching experience. For example, pre-service teachers could learn and get valuable experience if they had the opportunity to teach during their first school placement rather than only observe the class and school facilities and complete the observation report. Alternatively, they could have a mix of school observation and paired teaching strategy with the cooperating teacher and/or peers to meet specific learning outcomes.

8.3.3 *Recommendations to the Ministry of Education and schools*

This section includes the recommendations for both the Ministry of Education and schools because of Malaysia's 'top-down' approach in organising the school curriculum and management. Thus, the recommendations made to the schools also apply to the Ministry of Education. It would be helpful to support pre-service teachers to participate in a 'community beyond school' context, also called 'non-formal learning' (Eshach, 2007) to learn and gain more knowledge and experience. For example, one of the three pre-service teachers in the New Zealand case study indicated that her involvement in ICT projects organised by the community outside-of-school had helped her in developing ICT knowledge and skill for teaching. Thus, it is recommended to establish and support pre-service teachers' involvement in a community, which could also make up for the lack of access to ICT in schools.

Perhaps more importantly, pre-service teachers need assistance and guidance with the decision-making process during their teaching practice and it is also important for pre-service teachers to receive feedback after they have completed their field experience. The discussion process after each classroom observation provides more meaningful information for pre-service teachers in terms of different strategies they could use for teaching. However, it would be useful for associate/cooperating teachers to provide more support and immediate feedback for pre-service teachers in order to build up their confidence in teaching. Although the cooperating teachers did not use the ICT in their teaching, it is recommended for them to support and give the opportunity for the pre-service teachers, like Ida in the Malaysian case study, to enhance their ICT knowledge and skill. To establish this, the associate/cooperating teacher could have more training in supervising the pre-service teachers. Teachers need to be aware and clear about their responsibilities before, during and after the supervision period. It is recommended that the supervision training for cooperating teachers, which could also include the TPACK and ICT be organised. Given this lack nationwide, it is recommended that the Ministry of Education consider this as an innovative project to be accompanied by evaluative research.

8.3.4   Recommendations for further research

In order to confirm the current findings and contribute further understandings in this field, there is need for further research. Further studies are therefore recommended in order to provide more insights to deepen understanding of how to effectively integrate ICT in teaching, including field experience. As exemplified in the current study, the TPACK survey, with some adaptations, was proven a reliable and valid instrument to be used in the setting of the current research. Despite evidence of good psychometric properties of the instruments used in this study, validity of the instruments in similar settings needs to be further enhanced through replication of the study. Further research into the practice of a larger sample of New Zealand and Malaysian pre-service teachers may reveal further variations of practice as well as enabling greater confirmation and generalisation of these findings. Additionally, the TPACK survey provides a data-gathering tool for researchers to better understand the TPACK construct and for pre-service teachers

and teacher educators to help them better understand their own TPACK and use it as a basis for improving ICT integration in teacher education programmes. Furthermore, the sample involved in this study was secondary school pre-service teachers. Thus, other areas that are recommended for further research include primary school pre-service teachers and in-service teachers.

Furthermore, the TPACK instrument used in this study could be further improved. It is recommended that researchers consider ways in which they may learn from and possibly incorporate the (Jamieson-Proctor, et. al., 2013) TTF TPACK survey in measuring pre-service teachers' TPACK, while also noting that TTF TPACK survey has a different perspective of integrating ICT in teaching and learning.

According to Chai, Koh and Tsai (2013) in their review article of Technological Pedagogical Content Knowledge, most of the studies were conducted in the North America, Europe and the Mediterranean and very few studies have been conducted in the Asia Pacific region. Thus, it is recommended that more studies should be carried out to include the countries with little TPACK research, for example, New Zealand and Malaysia, to further demonstrate the usability of TPACK in other contexts to enhance ICT integration in teaching.

Although the TPACK survey was proven reliable and valid to measure pre-service teachers' TPACK, the measurement of TPACK was not solely based on the survey. It is strongly recommended further TPACK research employ both quantitative and qualitative approaches. In particular, research to explore the differences in the quantitative findings which showed a positive and negative direction of pre-service teachers' TPACK before and after field experience (see section 5.2.4 and 5.3.4 for further analysis of New Zealand and Malaysian findings respectively). This would be useful to provide valuable insights in relation to the understanding and development of TPACK.

This study has included the voices of pre-service teachers and inquired into their experiences of teaching and learning in secondary school classrooms. Gathering

more in-depth accounts of student experience may also offer greater insight into the relational nature of TPACK and ICT development in education. In addition, it would be worthwhile for further research to better understand how variances within and between countries influence the interpretation of the findings, inlcuding variations with languages and cultures as discussed earlier.

8.4   Concluding remarks

As noted earlier, my academic experiences as a teacher educator prior to undertaking this research were focussed on preparing graduates in the field of ICT in education. I was keen to explore the role and value of field experience in schools to complement the university-based initial teacher education programme. For me this PhD has provided an opportunity to explore and understand more about ICT integration in teaching. My study will lead me to further research and so provides a foundation for additional publications and future research.

My PhD journey has guided me to discover strategies to improve my own role as a teacher educator and introduced me to the new role as a researcher and a leader. This experience reinforced my desire to help bridge the gap between teachers and research. By completing a doctorate, I plan to improve my own proficiency in integrating ICT in education so that I can help bridge the gap between research and practice. The collaboration with pre-service teachers and teachers in schools has helped me see the need to bring research back to the classroom and to lead teacher educators and teachers toward a better understanding of ways to integrate ICT in their teaching. That is where my academic journey leads me next, in collaboration with my colleagues in Malaysia and those who I have met abroad during my doctoral studies who share my passion for teacher education and ICT.

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Appendices

Appendix A: Approval Letter

Ref: 2010/49/ERHEC

4 August 2010

Hasniza Nordin

2/181 Ilam Road
Ilam
CHRISTCHURCH

Dear Hasniza

The College of Educational Research Human Ethics Committee is pleased to inform you that your research proposal "Pre-service teachers' development and experience of ICT integration in schools" has been granted ethical approval at their meeting on 28 July 2010.

However, this approval is subject to the following amendment:
Please amend question 7 of the application to read "A high level of anonymity will be ensured by using pseudonyms instead of names to refer to participants, not revealing identifying information and preventing duplication of records and access to data".

Please forward a copy of the amended application to the Secretary of the Educational Research Human Ethics Committee.

If you have any questions regarding the above comments please don't hesitate to contact me.

Yours sincerely

Dr Mere Skerrett and Nicola Surtees

Co-Chairs
Educational Research Human Ethics Committee

"Please note that Ethical Approval and/or Clearance relates only to the ethical elements of the relationship between the researcher, research participants and other stakeholders. The granting of approval or clearance by the Ethical Clearance Committee should not be interpreted as comment on the methodology, legality, value or any other matters relating to this research."

Appendix B: Second Approval Letter

University of Canterbury Private Bag 4800, Christchurch 8140, New Zealand.
www.canterbury.ac.nz
HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen

Email: human-ethics@canterbury.ac.nz

Ref: 2010/49/ERHEC

18 May 2011

Hasniza Nordin

School of Literacies & Arts in Education
College of Education
UNIVERSITY OF CANTERBURY

Dear Hasniza

I am very pleased to inform you that your application for an amendment to the research proposal"Pre-service teachers' development and experience of ICT integration in schools" has been grantedethical approval from the Educational Research Human Ethics Committee.

Please note that should circumstances relevant to this current application change you are required toreapply for ethical approval.

If you have any questions regarding this approval please let me know.

We wish you well for your continuing research.

Yours sincerely

Nicola Surtees
Chair
Educational Research HEC

"Please note that Ethical Approval and/or Clearance relates only to the ethical elements of the relationship between the researcher, research participants and other stakeholders. The granting of approval or clearance by the Ethical Clearance Committee should not be interpreted as comment on the methodology, legality, value or any other matters relating to this research."

Appendix C: Approval Letter Economy Planning Unit, Malaysia.

UNIT PERANCANG EKONOMI
Economic Planning Unit
JABATAN PERDANA MENTERI
Prime Minister's Department
BLOK B5 & B6
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN
62502 PUTRAJAYA
MALAYSIA

EPU

Telefon : 603 8872 3333

Ruj. Tuan:
Your Ref :
UPE: 40/200/19/2785

Ruj. Kami:
Our Ref.:

Tarikh:
Date:
7 April 2011

Hasniza Nordin
55 Taman Sri Pekula 2 Tikam Batu
Sungai Petani
Kedah
Email: hasniza.nordin@pg.canterbury.ac.nz

APPLICATION TO CONDUCT RESEARCH IN MALAYSIA

With reference to your application, I am pleased to inform you that your application to conduct research in Malaysia has been *approved* by the **Research Promotion and Co-Ordination Committee, Economic Planning Unit, Prime Minister's Department.** The details of the approval are as follows:

Researcher's name :   **HASNIZA BINTI NORDIN**

Passport No. / I. C No: **780817-02-5908**

Nationality   :   **MALAYSIAN**

Title of Research   :   **"PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS"**

Period of Research Approved: **3 YEARS**

2.   Please collect your Research Pass in person from the Economic Planning Unit, Prime Minister's Department, Parcel B, Level 4 Block B5, Federal Government Administrative Centre, 62502 Putrajaya and bring along two (2) passport size photographs. You are also required to comply with the rules and regulations stipulated from time to time by the agencies with which you have dealings in the conduct of your research.

3.   I would like to draw your attention to the undertaking signed by you that you will submit without cost to the Economic Planning Unit the following documents:

a)   A brief summary of your research findings on completion of your research and before you leave Malaysia; and

b)   Three (3) copies of your final dissertation/publication.

4.   Lastly, please submit a copy of your preliminary and final report directly to the State Government where you carried out your research. Thank you.

Yours sincerely,

(MUNIRAH ABD. MANAN)
For Director General,
Economic Planning Unit.
E-mail: munirah@epu.gov.my
Tel: 88882809
Fax: 88883961

ATTENTION

This letter is only to inform you the status of your application and **cannot be used as a research pass**.

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF
ICT INTEGRATION IN SCHOOLS.

My name is Hasniza Nordin. I am a PhD student at the College of Education, University of Canterbury. My research study will address Do pre-service teachers in New Zealand and Malaysia use their field experience to develop their potential to integrate ICT in schools? If they do, how? If not, why? In this study I seek to understand students' perceptions and investigate their experiences and development of ICT integration in the classrooms to better prepare them for future teaching. Your experience and particular viewpoints will make an important contribution to this research.

Your involvement in this project will include an individual interview. The interview will focus on your perceptions of students' experiences and development of ICT integration during the course as well as your experiences as the course lecturer. The interview will take about 30-40 minutes and will be recorded. You may request the recording to be stopped temporarily or permanently if at any time you feel uncomfortable. As the principal researcher, I will conduct and transcribe the interview. You will be provided with a copy of the interview transcript for review and approval. Your participation is voluntary and you have the right to withdraw from the project at any time. If you choose to withdraw, I will use my best endeavours to remove any of the information relating to you from the project, including any final publication, provided that this remains practically achievable. The research will not interfere with the normal course schedule.

All information will be treated in strictest confidence, all participants will remain anonymous. All data will be kept by the researcher and any data that can identify the participants will not be given to any other researcher or agency. As required by the University's research policy, at the completion of the project all information collected will be retained in secure storage for five years, after which it will be destroyed. The results of the study may be submitted for publication to national or international journals or presented at educational conferences. You may at any time ask for additional information or results from the study.
If you would like more information or have any questions about the research, you can contact me or my supervisors Professor Niki Davis(niki.davis@canterbury.ac.nz) and Dr. Donna Morrow(donna.morrow@canterbury.ac.nz). If you have any concerns or complaints about this research, please use the contact details below. If you are happy to take part you will need to sign the consent form and return it to me. Please retain this information sheet. Thank you for your consideration of this research project.

HASNIZA NORDIN (hasniza.nordin@pg.canterbury.ac.nz)

Office Phone: (03) 3667001 etxn: 4177

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project Title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS.

I understand the aims and purposes of the research study undertaken by HASNIZA NORDIN.

The study has been explained to me and I understand the information that was given to me on the information sheet.

I am aware that my participation in this project is voluntary. I have had all questions answered to my satisfaction.

I understand that my involvement will include an individual interview concerning my perceptions on students' experiences and development of ICT integration during the course as well as my experiences as the course lecturer.

I understand that I (as course lecturer) can withdraw from the study at any time, that I do not have to give any reason for withdrawing. I understand my involvement in the project.

I understand that all information will be treated in strictest confidence, that participants will remain anonymous and that no information that could identify me will be given to other researchers or agencies. I understand that all data from this research will be securely stored in password protected facilities and/or locked storage at the University of Canterbury for five years following the study.

I understand that within these restrictions, the findings may be submitted for publication to national or international journals or presented at educational conferences; that the results of the study can be made available to me at my request and that I can request additional information at any time.

I understand that interviews will be recorded and I can ask the recording to be stopped any time temporarily or permanently. I will be provided with a copy of interview transcript to check for accuracy.

I have read the information sheet and consent form. I agree to participate in the study.

Name: _____

Signed: _____

Date: _____

Please return this form to Hasniza Nordin, Te Pourewa 516A

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS.
My name is Hasniza Nordin. I am a PhD student at the College of Education, University of Canterbury. The key research question in this study will address do pre-service teachers in New Zealand and Malaysia use their field experience to develop their potential to integrate ICT in schools? If they do, how? If not, why? In this study I seek to understand students' perceptions and investigate their experiences and development of ICT integration in the classrooms to better prepare them for future teaching. I am also interested in exploring factors that contribute to ICT integration in the classrooms.

Student teachers' involvement in this project will include completing a survey and if selected being observed in their classroom during teaching practice and an individual interview before, during and after the teaching practice. Data will be gathered on students' concern, experiences and development of ICT integration in classroom throughout the teaching practice. The course lecturers' involvement in this project will include responding to an interview before student teachers undertake the teaching practice. The interviews will focus on their perceptions of students' experiences and development of ICT integration during the course as well as experiences as the course lecturers. The visiting lecturers will be involved in an individual interview at the start of, during and after teaching practice. The interviews will focus on their perceptions of students' experiences and development of ICT integration throughout the teaching practice as well as experiences in supervising and/or teaching.The classroom observation for student teachers and interviews for course lecturers, visiting lecturers and student teachers will be recorded. However, they may request the recording to be stopped if they feel uncomfortable being recorded during the interview. All participants will be provided with a copy of interview transcript for review and approval. As the principal researcher, I will conduct and transcribe all the interviews. Course Lecturers, visiting lecturers and student teachers participation in this project is completely voluntary and their informed consent will be sought. Participants may withdraw from the study any time. If they choose to withdraw, I will use my best endeavours to remove any of the information relating to them from the project, including any final publication, provided that this remains practically achievable.

All information will be treated in strictest confidence, all participants will remain anonymous. All data will be kept by the researcher and any data that can identify the participants will not be given to any other researcher or agency. As required by the University's research policy, at the completion of the project all information collected will be retained in secure storage for five years, after which it will be destroyed. The results of the study may be submitted for publication to national or international journals or presented at educational conferences. Participants may at any time ask for additional information or results from the study. If you would like more information or have any questions about the research, you can contact me hasniza.nordin@pg.canterbury.ac.nz or my supervisors Professor Niki Davis (niki.davis@canterbury.ac.nz) and Dr. Donna Morrow (donna.morrow@canterbury.ac.nz). If you have any concerns or complaints about this research, please see details below. If you are happy to take part you will need to sign the

consent form and return it to me in the envelope provided. Please retain this information sheet. Thank you for your consideration of this research project.

Appendix G:College Administration Consent Form

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project Title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS.

We understand the aims and purposes of the research study undertaken by HASNIZA NORDIN.
The study has been explained to us and we understand the information that was given in the information sheet and we understand we can ask for more information any time.
Participation in this study by the course lecturers, visiting lecturers and students is voluntary and they will have all questions answered to their satisfaction.
The course lecturers, visiting lecturer and student participants are aware that they can withdraw from the study at any time without penalty and they understand their involvement in the project.
All information will be treated in strictest confidence, participants will remain anonymous where possible and no information that could identify participants will be given to other researchers or agencies. All data from this research will be securely stored in password protected facilities and/or locked storage at the University of Canterbury for five years following the study.
Within these restrictions, the findings may be submitted for publication to national or international journals or presented at educational conferences and that the results of the study can be made available to participants upon their request and participants can request additional information at any time.
Classroom observation and interviews (for selected students only) will be recorded and participants can ask that the recording to be stopped temporarily or permanently at any time and will be provided with a copy of the interview transcript to check for accuracy.
The study will be carried out as described in the information statement, a copy of which we have retained.

We have read the information sheet and consent form. We allow you to conduct your study within this institution.

Name:	_____

Signed: _____

Date:	_____
Please return this form to Hasniza Nordin, Te Pourewa 516A

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS.

My name is Hasniza Nordin. I am a PhD student at the College of Education, University of Canterbury. I am conducting a research project that looks at Do pre-service teachers in New Zealand and Malaysia use their field experience to develop their potential to integrate ICT in schools? If they do, how? If not, why? I am also interested in exploring those factors that contribute to integrate ICT in classroom. Your learning experiences and particular viewpoints will make an important contribution to this research.

Your involvement in this project will include completing a survey. A follow-up with an individual interview and classroom observation will be held if needed. The interview will be recorded and during the classroom observation I will use an audio recorder and an observation checklist. It will take you about 30 minutes to answer the survey while the interview will take about 30-40 minutes. The classroom observation will take the whole period of one class session. As the principal researcher, I will conduct and transcribe all the interviews. You may ask that the recording to be stopped any time temporarily or permanently.You will be provided with a copy of interview transcript for review and approval.Data will also be gathered on products and processes generated throughout the normal progression of the course. Your participation is voluntary and you may choose to withdraw any time. If you choose to withdraw, I will use my best endeavours to remove any of the information relating to you from the project, including any final publication, provided that this remains practically achievable.

All information will be treated in strictest confidence, all participants will remain anonymous. All data will be kept by the researcher and any data that can identify the participants will not be given to any other researcher or agency. As required by the University's research policy, at the completion of the project all information collected will be retained in secure storage for five years, after which it will be destroyed. The results of the study may be submitted for publication to national or international journals or presented at educational conferences. You may at any time ask for additional information or results from the study.

If you would like more information or have any questions about the research, you can contact me or my supervisors Professor Niki Davis(niki.davis@canterbury.ac.nz) and Dr. Donna Morrow (donna.morrow@canterbury.ac.nz). If you have any concerns or complaints about this research, please use the contact details below. If you are happy to take part you will need to sign the consent form and return it to me in the envelope provided. Please retain this information sheet. Thank you for your consideration of this research project.

HASNIZA NORDIN (hasniza.nordin@pg.canterbury.ac.nz); Office Phone: (03) 3667001 etxn: 4177.

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project Title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS.

I understand the aims and purposes of the research study undertaken by HASNIZA NORDIN.

The study has been explained to me and I understand the information that was given to me on the information sheet.

I am aware that I can withdraw from the study at any time without penalty, and I do not have to give any reason for withdrawing. I have had all questions answered to my satisfaction.

I understand that my involvement will include completing a survey, and may include individual interviews which will be recorded and observations in the classroom during my teaching practise.

I understand that interviews and classroom observation will be recorded and I can ask the recording to be stopped any time temporarily or permanently. I will be provided with a copy of interview transcript to check accuracy.

I understand that all information will be treated in strictest confidence, that participants will remain anonymous and that no information that could identify me will be given to other researchers or agencies. I understand that all data from this research will be securely stored in password protected facilities and/or locked storage at the University of Canterbury for five years following the study.

I understand that within these restrictions, the findings may be used to prepare articles for publication in national and/or international journals and for presentation at conferences; that the results of the study can be made available to me at my request and that I can request additional information at any time.

I understand that I may receive either a copy of the full report or a summary of the findings of this study and have provided my email details below for this purpose. I realise that whether or not I decide to participate is my decision and will not affect my grade.

By signing below, I agree to participate in this research project.

Name: _____

Signed: _____

Date: _____

Please return this completed consent form in the envelope provided.

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS.

My name is Hasniza Nordin. I am a PhD student at the College of Education, University of Canterbury. My research study will address Do pre-service teachers in New Zealand and Malaysia use their field experience to develop their potential to integrate ICT in schools? If they do, how? If not, why? In this study I seek to understand students' perceptions and investigate their experiences and development of ICT integration in the classrooms to better prepare them for future teaching. Your experience and particular viewpoints will make an important contribution to this research.

Your involvement in this project will include an individual interview at the start of, during and after teaching practice. The interviews will focus on your perceptions of students' experiences and development of ICT integration throughout the teaching practice as well as your experiences in supervising and/or teaching. The interview will take about 30-40 minutes and will be recorded. You may request the recording to be stopped temporarily or permanently if at any time you feel uncomfortable. As the principal researcher, I will conduct and transcribe the interview. You will be provided with a copy of the interview transcript for review and approval. Your participation is voluntary and you have the right to withdraw from the project at any time. If you choose to withdraw, I will use my best endeavours to remove any of the information relating to you from the project, including any final publication, provided that this remains practically achievable. The research will not interfere with the normal course schedule.

All information will be treated in strictest confidence, all participants will remain anonymous. All data will be kept by the researcher and any data that can identify the participants will not be given to any other researcher or agency. As required by the University's research policy, at the completion of the project all information collected will be retained in secure storage for five years, after which it will be destroyed. The results of the study may be submitted for publication to national or international journals or presented at educational conferences. You may at any time ask for additional information or results from the study.

If you would like more information or have any questions about the research, you can contact me or my supervisors Professor Niki Davis(niki.davis@canterbury.ac.nz) and Dr. Donna Morrow(donna.morrow@canterbury.ac.nz). If you have any concerns or complaints about this research, please use the contact details shown below. If you are happy to take part you will need to sign the consent form and return it to me at Te Pourewa 516A. Please retain this information sheet. Thank you for your consideration of this research project.

HASNIZA NORDIN (hasniza.nordin@pg.canterbury.ac.nz); Office Phone: (03) 3667001 etxn: 4177

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project Title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS.

I understand the aims and purposes of the research study undertaken by HASNIZA NORDIN.

The study has been explained to me and I understand the information that was given to me on the information sheet.

I am aware that my participation in this project is voluntary. I have had all questions answered to my satisfaction.

I understand that my involvement will include an individual interview at the start, during and end of the teaching practise concerning my perceptions on students' experiences and development of ICT integration during the teaching practice as well as my experiences as the visiting lecturer.

I understand that I (as visiting lecturer) can withdraw from the study at any time, that I do not have to give any reason for withdrawing. I understand my involvement in the project.

I understand that all information will be treated in strictest confidence, that participants will remain anonymous and that no information that could identify me will be given to other researchers or agencies. I understand that all data from this research will be securely stored in password protected facilities and/or locked storage at the University of Canterbury for five years following the study.

I understand that within these restrictions, the findings may be submitted for publication to national or international journals or presented at educational conferences; that the results of the study can be made available to me at my request and that I can request additional information at any time.

I understand that interviews will be recorded and I can ask the recording to be stopped any time temporarily or permanently. I will be provided with a copy of interview transcript to check for accuracy.

I have read the information sheet and consent form. I agree to participate in the study.

Name: 	_____

Signed: _____

Date: 	_____

Please return this completed consent form to Hasniza Nordin, at Te Pourewa 516A.

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS.

My name is Hasniza Nordin. I am a PhD student at the College of Education, University of Canterbury. My research study will address the question: do pre-service teachers in New Zealand and Malaysia use their field experience to develop their potential to integrate ICT in schools? If they do, how? If not, why? In this study I seek to understand students' perceptions and investigate of their experiences and development of ICT integration in the classrooms to better prepare them for future teaching. Your experience and particular viewpoints will make an important contribution to this research.

Your involvement in this project will include responding to an individual interview at the start of, during and after the teaching practise concerning your perceptions on student teachers' experiences and development of ICT integration during teaching practise as well as your experiences as the associate teacher. The interview will take about 30-40 minutes and will be recorded. You may request the recording to be stopped temporarily or permanently if at any time you feel uncomfortable. As the principal researcher, I will conduct and transcribe the interview. You will be provided with a copy of the interview transcript for review and approval. Your participation is voluntary and you have the right to withdraw from the project at any time. If you choose to withdraw, I will use my best endeavours to remove any of the information relating to you from the project, including any final publication, provided that this remains practically achievable. The research will not interfere with the normal schedule.

All information will be treated in strictest confidence, all participants will remain anonymous. All data will be kept by the researcher and any data that can identify the participants will not be given to any other researcher or agency. As required by the University's research policy, at the completion of the project all information collected will be retained in secure storage for five years, after which it will be destroyed. The results of the study may be submitted for publication to national or international journals or presented at educational conferences. You may at any time ask for additional information or results from the study.
If you would like more information or have any questions about the research, you can contact me or my supervisors Professor Niki Davis(niki.davis@canterbury.ac.nz) and Dr. Donna Morrow(donna.morrow@canterbury.ac.nz). If you have any concerns or complaints about this research, please see the contact details below.
If you are happy to take part you will need to sign the consent form and return it to me in the envelope provided. Please retain this information sheet. Thank you for your consideration of this research project.
HASNIZA NORDIN (hasniza.nordin@pg.canterbury.ac.nz); Office Phone: (03) 3667001 etxn: 4177

College of Education
School of Literacies and Arts in Education
Tel: +64 3 343 7771, Fax: + 64 343 7790

Project Title: PRE-SERVICE TEACHERS' DEVELOPMENT AND EXPERIENCE OF ICT INTEGRATION IN SCHOOLS.

I understand the aims and purposes of the research study undertaken by HASNIZA NORDIN.

The study has been explained to me and I understand the information that was given to me on the information sheet.

I am aware that my participation in this project is voluntary. I have had all questions answered to my satisfaction.

I understand that my involvement will include an individual interview at the start of, during and after the teaching practise concerning my perceptions on student teachers' experiences and development of ICT integration during teaching practise as well as my experiences as the associate teacher.

I understand that I (as an associate teacher) can withdraw from the study at any time, that I do not have to give any reason for withdrawing. I understand my involvement in the project.

I understand that all information will be treated in strictest confidence, that participants will remain anonymous and that no information that could identify me will be given to other researchers or agencies. I understand that all data from this research will be securely stored in password protected facilities and/or locked storage at the University of Canterbury for five years following the study.

I understand that within these restrictions, the findings may be submitted for publication to national or international journals or presented at educational conferences; that the results of the study can be made available to me at my request and that I can request additional information at any time.

I understand that interviews will be recorded and I can ask the recording to be stopped any time temporarily or permanently. I will be provided with a copy of interview transcript to check for accuracy.

I have read the information sheet and consent form. I agree to participate in the study.

Name: _____

Signed: _____

Date: _____
Please return this completed consent form in the envelope provided

Appendix N: Interview protocolfor pre-service teacher

Project title: Pre-service Teachers Development and Experience of ICT Integration in Schools

School Name: Respondent: Date:

Key research question: Do pre-service teachers in New Zealand and Malaysia use their field experience to develop their potential to integrate ICT in schools?

Introduction

This study will inform ways of integrating ICT into classroom instruction through developing an adequate knowledge in teacher education programmes, specifically the ways pre-service teachers develop their ICT knowledge and skills during field experience. Furthermore, this study is also useful to pre-service teachers for them to reflect their experiences with the knowledge they have and to think about suitable and creative ways to integrate ICT into their teaching by understanding how field experience and development of technology, pedagogy and content knowledge could enhance the integration of ICT in teaching.

Your participation is highly appreciated.

Questions guide/Prompts

Could you please tell me about yourself and your role in this school?
- What subjects have you taught?
2.   What do you expect when doing teaching practise?
- What are your concerns about integration of ICT in schools before you start your TP?
3.   Has your training at education programme equipped you with pedagogy, technology and content knowledge to prepare you for teaching? How?
- How would you describe your TK, PK and CK, PCK, TPK, PCK and TPACK?
- Were you able to integrate ICT in teaching? How / Why not?
4.   What role/support did you expect from the associate teacher on the success of your TP and ICT integration?
5.   How do you think you can develop that knowledge (TPACK)?
6.   Is there anything else you would like to say?
What technologies did you have access to during your field placement, both in the classroom and the lab?
2. Describe the ways in which your mentor teacher used technology in his/her teaching.
3. Describe how you were able to integrate technology in your field experience. What conditions in the classroom inhibited/enhanced your ability to integrate technology?
4. Did your mentor teacher provide a good model for the integration of technology?
5. Has the field experience helped prepare you to integrate technology into your future teaching practice?
Has your training at education programme equipped you with skills and knowledge in ICT integration in schools?

Thank you for giving your time to be interviewed. Many thanks, Hasniza Nordin (Doctoral research student, UC)

Appendix N: Interview protocolfor Associate/CooperatingTeacher

Project title: Pre-service Teachers Development and Experience of ICT Integration in Schools

School Name: School   **Respondent:**   **Date**:

Key research question: Do pre-service teachers in New Zealand and Malaysia use their field experience to develop their potential to integrate ICT in schools?

Introduction

This study will inform ways of integrating ICT into classroom instruction through developing an adequate knowledge in teacher education programmes, specifically the ways pre-service teachers develop their ICT knowledge and skills during field experience. The aim of teacher education programmes and schools is to better prepare future teachers. Thus, this study also will be useful for schools in their role in preparing future teachers especially to effectively integrate ICT in classrooms. Additionally, when it comes to ICT integration in classroom, both pre-service teachers and schools can benefit from each other expertise and related research. Furthermore, this study is also useful to pre-service teachers for them to reflect their experiences with the knowledge they have and to think about suitable and creative ways to integrate ICT into their teaching by understanding how field experience and development of

Your participation is highly appreciated.

Questions guide/Prompts

1. Tell me about yourself and your role in this school.
2. Tell me about your experience in teaching the subject?
3. What kind of criteria are you looking for during supervising the student teacher?
4. What about the use of ICT in the classroom?
    a. Do you think that it is important to integrate ICT in the classroom? Why or why not?
    b. Do you foresee any challenges or something that you might have during student teachers doing their teaching practice in this school?
5. What role do you play in modelling the use of ICT in the classroom?
    a. Do you foresee any challenges that you might experience in the process of integrating ICT in classroom?
6. As an experienced teacher, how do you envision the use of ICT in teaching and learning?
    a. among student teacher?
7. Is there anything else you would like to say?
Thank you for giving your time to be interviewed.Many thanks, Hasniza Nordin (Doctoral research student, UC)

Appendix O: Interview protocolfor Visiting Lecturer

Project title: Pre-service Teachers' Development and Experience of ICT Integration in Schools

Respondent: Visiting Lecturer   Date:

Key research question: Do pre-service teachers in New Zealand and Malaysia use their field experience to develop their potential to integrate ICT in schools?

Introduction

I would like to get your views and experiences through this interview. This study will inform ways of integrating ICT into classroom instruction through developing an adequate knowledge in teacher education programmes, specifically the ways pre-service teachers develop their ICT knowledge and skills during field experience. Defining and developing the understanding of TPACK during field experience would assist teacher educators in developing pre-service teachers' thinking and knowledge to better prepare them for their future teaching. Therefore, this study will be beneficial in providing information for teacher educators to educate and assist pre-service teachers in transferring the knowledge gained in teacher education program into schools. Furthermore, this study is also useful to pre-service teachers for them to reflect their experiences with the knowledge they have and to think about suitable and creative ways to integrate ICT into their teaching by understanding how field experience and development of technology, pedagogy and content knowledge could enhance the integration of ICT in teaching.

Your participation is highly appreciated.

Questions guide

Tell me about your experience in supervising student teachers?

How many times do you allocate for supervision?
Do you foresee any challenges that you might experience in supervision,
in the process of integrating ICT in classroom?
How important it should be to train student teachers to integrate ICT in the classroom.
How do you decide to observe the students?
How do you select the schools?
What sort of things are you looking for during observation/supervision?
Is there anything else you would like to say?

Thank you for giving your time to be interviewed.
Many thanks, Hasniza Nordin (Doctoral research student, UC)

Appendix P: New Zealand TPACK Survey

Welcome to the survey.

This survey is being conducted by Hasniza Nordin, PhD student at University of Canterbury, New Zealand, sponsored by the Ministry of Higher Education of Malaysia. The study is focusing on pre-service teachers' development and experience of ICT integration in schools. This survey is looking at pre-service teachers' perceptions on their understanding of technological, content, and pedagogical knowledge as one domain of knowledge and also the combination of these three domains of knowledge.

The data collected from this survey will be used to establish the instrument to measure the pre-service teachers' perception of the understanding of Technological Pedagogical Content Knowledge in New Zealand. Submitting this questionnaire means that you have read and understood the information sheet which was sent to you, and that you understand that completion of the questionnaire signals your agreement for your answers to be used for the purposes of this study. Thank you for contributing your information.

A. In this section, you will be asked to report on your understanding of TECHNOLOGICAL KNOWLEDGE. Please read each item carefully and circle the response that best fits your abilities.

Technological Knowledge (TK)

Knowledge about digital technology, such as computers, laptops, iPods, handhelds, interactive whiteboards, and software programs. This knowledge also includes the skills required to operate, learn and adapt to new technologies.		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I know how to solve my own technical problems.	1	2	3	4	5
2.	I keep up with important new technologies	1	2	3	4	5
3.	I know about a lot of different technologies	1	2	3	4	5
4.	I have the technical skills I need to use technologies	1	2	3	4	5
5.	I have had sufficient opportunities to work with a range of technologies.	1	2	3	4	5
6.	I can learn to use new software easily.	1	2	3	4	5

B. In this section, you will be asked to report on your understanding of CONTENT KNOWLEDGE. Please read each item carefully and circle the response that best fits your abilities.

Content Knowledge (CK) Knowledge about the actual subject matter (e.g. Science) that is to be learned or taught.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I have sufficient knowledge about my subject matter (Schmidt)	1	2	3	4	5
2. I have various ways and strategies of developing my understanding of my subject matter (Schmidt)	1	2	3	4	5
3. I have a deep and wide understanding of the subjects I plan to teach. (deleted item from Schmidt)	1	2	3	4	5
4. I can comfortably plan the scope and sequence of concepts that need to be taught within my class (archambault and crippen)	1	2	3	4	5
5. I know about various examples of how my subject matter applies in the real world (deleted item from Schmidt)	1	2	3	4	5

C. In this section, you will be asked to report on your understanding of PEDAGOGICAL KNOWLEDGE. Please read each item carefully and circle the response that best fits your abilities.

Pedagogical Knowledge (PK) Pedagogical Knowledge (PK) has been defined as a generic form of knowledge that is involved in all issues of student learning, classroom management, lesson plan development and implementation, student evaluation and knowledge about techniques or methods to be used in the classroom.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I know how to assess student performance in a classroom.	1	2	3	4	5
2. I can adapt my teaching based upon what students currentlyunderstand or do not understand.	1	2	3	4	5

278

3.	I can adapt my teaching style to fit learners with different learning styles	1	2	3	4	5
4.	I can use a wide range of teaching approaches in a classroom setting.	1	2	3	4	5
5.	I know how to organize and maintain classroom management.	1	2	3	4	5

D. In this section, you will be asked to report on your understanding of PEDAGOGICAL CONTENT KNOWLEDGE. Please read each item carefully and circle the response that best fits your abilities.

Pedagogical Content Knowledge (PCK) The PCK refers to knowledge of what makes concepts difficult or easy to learn and knowledge of students' prior knowledge.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I can select effective teaching approaches to guide student thinking and learning in my subject matter	1	2	3	4	5
2. I can produce lesson plans with a good understanding of the topic in my subject matter	1	2	3	4	5
3. I can anticipate likely student misconceptions within a particular topic.	1	2	3	4	5
4. I can assist students in identifying connections between various concepts in my subject matter	1	2	3	4	5
5. I can distinguish attempts by students in solving their problems within my class	1	2	3	4	5

E. In this section, you will be asked to report on your understanding of TECHNOLOGICAL CONTENT KNOWLEDGE. Please read each item carefully and circle the response that best fits your abilities.

Technological Content Knowledge (TCK) The TCK helps teachers visualize instances in which technology can be effectively integrated into their teaching. It is a knowledge about how technology may be used to provide new ways of teaching content (Niess, 2005)	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I know about technologies that I can use for teaching specific concepts in my subject matter	1	2	3	4	5
2. I know how my subject matter can be represented by the application of technology	1	2	3	4	5
3. I know about technologies that I can use for enhancing the understanding of specific concepts in my subject matter	1	2	3	4	5
4. I can use technological representations (i.e. multimedia, visual demonstrations, etc.) to demonstrate specific concepts in my subject matter	1	2	3	4	5
5. I can use various types of technologies to deliver the content of my subject matter	1	2	3	4	5

F. In this section, you will be asked to report on your understanding of TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE. Please read each item carefully and circle the response that best fits your abilities.

Technological Pedagogical Knowledge (TPK) TPK requires an understanding of general pedagogical strategies applied to the use of technology.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I can choose technologies that enhance the teaching approaches for a lesson.	1	2	3	4	5
2. I can choose technologies that enhance students' learning of a lesson.	1	2	3	4	5
3. My teacher education program has stimulated me to think more deeply about how technology could influence the teaching approaches I use in my classroom	1	2	3	4	5

| 4. | I am thinking critically about how to use technology in my classroom. | 1 | 2 | 3 | 4 | 5 |
| 5. | I can apply the technologies that I am learning about to different teaching activities | 1 | 2 | 3 | 4 | 5 |

G. In this section, you will be asked to report on your understanding of TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE. Please read each item carefully and circle the response that best fits your abilities.

Technological Pedagogical Content Knowledge (TPACK)

An understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students faced (Mishra & Koehler, 2006).

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I can teach lessons that appropriately combine my subject matter, technologies, and teaching approaches	1	2	3	4	5
2.	I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn	1	2	3	4	5
3.	I can use strategies that I learned about in my coursework to combine content, technologies, and teaching approaches in my classroom	1	2	3	4	5
4.	I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school	1	2	3	4	5
5.	I can choose technologies that enhance the understanding of the content for a lesson	1	2	3	4	5

H. In this section, you will be asked about your DEMOGRAPHIC INFORMATION. Please answer ALL QUESTIONS.Please note that your name is required in this survey to support the researcher in linking and organizing the data accordingly during data analysis. However, your name will not appear in any report or publication.

1. Name:
2. Gender:
3. Age:
4. Major Subject 1:
5. Major Subject 2:

6. ICT Experience:
☐ year
☐
☐
☐ 0

7. How would you rate your ability to use ICT after teaching practice?
☐ ginner
☐ rmediate
☐ pert
☐ er (please specify): Better than intermediate but not quite expert

I have read and understood the information sheet which accompanied this questionnaire, and I understand that my name is required in this survey to support the researcher to link and organize the data accordingly during data analysis. I understand that my name will not appear in any report or publication also completion and return of this questionnaire signals my consent for the data to be used for the purposes of this study.

End of Survey

BAHAGIAN 1

ARAHAN: Sila baca setiap pernyataan berikut dan bulatkan nombor yang paling tepat bagi menerangkan sejauh mana anda bersetuju atau tidak bersetuju dengan pernyataan berikut:

A. **Pengetahuan Teknologi** Pengetahuan berkaitan teknologi digital seperti computer peribadi, computer riba, iPod, kendalian tangan, papan putih interaktif dan perisian program. Pengetahuan ini juga merangkumi kemahiran yang diperlukan untuk mengendali, mempelajari dan mengadaptasi dengan teknologi baru.	Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju
1. Saya tahu bagaimana untuk menyelesaikan masalah teknikal saya sendiri.	1	2	3	4	5
2. Saya mengikuti perkembangann teknologi terkini	1	2	3	4	5
3. Saya tahu tentang pelbagai jenis teknologi	1	2	3	4	5
4. Saya mempunyai kemahiran teknikal yang saya perlukan untuk menggunakan teknologi	1	2	3	4	5
5. Saya mempunyai peluang yang mencukupi untuk bekerja dengan pelbagai jenis teknologi	1	2	3	4	5
6. Saya boleh belajar menggunakan perisian baru dengan mudah	1	2	3	4	5

BAHAGIAN 2

ARAHAN: Sila baca setiap pernyataan berikut dan bulatkan nombor yang paling tepat bagi menerangkan sejauh mana anda bersetuju atau tidak bersetuju dengan pernyataan berikut:

B. **Pengetahuan Isi Kandungan** Pengetahuan mengenai subjek (contoh; Perdagangan) yang akan dipelajari atau diajar.	Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju
1. Saya mempunyai pengetahuan yang mencukupi mengenai mata pelajaran yang akan diajar	1	2	3	4	5
2. Saya mempunyai pelbagai cara dan strategi membina pemahaman saya tentang mata pelajaran yang akan diajar	1	2	3	4	5

3.	Saya mempunyai pemahaman yang mendalam serta meluas mengenai mata pelajaran yang saya rancang untuk mengajar	1	2	3	4	5
4.	Saya selesa dan mudah untuk merancang skop serta aturan konsep-konsep yang perlu diajar di dalam kelas	1	2	3	4	5
5.	Saya tahu mengenai pelbagai contoh bagaimana mata pelajaran saya boleh diaplikasikan di dalam dunia sebenar	1	2	3	4	5

BAHAGIAN 3

ARAHAN: Sila baca setiap pernyataan berikut dan bulatkan nombor yang paling tepat bagi menerangkan sejauh mana anda bersetuju atau tidak bersetuju dengan pernyataan berikut:

C. **Pengetahuan Pedagogi**

Pengetahuan pedagogi didefinisikan sebagai satu bentuk pengetahuan generik yang merangkumi semua isu pembelajaran pelajar, pengurusan kelas, pembangunan dan perlaksanaan perancangan pengajaran, penilaian prestasi pelajar serta pengetahuan mengenai teknik-teknik atau kaedah-kaedah untuk digunakan di dalam kelas.

		Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju
1.	Saya tahu bagaimana untuk menilai prestasi pelajar di dalam kelas	1	2	3	4	5
2.	Saya boleh mengadaptasi cara pengajaran saya mengikut tahap pemahaman pelajar	1	2	3	4	5
3.	Saya boleh mengadaptasi cara pengajaran saya bersesuaian dengan stail pembelajaran pelajar yang berbeza	1	2	3	4	5
4.	Saya boleh menggunakan pelbagai pendekatan pengajaran di dalam kelas	1	2	3	4	5
5.	Saya tahu bagaimana untuk mengurus and mengekalkan pengurusan kelas	1	2	3	4	5

BAHAGIAN 4

ARAHAN: Sila baca setiap pernyataan berikut dan bulatkan nombor yang paling tepat bagi menerangkan sejauh mana anda bersetuju atau tidak bersetuju dengan pernyataan berikut:

D. Pengetahuan Pedagogi Isi Kandungan Merujuk kepada pengetahuan mengenai apa yang menyebabkan pengetahuan konsep-konsep yang sukar atau mudah untuk dipelajari serta pengetahuan mengenai pengetahuan pelajar terlebih dahulu	Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju
1. Saya boleh memilih pendekatan pengajaran yang efektif untuk membimbing pemikiran dan pembelajaran pelajar di dalam mata pelajaran yang di ajar	1	2	3	4	5
2. Saya boleh menghasilkan rancangan pengajaran dengan kefahaman yang baik mengenai tajuk di dalam mata pelajaran yang di ajar	1	2	3	4	5
3. Saya boleh mengenalpasti kekeliruan pelajar mengenai sesuatu tajuk	1	2	3	4	5
4. Saya boleh membantu pelajar mengenalpasti hubungan antara pelbagai konsep di dalam mata pelajaran yang di ajar	1	2	3	4	5
5. Saya boleh membezakan percubaan/pendekatan pelajar dalam menyelesaikan masalah di dalam kelas	1	2	3	4	5

BAHAGIAN 5

ARAHAN: Sila baca setiap pernyataan berikut dan bulatkan nombor yang paling tepat bagi menerangkan sejauh mana anda bersetuju atau tidak bersetuju dengan pernyataan berikut:

E. Pengetahuan Teknologi Isi Kandungan Pengetahuan ini membantu guru-guru memikirkan contoh-contoh bagaimana teknologi boleh diintegrasikan dengan berkesan di dalam pengajaran mereka. Ia juga merupakan pengetahuan bagaimana teknologi boleh digunakan untuk menyediakan kaedah baru dalam pengajaran (Niess, 2005)	Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju
1. Saya tahu mengenai teknologi yang boleh digunakan untuk pengajaran konsep-konsep tertentu di dalam mata pelajaran yang di ajar	1	2	3	4	5
2. Saya tahu bagaimana mata pelajaran yang diajar boleh disampaikan melalui aplikasi teknologi	1	2	3	4	5
3. Saya tahu tentang teknologi yang boleh saya gunakan untuk meningkatkan pemahaman tentang konsep-konsep tertentu dalam mata pelajaran yang di ajar	1	2	3	4	5

		Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju
4.	Saya boleh menggunakan aplikasi teknologi seperti multimedia untuk menjelaskan konsep-konsep tertentu di dalam mata pelajaran yang di ajar	1	2	3	4	5
5.	Saya boleh menggunakan pelbagai jenis teknologi untuk menyampaikan kandungan mata pelajaran yang di ajar	1	2	3	4	5

BAHAGIAN 6

ARAHAN: Sila baca setiap pernyataan berikut dan bulatkan nombor yang paling tepat bagi menerangkan sejauh mana anda bersetuju atau tidak bersetuju dengan pernyataan berikut:

F. Pengetahuan Teknologi Pedagogi Pengetahuan ini memerlukan pemahaman mengenai strategi pedagogi yang umum yang boleh diaplikasikan bersama penggunaan teknologi.	Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju
1. Saya boleh memilih teknologi yang dapat meningkatkan pendekatan pengajaran untuk sesi pengajaran	1	2	3	4	5
2. Saya boleh memilih teknologi yang dapat meningkatkan pembelajaran pelajar bagi sesuatu pengajaran	1	2	3	4	5
3. Program pendidikan perguruan guru yang saya ikuti menggalakkan saya untuk berfikir dengan lebih mendalam mengenai bagaimana teknologi dapat mempengaruhi pendekatan pengajaran yang saya gunakan di dalam kelas	1	2	3	4	5
4. Saya berfikir secara kritis mengenai bagaimana untuk menggunakan teknologi dalam kelas saya	1	2	3	4	5
5. Saya boleh mengaplikasikan teknologi yang saya pelajari untuk pelbagai aktiviti pengajaran	1	2	3	4	5

BAHAGIAN 7

ARAHAN: Sila baca setiap pernyataan berikut dan bulatkan nombor yang paling tepat bagi menerangkan sejauh mana anda bersetuju atau tidak bersetuju dengan pernyataan berikut:

G. Pengetahuan Teknologi Pedagogi Isi Kandungan Pemahaman mengenai bagaimana konsep-konsep boleh disampaikan dengan menggunakan teknologi; teknik-teknik pedagogi yang menggunakan teknologi secara konstruktif untuk mengajar isi kandungan; pengetahuan mengenai apa	Sangat Tidak Setuju	Tidak Setuju	Neutral	Setuju	Sangat Setuju

yangmenyebabkan konsep-konsep sukar atau mudah dipelajari dan bagaimana teknologi boleh membantu mengatasi masalah-masalah yang dihadapi oleh pelajar-pelajar (Mishra & Koehler, 2006).

1.	Saya boleh mengajar pelajaran yang menggabungkan mata pelajaran yang di ajar, penggunaan teknologi dan pendekatan pengajaran dengan bersesuaian	1	2	3	4	5
2.	Saya boleh memilih teknologi untuk digunakan di dalam kelas untuk membantu mengukuhkan apa yang saya ajar, bagaimana saya mengajar dan apa yang pelajar pelajari	1	2	3	4	5
3.	Saya boleh menggunakan strategi yang telah saya pelajari di dalam kerja kursus saya untuk menggabungkan isi kandungan, teknologi dan pendekatan pengajaran dalam kelas saya	1	2	3	4	5
4.	Saya boleh mengambil peranan sebagai pemimpin untuk membantu orang lain mengkoordinasikan isi kandungan, penggunaan teknologi dan pendekatan pengajaran di sekolah saya	1	2	3	4	5
5.	Saya boleh memilih teknologi yang dapat meningkatkan pemahaman kandungan pelajaran saya	1	2	3	4	5

BAHAGIAN 8

ARAHAN: Sila berikan maklumat-maklumat berikut

1. Jantina: ☐ Perempuan
          ☐ Lelaki

2. Umur: _____ tahun

3. Pengalaman ICT : _____ tahun

4. Major:
5. Minor: