

Developing Pre-Service Teachers' ICT in Education Competencies in a
Chinese Normal University: The Role of Curriculum Leaders

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PhD

THE HONG KONG INSTITUTE OF EDUCATION

YEAR

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Developing Pre-Service Teachers' ICT in Education Competencies
in a Chinese Normal University: The Role of Curriculum Leaders

By

XIONG, XIBEI

A Thesis Submitted to
The Hong Kong Institute of Education
in Partial Fulfilment of the Requirement for
the Degree of Doctor of Philosophy

June 2015



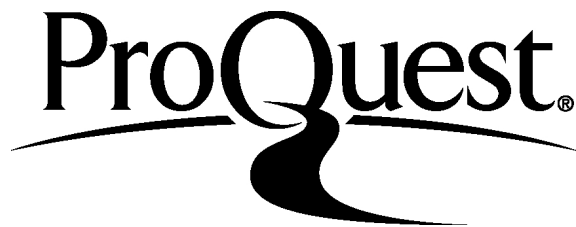
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ABSTRACT

Given its rapid global development, the effective use of information and communications technology (ICT) to enhance teaching and learning outcomes has been highly emphasised in contemporary teacher education. Developing pre-service teachers' ICT in education competencies ensures that tomorrow's teachers are equipped with systematic integrated technological pedagogical content knowledge (TPACK), as pre-service teachers' TPACK perceptions may predict their level of ICT in education competencies.

Looking at higher education in China, in addition to the political control of the central government, the top-down curriculum management system of the universities seems to support the effectiveness of teacher education programmes. Thus, the demand for ICT in teacher education not only affects the context and structure of teacher education programmes, but also challenges the role of curriculum leaders. As the core of all other leadership activities (Wiles, 2009), curriculum leadership is responsible for both the maintenance and improvement of teacher education programmes. Furthermore, in creating a meaningful learning context, it is vital for pre-service teachers to develop ICT in education competencies. Therefore, there are research gaps in the investigation of how curriculum leadership supports



or hinders teacher education programmes in the development of pre-service teachers' ICT in education competencies. This study is intended to fill in the research gaps. It poses the following guiding questions to explore the theme in greater depth. First, how do teacher education programmes affect the development of pre-service teachers' ICT in education competencies? Second, how does curriculum leadership shape teacher education programmes, and how do those programmes shape it in turn? Third, what are the roles of curriculum leaders in developing pre-service teachers' ICT in education competencies?

This study was conducted at Guangxi Normal University (GXNU), a provincial normal university in mainland China. Based on the theoretical and contextual background, its conceptual framework was contextualised in three top-down layers of administration, including the Ministry of Education (MOE), the Guangxi Provincial Department of Education and GXNU. The curriculum leaders at the university, subordinate school and classroom levels constitute the curriculum leadership system at GXNU. They play interactive roles in programme planning, implementation and evaluation to develop pre-service teachers' ICT in education competencies. This framework provided a general guide for the tools and parameters required for data collection and analysis in this study.



According to the research questions, this study adopted a mixed-methods research approach, sequentially integrating a quantitative survey with qualitative interviews and documentation analysis. As pre-service teachers' self-assessed perceptions of TPACK were likely to predict their ICT in education competencies, 211 pre-service teachers in the three programmes were surveyed to examine their TPACK perceptions. Valid data were analysed via statistical methods in SPSS 17.0. The interviewees included 13 curriculum leaders at the university, subordinate school and classroom levels, respectively, and 12 pre-service teachers were selected for focus group interviews. The qualitative data were analysed via open and axial coding. The findings from both methods were compared and combined.

The integrated findings clarify the role of curriculum leaders in developing pre-service teachers' ICT in education competencies. Curriculum leaders at the university level (e.g., the Vice-President (Academic)) provide support in the forms of policy formulation and resource allocation. Curriculum leaders at the subordinate school level (e.g., the Vice-Dean (Academic)) have a significant effect on the application of ICT to education curriculum structures, course objectives and academic credit management. Furthermore, curriculum leaders at the classroom level (e.g., course coordinators or lecturers) have a significant effect on course content and pedagogy.



The results of this study indicate the interactions between curriculum leadership and teacher education programmes. Curriculum leadership shapes teacher education programmes by providing supportive policies, planning or managing curricula and evaluating pre-service teachers' learning outcomes. The programmes may also shape the practices of curriculum leaders in terms of the changing educational system requirements and current curricula constraints. This finding may help to provide empirical evidence and achieve an understanding of the effectiveness of teacher education programmes.

This study also reveals that curriculum leaders are under pressure to acquire and use effective programme management strategies related to the use of ICT in education. In particular, this study highlights the importance of university senior management in supporting coordination and communication between curriculum leaders. This study also explains that pre-service teachers' teaching reflections and evaluations are of great importance for improving courses or programmes and informing the practices of curriculum leaders.

Beyond these findings, this study contributes to an important future direction for TPACK. It suggests that examining TPACK at the programme and course levels with a focus on curriculum leadership requires more research. The outcomes of the study are expected to expand the theoretical knowledge of curriculum leadership effects, especially in relation to



the use of ICT in teacher education. The findings imply the need for consistent support, collaboration and commitment to programme improvement from all educational stakeholders.

Finally, the limitations of the study are highlighted, including its generalisation and methodological limitations and its small sample of interviewed curriculum leaders and surveyed pre-service teachers. It is necessary to conduct larger-scale studies that involve more curriculum leaders and pre-service teachers. Future studies may also require multiple sources of data to verify the potential of curriculum leadership in developing ICT curricula.



ACKNOWLEDGEMENTS

The journey towards my PhD has been rewarding, fulfilling and challenging. I would like to express my heartfelt gratitude to the people who have encouraged and supported me along the way. Without their assistance and cooperation, this thesis would not have been completed.

My deepest appreciation goes first and foremost to Professor Lim Cher Ping, my principal supervisor, for his professional guidance, advice and encouragement. Professor Lim continuously offered critical feedback that helped me develop my academic research skills. I owe every bit of progress I have made over the past three years to his invaluable inspiration and patience. Professor Lim is more than simply my thesis supervisor; more importantly, he is the supervisor of my life. He taught me how to develop a commitment to education and a real passion for life.

I express my sincere thanks to my two associate supervisors. I thank Professor Allan Walker for the constructive and stimulating comments he offered during the thesis-writing process. I also thank Dr NG Mee Wah, Eugenia for giving me terrific advice when I was miserable in the middle of my journey. Special thanks also go to Professor Lo Sing Kai and Professor So Wing Mui, Winnie for their valuable advice about my thesis proposal.



I thank Mr Chu Yan Kit, Anthon; Dr Lu Jiafang; Dr Qian Haiyan; Dr Hui King Fai, Sammy; Ms Poon Sin Yi, Teresa; Ms Zhang Shaolin; Mr Zhao Minxing; and Mr Zheng Yuan for their untiring support and encouragement. Thanks also go to my HKIEd friends for their warm support and friendship.

I thank my parents for their patience, unconditional support and countless contributions to my life. Finally, I thank my son, who always forgave me for leaving home to study.



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LIST OF ABBREVIATIONS

CK	Content Knowledge
GXNU	Guangxi Normal University
ICT	Information and Communications Technology
ICT-CFT	ICT Competency Framework for Teachers
MOE	Ministry of Education
M-TPACK	Mathematical-Technological Pedagogical and Content Knowledge
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
TAO	Teaching Affairs Office
TCK	Technological Content Knowledge
TEI	Teacher Education Institution
TK	Technological Knowledge
TPK	Technological Pedagogical Knowledge
TPACK	Technological Pedagogical Content Knowledge
TPCK	Synthesised Knowledge of Technology, Pedagogy and Content
TPACK-W	Technological Pedagogical and Content Knowledge-Web
UNESCO	United Nations Educational Scientific and Cultural Organisation



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CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The rapid advancement of information and communications technology (ICT) has had a significant effect on people's learning behaviour (Martinovic & Zhang, 2012) and challenged how education should be delivered (Voogt, 2010). Studies have documented that the use of ICT in education can enhance teaching and students' learning outcomes (Culp, Honey, & Mandinach, 2005; Zhou et al., 2005; Zhou, Zhang, & Li, 2011).

As the gatekeepers of the classroom, teachers play a vital role in implementing ICT in their teaching and learning practices. The use of ICT in teacher education has become a foregrounded issue in dynamic educational reform (Davis, 2002). Pre-service teacher education has been a critical entry point for integrating ICT into the education system (Northcote & Lim, 2009). The next generation of teachers are expected to not only be the greatest source of information for curriculum design and education content (Martin, 2000), but also take on the demanding roles of change agents, bridging the gap between how ICT is



applied to classroom teaching and the opportunities it offers to enhance learning (Northcote & Lim, 2009). Therefore, educating pre-service teachers on how to use ICT to enhance their teaching practices has become an important objective of teacher education (Chang et al., 2012). Furthermore, applying ICT to the education competencies of pre-service teachers is likely to have significant implications for enhancing students' learning outcomes (Chai et al., 2014).

The use of ICT in education encompasses various activities that teachers must perform. These activities require a range of competencies. Thus, this study focuses mostly on developing the competencies involved in the pedagogical use of ICT. However, defining the pedagogical competencies teachers require is a difficult and complex task (Lim, Chai, & Churchill, 2010). The ICT Competency Framework for Teachers (ICT-CFT) developed by UNESCO in 2008 and recently updated in 2011 provides internationally recognised guidelines and valuable references for preparing the next generation of teachers to use ICT (Lim, Chai, & Churchill, 2010). It categorises teachers' ICT in education competencies into three developmental stages: 'technology literacy, knowledge deepening and knowledge creation in six aspects of their everyday work including understanding ICT in education, curriculum and assessment, pedagogy, ICT, organisation and administration, and teacher professional learning' (UNESCO, 2011, p. 10).



In addition, the technological pedagogical content knowledge (TPACK) framework developed by Mishra and Koehler (2006) is a theoretical framework that captures the type of teachers' knowledge required to apply ICT to teaching and learning practices. The TPACK framework proposes that effective teaching with ICT must focus on the interactions between technology, pedagogy and subject content (Chai, Ho, Koh, & Tsai, 2012). The TPACK framework has been adopted in many teacher education programmes globally to design, develop and evaluate curricula based on pre-service teachers' ICT in education competencies (Chai, Koh, & Tsai, 2010). However, the framework's emerging importance has prompted many researchers to create various surveys to examine teachers' perceptions of TPACK in general or specific subjects. Teachers' perceptions of TPACK can be assessed, and their self-efficacy in using the framework is a good predictor of their ICT in education competencies (Tschannen-Moran & Hoy, 2001). This study discusses pre-service teachers' ICT in education competencies based on the teachers' self-perceptions of TPACK.

Although many national and international frameworks have been established and many financial and human resources have been invested, pre-service teachers feel unprepared to teach with ICT (Batane, 2004; Liang et al., 2013). Pre-service teachers have reported that they need more training and support along with the skills, competencies and experience



necessary to use ICT effectively in their classrooms (Duran, 2000; Moursund & Bielefeldt, 1999; Bullock, 2004; Mehlinger & Powers, 2002). In reality, they lack the support required to connect their ICT knowledge, pedagogical beliefs and classroom practices. Although they may grasp the knowledge and skills required to use ICT, they are unable to integrate these knowledge and skills into their teaching practices (So & Kim, 2009). A gap remains between what pre-service teachers are taught in their teacher education programmes and how they use ICT in an authentic classroom (Pope, Hare, & Howard, 2002; Krumsvik, 2014; Aydın & Zhu, 2015).

Many educators have reported that pre-service teachers' ICT in education competencies is influenced by many variables such as curriculum objectives, pedagogical activities, participants, sociocultural contexts, learning environments and learner levels (Kennewell, 2001; Lim & Tay 2003; Lim & Khine, 2006; McFarlane, 2000; Zhao & Frank, 2003). However, it has generally been assumed that teacher education programmes are critical in developing pre-service teachers' ICT in education competencies during the apprenticeship phase by providing systematic learning experiences via curricula, assessments and practicums (Lim, Chai, & Churchill, 2010; Albion et al., 2015).



In fact, the effectiveness of teacher education programmes depends on connections and integrated approaches that incorporate subject content, pedagogy and technology (Chai, Ho, Koh, & Tsai, 2012). Numerous studies have observed that these integrated approaches are superior to separate approaches to instruction in developing pre-service teachers' TPACK perceptions (Angeli & Valandies, 2005). To develop pre-service teachers' systematic TPACK, the integrated approaches should teach ICT skills; incorporate ICT into subjects, pedagogies and practices; model the use of ICT by institution; and encourage learning with ICT rather than on ICT (Brush et al., 2001; Downes et al., 2001; Northrup & Little, 1996; Schrum, 1999).

Although pre-service teachers' TPACK perceptions may indicate their ICT in education competencies, studies have found it difficult to distinguish the TPACK factors due to their unclear boundaries (Cox & Graham, 2009; Archambault & Barnett, 2010; Chai et al., 2011a). Pre-service teachers' TPACK domains may overlap or connect, which may complicate the teacher education programmes. The structure and content of teacher education programmes in most institutions around the world require continuous development.

Teacher education programmes are key factors that may influence pre-service teachers' ICT in education competencies. However, these programmes cannot function independently of a



leadership support mechanism (Robinson, Lloyd, & Rowe, 2008). Curriculum leadership must be examined to support teacher education programmes, and doing so is particularly important due to the complexity of the teacher education context.

- Curriculum leadership may be primarily responsible for the integration of ICT into learning, teaching and administration (Schiller, 2003). In other words, curriculum leaders must take on new roles in leading ICT teaching and learning, building pre-service teachers' capacity and managing resources (Jacobsen, 2003).
- Curriculum leadership is critical to ensuring that ICT is made a part of the education competencies of those enrolled in teacher education programmes. The decisions made and practices adopted by curriculum leaders in programme planning, implementation and evaluation may affect the ICT learning experiences of pre-service teachers.
- Curriculum leadership is critical for offering meaningful learning opportunities to develop pre-service teachers' subject knowledge and pedagogical beliefs and effective educational applications for ICT (Lim, Chai, & Churchill, 2010).
- Curriculum leadership may facilitate a supportive environment based on the strategic dimensions of (1) vision and philosophy; (2) programme curriculum, assessment and practicum; (3) the professional learning of deans, teacher educators and support staff; (4) ICT plans, infrastructure, resources and support; (5) communication and partnerships; and (6) research and evaluation.



However, pre-service teacher education is a unique educational context in which knowledge emerges out of a learning environment comprising courses, workshops and other pre-service learning experiences. Only when the components of this dynamic and complex teacher education system and their interactions have been clearly explained can the behaviour of the system be understood and related problems be solved (Davis, 2002). The effective development of pre-service teachers' ICT in education competencies and teaching and learning practices requires more than a focus on teacher education programmes. There is also a need to clarify the roles of curriculum leadership when organising strengths to support the development of those competencies.

Like other governments, the Chinese government has realised the significance of ICT in teacher education. Based on the Outline of China's National Plan for Medium and Long-term Education Reform and Development (2010-2020), the Chinese Ministry of Education (MOE) formulated the Development Strategies Planning for Education Informatisation (2010-2020) in March 2012. This document provides a clear instructional blueprint for educational ICT integration over the next several years. It also provides a national documental background for building pre-service teachers' ICT in education competencies. Hence, it is timely and



necessary to conduct broader research related to the role of curriculum leadership in teacher education as it relates to developing such competencies.

1.2 Research purposes

Many studies have generated valuable references and formed an empirical background for applying ICT to different teacher education contexts. However, the ambiguity of the role of curriculum leadership has led to a research gap in the teacher education field, such that few investigations of curriculum leadership have focused on pre-service teachers' ICT in education competencies.

The preceding contextual information establishes a strong international and local background for studies of the role of curriculum leadership in building pre-service teachers' ICT in education competencies. The main purpose of this study is to investigate how curriculum leadership supports or hinders teacher education programmes in developing pre-service teachers' ICT in education competencies at a teacher education institution (TEI) in mainland China. The study specifically aims to (1) examine how teacher education programmes affect the development of pre-service teachers' ICT in education competencies, (2) explore how curriculum leadership shapes and is shaped by teacher education programmes and (3)



investigate the roles of curriculum leaders in the development of pre-service teachers' ICT in education competencies.

1.3 Significance of the study

The findings of this study reveal the reference coordinates, implications and objective instructions for the role of curriculum leadership in building pre-service teachers' ICT in education competencies, especially in the context of Chinese provincial TEIs, which have not yet been thoroughly researched. In addition, according to various educational contexts, educators and policymakers who like to learn from the research and experiences of others may be enlightened as to the challenges involved in improving these competencies in these ever-changing times.

- This study provides descriptive value in its portrayal of the development of Chinese pre-service teachers' ICT in education competencies and offers valuable insights into the linkage between the role of curriculum leadership, teacher education programmes and the development of pre-service teachers' ICT in education competencies.
- The outcomes of this study enhance the curriculum leadership literature in general and expand the theoretical knowledge of the effects of curriculum leadership, specifically in

relation to supportive teacher education programmes that enhance teachers' ICT in education competencies.

- This study contributes to an important future direction for TPACK. As pre-service teachers' TPACK perceptions indicate their ICT in education competencies, this study suggests that TPACK must be researched further at the programme and course levels with a focus on curriculum leadership.
- Beyond these findings, curriculum administrators in TEIs may reflect on their own situations, determine their challenges and seek opportunities to become more effective at leading the development of pre-service teachers' ICT in education competencies. Educational agencies may develop relevant policies or regulations for the curriculum administration and transformation of TEIs. Furthermore, educational researchers may reflect on their own circumstances and draw on some valuable experiences in the mainland Chinese educational context.

Therefore, the research outcomes have not only practical implications for current pre-service teacher education but also policy implications for future development.

1.4 Structure of the thesis

This thesis is organised into seven chapters. Chapter One provides the introduction, including an overview of the research background, the purpose of the study and its significance to the fields of curriculum leadership and ICT in teacher preparation.

Chapter Two presents an extensive review of the related literature and forms the theoretical foundation of the study. It reviews the major research areas, including teachers' ICT in education competencies, teacher education programmes and curriculum leadership, to establish an interconnected theoretical linkage. The research gaps are identified and research questions are generated in this chapter.

Chapter Three discusses the historical, political and sociocultural backgrounds of the study. The top-down layers of the administrative system and the curriculum leadership system in Guangxi Normal University (GXNU) are proposed to clarify the power distribution and interactions associated with curriculum leadership. This chapter also explains the curriculum leadership involved in programme planning, implementation and evaluation. A conceptual framework provides a vivid picture of the interrelationships between curriculum leadership, teacher education programmes and pre-service teachers' ICT in education competencies at GXNU to guide subsequent studies.



Chapter Four describes the research design and methodological considerations, including the sampling strategies and data collection and analysis methods used in the study. As this study adopted a sequential mixed-methods research design, data were collected from documentation, surveys and interviews. A multiple-case-study design was adopted, and three teacher education programmes were chosen as the units of analysis. This chapter also focuses on ethical considerations, the validity and reliability of the findings and issues of trustworthiness.

Chapters Five and Six comprise the core sections of this study. In Chapter Five, data analysed from the three case studies are presented as three profiles of teacher education programmes. Each profile indicates how curriculum leadership in subordinate schools helps teacher education programmes to develop pre-service teachers' ICT in education competencies. In particular, Hallinger's (2011) synthesised model of educational leadership is adopted to guide the four dimensions of data analysis, including the sources, values, foci and contexts of curriculum leadership.

Chapter Six addresses the key findings to compare and contrast the three case studies. This chapter explores curriculum leaders' practices in terms of the sources, values, foci and contexts of curriculum leadership. The roles of curriculum leadership in teacher education



programmes are investigated at the university, subordinate school and classroom levels, and the interrelationships between curriculum leaders are presented to depict the operations of the curriculum leadership system. Finally, this chapter proposes an appropriate curriculum leadership system framework for building pre-service teachers' ICT in education competencies.

Chapter Seven reviews the research questions of the study and summarises the major findings. It discusses the implications for curriculum leaders' practices and future research directions. The limitations of the study are also considered. Finally, a brief conclusion and a future vision are presented.



CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the relevant literature, which mainly seeks to investigate the theoretical linkage between pre-service teachers' ICT in education competencies, teacher education programmes and curriculum leadership in and especially to emphasise the importance of curriculum leadership in teacher education. To clarify the theoretical clues, this chapter begins by considering pre-service teachers' ICT in education competencies. The second section reviews the literature related to ICT preparation in teacher education programmes, including the key components of curricula, assessments and professional experience (practicums). The third section focuses on curriculum leadership in general, including the distribution of curriculum leadership, its four dimensions and its role in higher education in China. The fourth section examines the strategic dimensions of ICT capacity building in TEIs and of curriculum leadership in programme processes in addition to the improvement of students' learning outcomes. Finally, a potential research gap in the literature is identified and the research questions are generated.



2.2 Pre-service teachers' ICT in education competencies

There are several points to be noted about pre-service teachers' ICT in education competencies. First, one's personal application of ICT does not easily or automatically translate into an integration of ICT into one's teaching and learning practices (Lim, Chai, & Churchill, 2010). Second, although teachers have greater access to computers today, this easier access may not be synonymous with competencies (Elliott, 2004). Third, although current pre-service teachers are accustomed to studying in a digital environment, their information literacy and critical thinking skills remain weak (Oblinger & Oblinger, 2005). Fourth, demonstrating technology knowledge alone is insufficient. Pre-service teachers must be prepared with the necessary ICT and pedagogical capabilities to integrate ICT into their teaching, learning and even administrative practices (Mims et al., 2006). Therefore, this study focuses mostly on developing pre-service teachers' competencies in the pedagogical use of technology.

However, it is difficult to define the pedagogical competencies a pre-service teacher requires due to their complexity. These competencies involve a range of knowledge and skills. Many national and international standards have fortunately been established to provide good



references (Lim, Chai, & Churchill, 2010). The ICT-CFT developed by UNESCO in 2008 and recently updated in 2011 provides internationally recognised guidelines and valuable references, especially for countries that have not yet formulated their own ICT standards for teachers. The framework defines teachers' competencies based on three developmental stages: 'Technology literacy, knowledge deepening and knowledge creation. These approaches are mapped across six dimensions of the education system: understanding ICT in education, curriculum and assessment, pedagogy, ICT, organisation and administration, and teacher professional learning' (Lim, Chai, & Churchill, 2010).

Based on the classification presented in the ICT-CFT (2011), most countries are likely to formulate their own national progressive standards for teachers according to specific social, economic and educational development stages. For instance, the MOE of China formulated the Development Strategies Planning for Education Informationisation (2010-2020) in March 2012. This document analyses the revolutionary effects of ICT in education. It clarifies that China mostly remains in a stage of 'technology literacy' and is developing towards a 'knowledge deepening' stage. The document is expected to improve the use of ICT in education by constructing ICT infrastructure, developing educational resources, standardising ICT curricula and training teachers to apply ICT in their teaching practices (Zhao & Xu, 2010).



2.2.1 Technological pedagogical content knowledge (TPACK) framework

Different from the sets of national and international standards that try to prescribe the expected competencies of teachers in various areas, the TPACK framework functions as an analytical scheme for understanding the knowledge teachers require to apply ICT in their teaching and learning practices. The TPACK framework provides a theoretical understanding of the aforementioned national and international standards and competencies.

In 2005, Mishra and Koehler (2006) added technology to Shulman's (1986) pedagogical content knowledge (PCK) theory and described the resulting technological PCK (TPCK) model as the knowledge base for teachers to effectively teach with technology (Voogt et al., 2012) (see Figure 2.1). The knowledge construct includes pedagogical knowledge (PK), content knowledge (CK) and technological knowledge (TK) along with four intersected knowledge constructs: PCK, technological CK (TCK), technological PK (TPK) and TPACK. Koehler and Mishra (2008) argued that teachers had to develop the flexibility to incorporate knowledge about their students, the available infrastructure and the school environment into their teaching and learning practices. Thus, they established a context for the TPACK framework.



In essence, as an analytical theoretical framework, TPACK demonstrates that teaching effectively with technology requires teachers to emphasise the interactions between the subject content, pedagogy and technology (Chai, Ho, Koh, & Tsai, 2012).

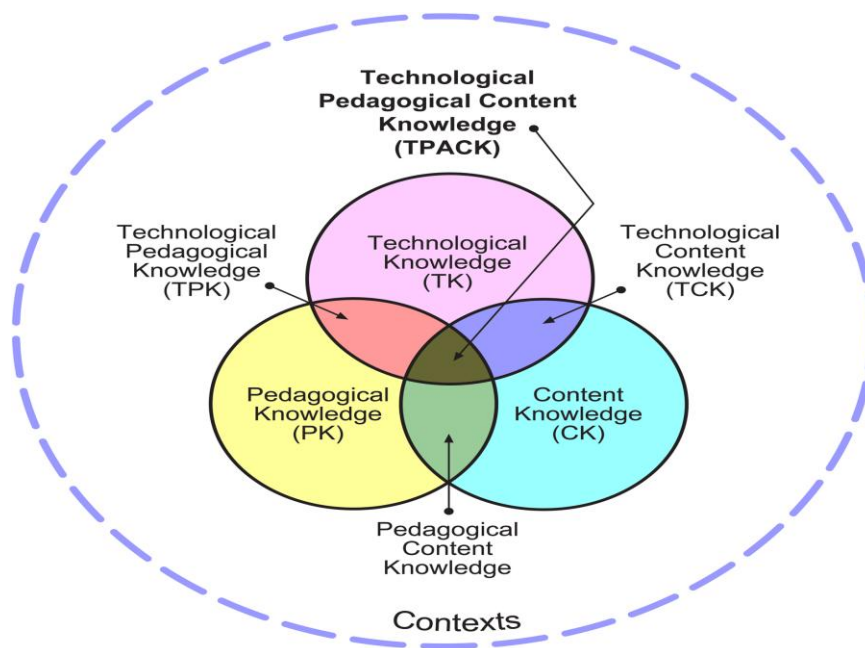


Figure 2.1: Technological pedagogical content knowledge framework (Koehler & Mishra, 2009, p. 63).

The TPACK framework for understanding teachers' ICT in education competencies has received a tremendous amount of attention recently. It has been applied in the educational research field and in professional development projects at the K-12 and even higher

education levels (Thompson & Schmidt, 2010). It is an appropriate framework for bridging teacher education and educational technology (Lin, Tsai, Chai, & Lee, 2012) and serves as a theoretical foundation to provide insights about quality teaching with technology (Niess, 2011).

2.2.2 Assessing teachers' TPACK perceptions

The TPACK framework has clarified the requisite ICT in education competencies for teachers. It reveals the necessity of considering how to assess or evaluate such competencies via the TPACK framework. In fact, this kind of quantitative effort has led to the development of various surveys to examine teachers' TPACK in both general (Koehler & Mishra, 2005; Schmidt et al., 2009; Archambault & Crippen, 2009, Koh, Chai, & Tsai, 2010; Chai et al., 2011a, 2011b) and specific (Graham et al., 2009; Lee & Tsai, 2010; Landry, 2010; Hatice, Lutifi, & Sinan, 2013) subjects.

Koehler and Mishra (2005) first attempted to assess teachers' TPACK perceptions using 14 survey items. Schmidt et al. (2009) constructed a survey of 58 items to measure pre-K-6 teachers' generic perceptions of TPACK in the content areas of Mathematics, Social Studies, Science and Literacy. Graham et al. (2009) developed a 30-item TPACK survey to measure



Science teachers' perceptions of TPACK. Archambault and Crippen (2009) developed a 24-item survey to assess K-12 teachers' perceptions of TPACK for on-line teaching. Koh, Chai and Tsai (2010) examined Singapore pre-service teachers' perceptions of TPACK via a large-scale survey. Lee and Tsai (2010) developed the Technological Pedagogical Content Knowledge-Web (TPACK-W) Survey to explore Taiwan teachers' self-efficacy in integrating Web technology into their teaching practices. Landy (2010) created a survey to measure Mathematics teachers' mathematical TPACK (M-TPACK). Zelkowski et al. (2013) developed a reliable TPACK instrument for secondary Mathematics pre-service teachers. In particular, Chai et al. (2013) validated a TPACK efficacy survey and administered it to 550 pre-service teachers from China, Hong Kong, Singapore and Taiwan. Their study identified seven TPACK factors. As Chai et al. (2013) conducted their study in the context of Chinese teacher education, their research instrument may be valid and reliable for the current study.

2.2.3 Teachers' TPACK perceptions and their ICT in education competencies

Emphasising teachers' TPACK development has become an important approach to improving current teacher education (Lin et al., 2012; Sancar-Tokmak, Surmeli, & Ozgelen, 2014). Researchers have recently shifted their interest to exploring teachers' ICT in education competencies through the TPACK framework.

One benefit of using a survey format is that it measures self-efficacy (Zelkowski et al., 2013). When a self-assessment instrument is used to measure teachers' self-efficacy, it usually provides a good indication of the teachers' behaviour and practices (Tschannen-Moran & Hoy, 2001). Thus, the self-efficacy of pre- and in-service teachers' TPACK may influence whether they can and will implement ICT to support their classroom practices (Bowers & Stephens, 2011; Dunham & Hennessey, 2008; Niess, 2013). Pre-service teachers' self-assessed efficacy and confidence in TPACK may serve as important predictors of whether they have developed ICT in education competencies (Graham, 2011; Koh et al., 2010; Voogt et al., 2012). Furthermore, assessments of teachers' perceptions of TPACK can indicate their level of ICT in education competencies in teaching and learning.

In this way, ICT in education competencies may be understood as TPACK perceptions. Given that few studies have introduced other approaches and the wide acceptance and validation of the TPACK framework, the current study bases pre-service teachers' ICT in education competencies on their self-perceptions of TPACK.

2.2.4 Application of the TPACK framework to Chinese teacher education

The TPACK framework has been used in various educational contexts to assess the TPACK perceptions of pre- and in-service teachers. The teaching practices in mainland China generally differ from those in Western countries, at least in term of class size, number of subjects taught, pressure from study loads and professional development of teachers (Deng et al., 2014). Thus, a brief overview of the application of the TPACK framework to Chinese teacher education is required.

In 2004, the MOE of China issued its Educational Technology Competency Standards for Primary and Secondary Teachers (Trial) (hereafter ‘the Standards (2004)’). The Standards (2004) demonstrate the knowledge teachers require to engage in effective ICT teaching and learning practices in China (MOE, 2004). It sets the tone for the ICT-related areas of teacher education programmes and influences the objectives, contents and assessments of these programmes (He, 2005). It also guides teacher education programmes to be more structured in their integration of TK, PK and CK. The teacher education programme requirements in the Standards (2004) are likely to complement the core theme of the TPACK framework. This indicates that the Standards (2004) can be understood from the perspective of the TPACK framework.



China is no exception from the TPACK research trend in teacher education. Many TPACK-related studies have been conducted in China in recent decades. The TPACK framework has been adopted to guide Chinese researchers to explore ICT teaching and learning strategies in secondary education (Zhang, 2012; Xu, Lan, & Zhang, 2014) and ICT curriculum reform in higher education (Chi & S, 2012; Yuan, Li, & Zheng, 2012; Yan, Xiao, & Wang, 2012; Lim, Yan, & Xiong, 2015). Chinese theoretical studies have also considered restructuring learning models (Lu, 2011), research issues and processes (Jiao & Zhong, 2010) and even discourse analysis of TPACK (Zhan, 2011). Efforts have also been made to explore the profiles of and interplay between pre- and in-service teachers' TPACK perceptions in China (Dong et al., 2015).

Chinese researchers have conducted various studies of teachers' self-assessed TPACK perceptions. Zhu (2014) investigated and counter-measured research related to the TPACK of primary and secondary Mathematics teachers. Wang (2014) studied English teachers' TPACK and their self-efficacy in integrating technology into education. Xu et al. (2014) conducted a large-scale study of the present situation and developed strategies related to the TPACK of high school information technology teachers.

2.3 ICT preparation in teacher education programmes



2.3.1 Adopting the TPACK framework for programme development

The TPACK framework has been widely implemented and validated by researchers interested in the educational application of ICT. In recent years, numerous teacher education programmes have begun to adopt TPACK to design, develop and evaluate both pre- and in-service teachers' curricula in areas that integrate ICT (Chai, Koh, & Tsai, 2010; Jimoyiannis, 2010; Dede & Soybas, 2011; Zelkowski et al., 2013).

Researchers have extensively applied the TPACK framework to various subject populations such as pre-service teachers (Chai et al., 2010, 2011a, 2011b, 2012; Yurdakul et al., 2011), in-service teachers (Lee & Tsai, 2010), on-line distance teachers (Archambault & Barnett, 2010; Archambault & Crippen, 2009) and teachers in professional development courses (Koehler & Mishra, 2005; Polly, 2011).

Chai, Koh, Ho and Tsai (2010) considered an ICT-mediated pedagogy course in Singapore entitled 'ICT for meaningful learning' to facilitate pre-service teachers' development of TPACK. In Taiwan, Lan, Chang and Chen (2012) adopted a three-stage cyclical model of cooperation-based cognition, action and reflection to develop the teaching skills of



pre-service Chinese as a Foreign Language teachers. Furthermore, Chang, Chien, Chang and Lin (2012) proposed the MAGDAIRE (modelled analysis, guided development, articulated implementation and reflected evaluation) model to enhance the ICT capability of science pre-service teachers. In Vietnam, Peeraer and Petegem (2012) reported on a case in which the TPACK framework was adopted to develop a teacher development cooperation programme and build the ICT capacity of teacher educators. South Korean teacher educators Kim, Choi, Han and So (2012) highlighted three approaches adopted by three ICT courses to train pre-service teachers, respectively: (1) learning Scratch for computational and creative thinking, (2) learning robotics as an emerging technology for convergent and divergent thinking and (3) learning by design for system thinking. All of these attempts and efforts were guided by the TPACK framework and may have implications for integrating ICT into teacher education programmes.

According to the TPACK framework, an effective teacher education programme plays a crucial role in preparing pre-service teachers with the necessary ICT and pedagogical competencies to integrate ICT into their teaching and learning practices (Mims et al., 2006).

Addressing the effective integration of ICT into teacher education programmes requires the specification of three components: education curricula, assessments and professional experience (practicums).



2.3.2 ICT in education curricula

The relationship between teacher education programmes and ICT in education curricula must be clarified to rethink the current teacher education programmes. A curriculum is a plan designed to guide teaching and learning in a school (Glatthorn, Boschee, & Whitehead, 2009). It delineates the educative experiences that learners should have in an education programme to achieve specific goals and objectives (Parkay, Hass, & Anctil, 2010). The curriculum in a teacher education programme aims to develop the skills, attitudes and knowledge that make up the core competencies of an effective teacher. These competencies include PK, subject knowledge, knowledge of social and cultural contexts and the development of values and beliefs. Central to such a curriculum is the expectation that pre-service teachers can develop and even seek out new teaching strategies (Mayer, 2006; Darling-Hammond & Baratz-Snowden, 2007; Ng & Lai, 2010). A programme is the total set of learning experiences gained within a multiyear period and typically encompasses several fields of study. According to Parkay, Hass and Anctil (2010, p. 3), ‘They are part of the same process, a process that consists of planning experiences that lead to students’ learning and growth’.

2.3.2.1 Curriculum design

According to the TPACK guidelines, the growth of each factor underlying the TPACK construct does not automatically contribute to increasing one's overall TPACK (Angeli & Valandies, 2009). It is therefore important to recognise that ICT applied to an education curriculum should effectively integrate technology, pedagogy and subject.

Technical competency is essential to the effective use of instructional technologies (Becker, 2001). In most teacher education programmes, the skills-oriented approach often comes in the form of ICT application courses, which provide training for general ICT skills (Brush et al., 2001). However, a single-course approach may be insufficient at encouraging pre-service teachers to apply their ICT skills to their practices during internships (Rees, 2002; Steketee, 2005; Govender & Naicker, 2014). When designing an ICT-friendly curriculum, it is important to offer a pedagogical-oriented unit to train pre-service teachers how to integrate ICT into their teaching practices (Brown, 2002; McNair & Galanouli, 2002; Zhu & Yan, 2002; Hu et al., 2014; Ebisine, 2015). The subject-specific integration approach has been recognised as an essential component of ICT curriculum design (McNair & Galanouli, 2002). As pre-service teachers must know how to integrate ICT into their specialised subject areas, such as Mathematics, Science, English and Society and the Environment, many teacher education programmes include training that integrates ICT into specific subjects (Steketee,



2005).

Therefore, in terms of improving the effectiveness of teacher education programmes, studies have suggested that integrated approaches are superior to separate subjects of instruction for preparing pre-service teachers to develop a body of knowledge known as ICT-related PCK (Brush et al., 2001; Downes et al., 2001; Angeli & Valandies, 2005; Wells, 2014).

2.3.2.2 Teacher educators

Teacher educators have a great effect on developing pre-service teachers' ICT in education competencies. Building relationships and modelling effective teaching practices are the most important roles played by teacher educators (Sharp & Turner, 2007, 2008; Voogt, 2010). Pre-service teachers must trust teacher educators to develop confidence in their own teaching abilities and gain valuable feedback and encouragement about their development as teachers (Howitt, 2007). A model of how to effectively integrate ICT skills into a subject may allow pre-service teachers to develop a practical understanding of what learning and teaching with ICT looks and feels like (Steketee, 2005). Such experiences may help them to see the connections between ICT knowledge and appropriate uses of ICT in the classroom (Vannatta & Beyerbach, 2000). The role of teacher educators is crucial in this process. Modelling is an



important element of teacher education programmes (Voogt, 2010). To allow pre-service teachers to build stronger TPACK during their programme of study, teacher educators should improve their own TPACK and model and emphasise the integration of ICT into their own teaching practices. They should also have the capacity to run the courses in the programme and establish links between them (Lim, Chai, & Churchill, 2010).

2.3.2.3 Teaching and learning strategies

Although teaching and learning strategies vary, ‘there has been a propensity towards strategies that are inquiry-based, problem-based, and case-based with the intention of providing rich opportunities for pre-service teachers to apply theoretically sound ideas about teaching and learning in realistic, complex and authentic educational contexts’ (Northcote & Lim, 2009, p. 28). Trends in teacher education have highlighted the value of teaching and learning with ICT rather than on ICT, i.e., ICT can be learned when it is used as a tool to strengthen the learning of content rather than as an isolated learning objective (Guy, Li, & Simanton, 2002; Kale & Goh, 2014). Many studies of the effectiveness of teacher education programmes have reported high levels of achievement when the focus of the learning is with ICT rather than on ICT (Drenoyianni, 2004). These studies have also provided empirical evidence of the belief that the use of ICT for teaching purposes is better learned by engaging



in ICT-mediated knowledge construction activities rather than direct instruction (Zhao et al., 2011).

2.3.3 Assessment

When designing an ICT course, assessment is an integral part of the ICT curriculum development task (Lim, Chai, & Churchill, 2010). Assessments for pre-service teachers should be designed based on their attitudes and beliefs towards ICT, pedagogical reasoning, ICT competency and uses of ICT in the classroom (Haydn & Barton, 2007). In addition to being linked with the curriculum, assessment practices ranging from standardised performance tests to learning e-portfolios must be integrated and balanced to monitor pre-service teachers' learning progress (e.g., pre- or post-learning questionnaires, individual product rubrics, peer evaluation, reflective papers or blogging). The tools used in these authentic assessment tasks help pre-service teachers to acquire the competency and dispositions necessary for the real-world integration of ICT (Lim, Chai, & Churchill, 2010).

2.3.4 Professional experience (practicums)



A teacher education programme with ICT meaningfully integrated into its coursework must ensure high quality, ICT-rich professional experiences for pre-service teachers (Davis, 2002). Professional experience or a practicum provides an authentic learning environment for pre-service teachers to make sense of theoretical knowledge and practise the skills they acquire (Dexter & Riedel, 2003; Sime & Priestley, 2005). It has been widely acknowledged that teacher educators, including mentors and cooperating and supervising teachers, play important roles in the professional experience of pre-service teachers. Meanwhile, teacher educators not only must consider the linkage between practicums, curricula and assessments, but also require adequate conditions or structures to support this linkage, such as active cooperation with K-12 schools, clear expectations of ICT use from TEIs and more resources or facilities supplied by both TEIs and K-12 schools to support the development of pre-service teachers' ICT in education competencies during practicums (Lim, Chai, & Churchill, 2010).

2.3.5 Current issues related to ICT preparation in teacher education programmes

The current issues and challenges facing teacher education programmes can be analysed from the following perspectives. First, what pre-service teachers learn is distant from the practices of K-12 schools. There is a gap between the knowledge and skills pre-service teachers



acquire through ICT core courses and those they are expected to possess to successfully integrate ICT into their teaching practices (Pope, Hare, & Howard, 2002). Second, the courses and units in the programmes are incoherent (Hammerness et al., 2005). Technology courses must focus on the connections and interactions between subject content and pedagogy (Koehler & Mishra, 2005; Chai et al., 2011a). Otherwise, they are unlikely to facilitate the knowledge pre-service teachers require to appropriately correlate their ICT skills with their teaching methods and/or subject matter (Chien et al., 2012). To establish a structured curriculum system, ICT core courses must be linked with one another and with non-ICT courses. Finally, cooperation with K-12 schools is inadequate. The effective use of ICT in practicums depends on consensus and support from both TEIs and K-12 schools (Lu, Tsai, & Wu, 2015). Otherwise, the practicums may inhibit ICT integration or discourage pre-service teachers' initiative and confidence (Lim, Chai, & Churchill, 2010).

In summary, teacher education programmes are key factors that may influence pre-service teachers' ICT in education competencies. However, these programmes depend on a leadership support mechanism (Robinson, Lloyd, & Rowe, 2008). It is equally important to examine the curriculum leadership that is particularly relevant to supporting teacher education programmes.



2.4 Curriculum leadership

The Western curriculum leadership literature has often focused on the primary and secondary school contexts. More studies must be conducted to uncover the relationships between the curriculum leadership system and its influence on higher education and especially teacher education. General curriculum management marks a good starting point for exploring these relationships. As the current case study involved a Chinese normal university, it is important to review the curriculum leadership at the higher education level in China.

2.4.1 What is curriculum leadership?

As the essential function of school leadership (Wiles, 2009), curriculum leadership involves cooperative and collaborative goal setting and planning, the maintenance and development of educational programmes, staffing, culture building and resource allocation (Weber, 1996; Lee & Dimmock, 1999). Curriculum leadership is responsible for both programme maintenance and improvement and consists of four basic tasks: ‘defining the programme, collaborating among staff, providing a path or way of working for others to follow, and coordinating activity leading to the attainment of the programme desired’ (Wiles, 2009, p. 22). Curriculum leaders require a thorough understanding of the goals, values, criteria and bases of their



curricula, and must change their administrative roles or responsibilities to meet the new challenges involved in making important curriculum decisions (Glatthorn, Boschee, & Whitehead, 2009). They must understand how social factors and learning theories and styles influence curricula (Parkay, Hass, & Anctil, 2010), ensure that their institutions adhere to good organisational structures and establish communities that foster sharing and communication (Boyce, 2003).

2.4.2 Curriculum leadership is distributed

Leadership practices often involve a distributed perspective (Spillane, Halverson, & Diamond, 2001). In fact, curriculum leadership does not simply involve the remittance of identified individuals within a formal management structure (Lofthouse et al., 1995), but is rather distributed, moves beyond leaders or potential leaders and involves multiple individuals in the work. It allocates responsibilities to every stakeholder with a deep understanding of the vision and mission of the core curriculum (Spillane, 2006). Thus, curriculum leadership is likely to be more effective when it allows for others to participate in its enactment and for powers to be distributed to leaders at various levels (Hallinger & Heck, 1997). These elements are essential and mutually constitute curriculum leadership practices, such as interactions between leaders and followers.



At the higher education level, it is important that the roles of different positions be identified and that responsibilities be allocated to every stakeholder with a deep understanding of ICT, from vice-chancellors and key university committees to departmental heads, course leaders, individual lecturers and students (Laurillard, 1993). According to these specific roles, the curriculum leadership structure can be approximately divided into three levels. First, the curriculum leaders at the university level (e.g., vice-chancellors or relevant senior curriculum administrators) play a vital role in the active supervision and coordination of a programme (Robinson, 2007). Second, the departmental or subordinate school level of curriculum leaders (e.g., the heads of departments or vice-deans) usually assume the major responsibility of coordinating the interface between leading and teaching within the department or subordinate school (Cardno, 1995). Third, the curriculum leaders at the classroom level (e.g., teacher educators or lecturers) recruited from the faculty take on more of the responsibility for curriculum design and instruction (Crowther et al., 2002). In practice, curriculum leadership is distributed across these three levels, providing the involved curriculum leaders with more opportunities to lead or take responsibility for their practices (Boyce, 2003; Cardno, 2006).

2.4.3 Four dimensions of curriculum leadership



In addition to these three distributed levels of curriculum leadership, a framework or model may be necessary to acquire a comprehensive understanding of curriculum leadership and guide in-depth analysis of the different dimensions of curriculum leaders' practices. Hallinger (2011) concluded the lessons from 40 years of empirical leadership research and proposed a synthesised educational leadership model with four dimensions including 'values of leadership, leadership focus, context for leadership, and sources of leadership' (p. 128). The model highlights several important assumptions about school leadership for learning. First, the personal values, beliefs, knowledge and experience of leaders may have an effect on leaders' practices. Second, school leadership not only affects students' learning directly, but also influences and is influenced by school-level conditions. Third, leadership is both shaped by and a response to the constraints and opportunities presented by a school and its contextual environment. Finally, leadership distribution or sharing comprises a range of different behaviour or strategies for involving others in the decision-making process (Hallinger, 2011).

The model can be applied to the context of teacher education in China for the following three reasons. First, it clarifies that school leaders operate within a context that consists of the community, institutional system and social culture (Hallinger, 2011). Pre-service teacher education is a complex education system in which teacher knowledge is the result of a



learning environment that comprises courses, workshops and other pre-service experiences. The components within the system and their interactions must be explained clearly and the behaviour of the system must be understood (Davis, 2002). Second, the model aims to provide a wide-angle lens through which to view the contributions that leadership makes to school improvement and student learning outcomes (Hallinger, 2011). Pre-service teacher education has been a critical entry point for integrating ICT into the education system. Pre-service teachers' ICT in education competencies are more likely to have significant implications for enhancing student learning outcomes (Northcote & Lim, 2009). Thus, leadership in teacher education institutions must organise different strengths to ensure the effectiveness with which pre-service teachers develop their ICT in education competencies. Third, the model was synthesised from empirical research covering a wide range of international education settings, including the Asia-Pacific Region, North America, the UK and Europe.

Given that curriculum leadership is the essential function of school leadership (Wiles, 2009), the model can be adopted to analyse curriculum leadership according to the preceding dimensions. In this study, 'leadership' is specified as 'curriculum leadership' and 'student outcomes' are specified as 'pre-service teachers' ICT in education competencies'. Meanwhile, the 'sources of curriculum leadership' dimension is made a frontline consideration to



emphasise the involved curriculum leaders. The four dimensions can be considered as the sources, values, foci and contexts of curriculum leadership. To ensure the structure and logic of analysis, these four dimensions are used to frame the discussion of curriculum leadership.

2.4.4 Curriculum leadership at the higher education level in China

Although curriculum leadership at the higher education level in China shares some similarities with that in other countries, some context-specific characteristics require emphasis. In recent decades, curriculum management has drawn wide attention from the main stakeholders in curriculum management, including educational experts, professors, administrators, scholars and lecturers (Zhang, 2014). The involvement of university stakeholders in curriculum management has become the basic trend of development at the higher education level and made curriculum management more democratic (Liu & Bai, 2014).

From a stakeholder perspective, the system of university curriculum management presents some practical difficulties. Due to the effects of a long-term planned economy system, curriculum management faces the following challenges and issues: (1) a rigid management mode and structure, (2) a poor curriculum evaluation system, (3) backwards



teaching-resource management and (4) insufficient lecturer involvement (Wang, Chang, & Zhao, 2011; Huang & Huang, 2008, Zhang, 2013a, Zhao, 2014; Liu, & Bai, 2014; Ma & Bai, 2015). Chinese researchers have conducted a range of studies and proposed the following main strategies. First, universities must improve teachers and students' involvement in curriculum management. Second, curriculum content must be adjusted to increase its practicality. Third, curriculum evaluations must be strengthened to clarify teaching quality and learning outcomes (Yu & He, 2013; Zhang, 2013b; Ma & Bai, 2015).

To date, the literature has not provided many operational guidelines for how to untangle the interactions between curriculum leadership and supportive teacher education programmes to develop pre-service teachers' ICT in education competencies. However, studies have attempted to explain the 'interactive web' by examining the literature from three related perspectives: the strategic dimensions for ICT capacity building in TEIs; curriculum leadership involved in programme planning, implementation and evaluation; and curriculum leadership involved in improving students' learning outcomes.

First, the strategic dimensions for ICT capacity building in TEIs require a supportive curriculum leadership system that smoothly and effectively ensures the development of pre-service teachers' ICT in education competencies. Second, the curriculum leadership



involved in programme processes specifically describes its role in the planning, implementation and evaluation stages. Each stage may have an effect on pre-service teachers' experiences with learning ICT. Third, the curriculum leadership involved in improving students' learning outcomes may reveal its effect on the outcomes of pre-service teachers' ICT in education competencies. Therefore, the following sections focus on reviewing the preceding three areas and identifying the linkage between them.

2.4.5 Strategic dimensions for developing pre-service teachers' ICT in education competencies

TEIs are currently responsible for providing opportunities and meaningful contexts to help pre-service teachers to develop ICT in education competencies. As such, the curriculum leaders in TEIs find it challenging to achieve the vision, capability and creativity necessary to use ICT professionally (Lim, Chai, & Churchill, 2010). They must take on new responsibilities and play new roles as ICT leaders, including in the areas of learning, student entitlement, capacity building and resource management (Jacobsen, 2003).

Focusing on the ICT preparation involved in a teacher education programme, Somekh (2006) proposed the necessity of developing curriculum leaders who could combine an



understanding of how ICT could be used to enhance teaching and learning practices with senior management experience in higher education institutions. She also explained that curriculum leaders should consider the nature of a task, the teacher's role (including the ways in which ICT could bring new kinds of job satisfaction to teachers), the organisation of the course (i.e., how changing the organisation of a lecture such as by including small group work or self-study or modifying the number of lectures could improve the use of ICT) and changes in assessment practice (e.g., formative self-tests, increased use of the multiple-choice approach) in the processes of programme planning, implementation and evaluation, respectively.

Furthermore, Lim, Chai and Churchill (2010) proposed six strategic dimensions for building pre-service teachers' ICT capacity in TEIs: (1) vision and philosophy; (2) programme curricula, assessments and practicums; (3) professional learning of deans, teacher educators and support staff; (4) ICT plans, infrastructure, resources and support; (5) communications and partnerships; and (6) research and evaluation. These six strategic dimensions not only provide guidelines for curriculum leadership to improve the ICT integration in TEIs, but also constitute dynamic processes with appropriate feedback loops that coordinate with the continuous improvement of TEIs (Lim, Chai, & Churchill, 2010).



Curriculum leaders must support the six strategic dimensions to maximise the learning outcomes associated with pre-service teachers' ICT in education competencies. Although teaching education programmes tend to comprise the core of curriculum work, curriculum leaders should not be restricted to taking responsibility for them. In fact, the following five strategic dimensions are important influential factors. They constitute a support system that ensures the effectiveness of teacher education programmes and have a negative influence on the effectiveness of such programmes when they have not been appropriately addressed.

First, it is critical to establish the mission, vision and shared values of ICT implementation in TEIs. The vision and underlying philosophy of a TEI should articulate its aspirations, foster the commitment of its staff (Abelman & Dalessandro, 2008) and contribute to creating a meaningful foundation for ICT development in teacher education programmes (Lim, Chai, & Churchill, 2010).

Second, deans, teacher educators and support staff play pivotal roles in engaging pre-service teachers to experience the effective use of ICT in every aspect of their teacher education programmes (Garrison & Kanuka, 2004). In turn, their professional ICT learning and ability to organise human resources to support teacher education programmes are likely to improve the quality and effectiveness of those programmes (Lim, Chai, & Churchill, 2010).



Third, appropriate ICT plans, infrastructure and resources are important factors in guaranteeing the implementation of teacher education programmes (Lim, Chai, & Churchill, 2010). National policy support and financial investment are essential conditions for improving ICT implementation at the higher education level. Financial, human and technical resources are also critical components. Financial support costs arise due to the sustained incentives for computers and release times in addition to the support required by instructional design and implementation. In terms of human resources, individuals with instructional design, technology and curriculum development skills are necessary to support teaching faculty who are new to ICT. In terms of technical resources, technical tools should be up to date and reliable to meet the learning requirements (Garrison & Kanuka, 2004).

Fourth, the communication between TEIs and other organisations provides a foundation for establishing mutual partnerships and increasing the strength of the trust and respect shared by various stakeholders. Communication and partnerships enhance external collaborations and provide an engaging environment for teacher education programmes (Lim, Chai, & Churchill, 2010).



Finally, ICT research and evaluation may be important supportive strategies for promoting the effectiveness of teacher education programmes. Lim, Chai and Churchill (2010) noted that research activities provided a platform for new knowledge that could be integrated into the development of teacher education programmes. ICT policies and practices must be regularly audited to identify areas for improvement and revision. Regular evaluation to maintain the suitability of curriculum content and the appropriateness of pedagogical practices and ICT applications is essential for teacher education programmes.

In summary, these strategic dimensions support the development of pre-service teachers' ICT in education competencies in TEIs. However, this study assumes that the role of curriculum leadership is to provide an effective programme that supports the development of those competencies. Hence, the other five dimensions may serve as a supportive foundation to ensure a better understanding of the programme. The following section discusses the roles of curriculum leadership in programme planning, implementation and evaluation to explore how curriculum leadership influences pre-service teachers' ICT learning experience.

2.4.6 Role of curriculum leadership in programme planning, implementation and evaluation



A programme is a set of well-organised curricula and a master blueprint for student learning (Wiles, 2009). A curriculum is a planned programme developed by teachers and other education professionals. Curricula and programmes are interdependent and mutually exclusive. Thus, they are part of the same process, which consists of planning experiences that lead to the development of pre-service teachers' learning and teaching capabilities (Parkay, Hass, & Anctil, 2010).

The literature has observed that curriculum leadership plays an essential role in the development of teacher education programmes. First, programme planning involves the specification and sequencing of the major decisions that must be made about a curriculum. Curriculum leaders must engage in detailed planning to ensure successful subsequent curriculum development (DeMatthews, 2014). Second, policy-level curricular and situation-specific decisions are influential components of curriculum development and implementation, and planning and aligning the curriculum and tying it to standards and learning outcomes are essential steps in meaningful development and implementation (Parkay, Hass, & Anctil, 2010). Third, evaluation is an important part of the curriculum development process. Curriculum leaders analyse their conditions, design curricula, adopt implementation strategies and evaluate the entire process to obtain results. The difference between planned and achieved curricula leads to a new analysis stage (Wiles, 2009).



2.4.7 Curriculum leadership and students' learning outcomes

Many educators have reported that school leadership is a major factor influencing students' learning outcomes (Hallinger, 2003; Leithwood et al., 2006, 2010; Day et al., 2010). Given that curriculum leadership may be central to every other leadership activity in a school (Wiles, 2009), the significance of curriculum leadership to learning outcomes must be emphasised (Yuen, Law, & Wong, 2003).

Curriculum leadership has an effect on students' learning outcomes from the perspectives of planning, coordinating and evaluating teaching and curricula (Robson et al., 2009), especially the curriculum, teaching and learning knowledge and skills of staff (Leithwood et al., 2010). In this way, curriculum leadership both influences and is influenced by school-level processes and conditions (Mulford & Silins, 2009; Hallinger & Heck, 2010; Leithwood et al., 2010). Meanwhile, as curriculum leaders' decisions or practices are directly related to programme effectiveness, programmes are among the key influential components in bridging curriculum leadership and students' learning outcomes.

Therefore, based on the reviewed literature, there is a need to bridge the gaps between



curriculum leadership, teacher education programmes and students' learning outcomes in TEIs, particularly in cases where curriculum leadership influences the development of pre-service teachers' ICT in education competencies.

2.5 Research questions

Although pre-service teachers' ICT in education competencies can be assessed based on TPACK perceptions (Koehler & Mishra, 2005; Schmidt et al., 2009; Graham et al., 2009; Archambault & Crippen, 2009, Koh, Chai, & Tsai, 2010; Chai et al., 2011a, 2011; Lee & Tsai, 2010; Landry, 2010; Hatice, Lutifi, & Sinan, 2013), the key factors of teacher education programmes have been identified (Ng & Lai, 2010; Govender & Naicker, 2014; Hu et al., 2014; Ebisine, 2015) and the roles of curriculum leaders can be analysed according to four dimensions (Hallinger, 2011), the literature provides few guidelines for uncovering how curriculum leadership supports or hinders teacher education programmes in developing pre-service teachers' ICT in education competencies. This study is intended to fill in this research gap. The following specific guiding questions are posed to explore the gap in greater depth.



1. How do teacher education programmes affect pre-service teachers' ICT in education competencies?
2. How does curriculum leadership shape teacher education programmes, and how do those programmes shape it in turn?
3. What are the roles of curriculum leaders in developing pre-service teachers' ICT in education competencies?

2.6 Summary

This chapter explores the theoretical linkage between pre-service teachers' TPACK perceptions, teacher education programmes and curriculum leadership.

This chapter reviews the application of the TPACK framework to teacher education. It reviews the literature related to the assessment of teachers' TPACK perceptions, which are among the important indicators of their ICT in education competencies. The TPACK framework bridges pre-service teachers' ICT in education competencies and teacher education programmes.



This chapter also presents a brief overview of the role of ICT in education curricula. Course design, teacher educators and pedagogies are essential factors in the effectiveness of teacher education programmes. The issues currently facing teacher education programmes necessitate an exploration of the role of curriculum leadership in those programmes.

This chapter reviews studies of how curriculum leadership has been distributed, the four dimensions of curriculum leaders' practices and the roles of curriculum leadership in programme planning, implementation and evaluation. It investigates the six strategic dimensions of curriculum leadership to strengthen the development of ICT in education competencies in TEIs. Its review of the role of curriculum leadership in students' learning outcomes indicates that curriculum leadership supports the development of pre-service teachers' ICT in education competencies at the programme level. The chapter concludes by identifying the research gaps and the research questions posed by this study.

However, the research in this area leaves much to be desired, particularly in terms of how curriculum leadership shapes and is shaped by teacher education programmes and the roles of curriculum leaders in developing pre-service teachers' ICT in education competencies. This study must develop an in-depth understanding of curriculum leadership and ICT in teacher education that contributes to the literature.



The next chapter supplements the literature reviewed in this chapter by examining the political and sociocultural effects, educational transformation and layers of the administration system in the Chinese context. It helps to make the study theoretically complete and significant.



CHAPTER THREE

CONTEXTUAL BACKGROUND

3.1 Introduction

This chapter aims to map the contextual background of the study. The first section introduces the Confucian-influenced political and sociocultural effects on the administration of Chinese higher education. The second section explains the transformational trends and organisational structure in contemporary Chinese normal universities. The three subsequent sections address the role of ICT preparation in Chinese teacher education. As this study must be considered in the context of the broader teacher education system, the three layers of the administration and curriculum leadership systems at GXNU are examined to clarify the power distribution and interactions of curriculum leadership. This chapter also explains how curriculum leadership supports the planning, implementation and evaluation of teacher education programmes. The contextual information presented in this chapter helps to make the study theoretically complete and historically, politically and socio-culturally significant. Finally, a conceptual framework is proposed as a guide for subsequent research.



3.2 Confucian-influenced administration in Chinese higher education

3.2.1 Centralised governance and university autonomy

According to Xu (2011), Confucianism continues to significantly influence leadership at the higher education level in China. Liu (2012) further explains the effect of the centralised governance on higher education: ‘the Confucian bureaucracy and hierarchy have shaped the strong state and top-down policy process; collectivism and elitism coupled with utilitarianism legitimises the paramount goal of development and strengthens the hierarchy of the higher education system’ (p. 647). Although Chinese higher education has evolved from a centralised closed system, leadership at the higher education level remains hierarchically authoritative in general (Yang, 2011). Most of the leaders in higher education institutions have generally preferred top-down authoritative leadership to democratic leadership, and most of their followers have tended to obey them (Tjeldvoll, 2011; Feng & Newton, 2012). This traditional acceptance of hierarchy and orders from above is assumed to increase the effectiveness of university leaders (Onsman, 2012). Given the historical and socio-political circumstances in China, intervention and control of the central government have been considered proper ways to promote prosperity and harmony and to ensure the autonomy and academic standards of higher education institutions (Chou, 1996; Chen, 1997).



The central government and Chinese Communist Party play commanding roles in the contemporary Chinese education system (Liu, 2012). Despite their slow liberalisation in recent decades, Confucian bureaucracy and hierarchy continue to influence leadership styles and approaches in China. Colleges and universities have long been operating in a centralised curriculum management system (Wang, Chang, & Zhao, 2011; Huang & Huang, 2008). The central government retains control over key aspects including access conditions, compulsory curricula, degree requirements and the examination system. Various forms of executive orders, departmental regulations, assessment and supervision belong to administrative management (Zhang, 2013). The higher education system in China continues to follow the state-control model (Chen & Xu, 2014).

With the development of higher education generalisation and university-system reformation in recent decades, the autonomy of colleges and universities has been enhanced and some significant changes have been made (Bray, 1999; Wang, Chang, & Zhao, 2011). By promulgating a series of national policies, the central government has granted universities more autonomy in their academic decisions and the administrative flexibility to compete in global markets. However, universities are granted less autonomy in their administrative flexibility than in their academic decisions (Wang, 2010). Furthermore, those universities



directly affiliated with the MOE are granted more autonomy than those affiliated with the provincial governments. Faculties enjoy much greater autonomy in terms of teaching, research, personnel and resource allocation (Yang, Vidovich, & Currie, 2007). Nevertheless, this has not led to a loss of centralised governance. In fact, the administrative system operating at the higher education level in China is carefully designed to strengthen regulations and political control and to ensure the smooth implementation of national education policies (Wang, 2010).

3.2.2 Policymaking and implementation in Chinese higher education institutions

Given that the central government controls academic freedom and institutional autonomy (Chen, 2012), the policymaking within its leadership system is more likely to be carried out in a predominantly top-down manner (Liu, 2012).

The national government governs the higher education system according to a detailed policy agenda that reflects the priorities and strategies of educational development (Marginson, 2011). Although the provincial and local governments have granted the education bureaus and higher education institutions increasing degrees of autonomy, agencies continue to tactically carry out the decisions made by the governmental bodies above them while



simultaneously interpreting the discourses in ways that enable them to incorporate their own intentions. For example, presidents of Chinese higher education institutions are appointed by the government rather than selected by university governing bodies. They tend to compromise their scopes of initiative and adopt the same values or ideologies expected by the central system (Marginson, 2011) rather than fulfil their accountability to other stakeholders (Chen, 2012). In addition, the voices from other interest groups are relatively weak in the policymaking process. However, sometimes these groups can successfully exert their influence to adopt policy initiatives (Liu, 2012).

3.3 Transformation of Chinese normal universities

Teacher education in China is typically carried out in normal universities at the national and provincial levels. As of 2012, six national key normal universities were affiliated directly with the MOE (Li, 2012). These universities have a leading responsibility to educate teachers throughout the country and have a strong influence on provincial and regional teacher education (Li & Hayhoe, 2010). It is common for each province to have at least one normal university. The 28 provincial normal universities affiliated with the provincial governments serve as the foundation of Chinese teacher education (Li, 2010; Li & Hayhoe, 2010).



Many major comprehensive universities have established faculties of education and contributed to certain dimensions of teacher education. In this case, normal universities are unlikely to compete with comprehensive universities due to the priority investment from the government and their inability to acquire market resources. The pressures imposed by the expansion of higher education and the emergence of mass higher education in China have also accelerated the transformation of normal universities (Li, 2010; Liu, 2012).

Since 2000, normal universities have struggled to transform themselves into comprehensive universities. This transformation is reflected in many ways, such as enrolment expansion, mergers, internal discipline restructuring, improvements in faculty quality, the development of new or cross-disciplinary programmes and the diversification of funding sources (Yuan, 2004).

3.4 Characteristics of the organisational structure of Chinese normal universities

During the transformation process, the organisational structure of Chinese normal universities has exhibited two major characteristics (Li, 2010).



First, these normal universities have become more comprehensive. Focusing on education as the leading field of knowledge, they have diversified and broadened their curricula and extended their educational focus to a broader range of educational studies (Gu, 2006). These include extensions from the professional preparation of secondary school teachers to all levels of teacher education (early childhood to secondary and adult education) and from educational leadership to public administration and human resources management in response to social demand (Li & Hayhoe, 2010).

Second, in these normal universities, secondary teacher education programmes are usually made available in a format in which pre-service teachers are registered in subject departments or subordinate schools, such as Physics, Chemistry and Mathematics (Gu, 2006). Lecturers from the faculties of education are dispatched to these subject departments to teach educational courses, particularly foundational educational courses. Pedagogical courses are taught by faculty members from the subject departments instead of those from the faculties of education (Zhou, Zhang & Li, 2011). The pedagogical courses are more PCK related, focusing on topics such as pedagogical theory and practice, teenager psychological development and pedagogical research and development.



3.5 Curriculum structures of teacher education programmes in Chinese normal universities

In most Chinese normal universities or colleges, the curriculum structures of teacher education programmes comprise the following four parts (Nie, 1999; Peng, 2000).

- The general education section includes Humanities, Natural Sciences, Social Sciences and tool courses (e.g., computer-based and English courses). The curricula in this section are comprehensive and rich and comprise the foundation of teacher education programmes.
- The specialisation education section includes fundamental studies, core courses and extended and practical studies in the specialisation. This section establishes pre-service teachers' professional knowledge system, strengthens the theoretical foundation of their subject knowledge and improves their ability to engage in scientific research.
- The teacher education section includes basic studies of education and psychology, extended studies of education and research, practical and skill-oriented studies of education and education courses in the specialisation. This section is an important symbol for differentiating normal education from other education and reflects the professional characteristics of teachers.



- The practicum or field experience section allows pre-service teachers to master their knowledge and skills in teaching practices and fully combine theory with practice. It is usually arranged in the senior year of a teacher education programme and involves eight to nine weeks of primary or secondary school teaching in Semesters 8 and 9.

3.6 ICT preparation in Chinese teacher education

As a result of sustained effort on behalf of the central government, China has made great progress in applying ICT to education in recent decades. The MOE has formulated national plans, launched national-level projects and encouraged local governments, higher education institutions and local schools to become widely involved. The rapid advancement of ICT has influenced Chinese teacher education in four broad areas: (1) teacher knowledge or certification requirements, (2) teacher education curricula, (3) teaching and learning practices and (4) the social organisation of teaching and learning (Shi & Englert, 2008). Developing ICT in the teacher education system has become a national educational strategy (Han & Wang, 2010).

Although China is no exception to the global ICT development trend in teacher education, some context-specific problems persist in developing pre-service teachers' ICT in education



competencies in the Chinese teacher education system (Zhou & Zhang, 2011). These include cultural and historical traditions of education, vision and investment; the contradictions between different teaching systems and pedagogies (Hu & Webb, 2009); the immaturity of the educational ICT industry; and the imbalance of economic development (Han & Wang, 2010).

3.6.1 Professional standards of Chinese teachers

In 2004, the MOE of China issued the “Educational Technology Competency Standards for Primary and Secondary Teachers (Trial)”; hereafter this document will be abbreviated as the Standards (2004). The Standards (2004) demonstrate the knowledge teachers require to engage in effective ICT teaching and learning practices in China. However, they do not regulate performance indicators due to the imbalance of economic development between the more developed east and underdeveloped west (Han & Wang, 2010). The Standards (2004) represent the country’s efforts to develop primary and secondary teachers’ ICT in education competencies by constructing ICT infrastructure, developing educational resources, standardising ICT curricula and training teachers to integrate ICT into their teaching practices (He, 2006; Zhao & Xu, 2010). In particular, the Standards (2004) emphasise the following aspects: (1) instructional design skills instead of the application of ICT to teaching practices,



(2) the integration and management of educational resources instead of the skills required to produce such resources and (3) comprehensive competency development instead of ICT skills.

To implement the Standards (2004) effectively, the MOE launched a national project known as the Education Technology Capacity Building Plan for All Primary and Secondary Teachers (He, 2006). The project comprised three components: training, examination and certification. The training aimed to develop teachers' ICT in education competencies as prescribed by the Standards (2004). Examinations were administered to assess these competencies and certificates were granted based on the results (He, 2006). All primary and secondary teachers are currently mandated to acquire ICT in education competencies that satisfy the requirements set out by the Standards (2004) (Han & Wang, 2010). In the past decade, over 3 million primary and secondary teachers have been trained according to the Standards (2004) whether in person, on-line or both (Zhu, 2011).

To set higher goals for teachers using ICT to support students' autonomy, collaboration and inquiry-based learning, the MOE issued its ICT Application Competency Standard for Primary and Secondary School Teachers (Trial) in 2014. These newly developed standards detailed the requirements for primary and secondary school teachers' ICT in education



competencies and illustrated how to improve these kinds of competencies within China's current educational situation.

3.6.2 ICT in the education curricula of pre-service teachers

Most of the training for in-service teachers' ICT in education competencies is designed and implemented in coordination with the Standards (2004). However, the Chinese central government has not formulated any specific guidelines for pre-service teacher education (Song et al., 2005). Instead, more control and flexibility are given to individual normal universities.

Most Chinese normal universities implement an ICT-mediated pedagogy course in their teacher education programmes and focus on how to integrate ICT into classroom practices (Lim, 2012). Chinese researchers have proposed many instructional models for ICT and curriculum integration (Zhao & Xu, 2010). The two practical models commonly adopted in current ICT curriculum design are the inquiry-based and collaborative learning models proposed by Wang and Shi (2004). Various research projects have been conducted to investigate the teaching models for ICT and curriculum integration (Zhao & Xu, 2010), i.e., the delivery-acceptance (He & Wu, 2008a), exploration-based (He & Wu, 2008b),



inquiry-based (He & Wu, 2008c), Web Quest (He & Cao, 2008) and JITT (just-in-time) (He & Liu, 2008) models. Beyond the aforementioned explorations, Chinese normal universities have often adopted group and multimedia-based lecturing, on-line platform-based, student-centred monitoring (Zhao & Xu, 2010) and subject inquiry-based curriculum integration (He, 2005) models in designing current ICT and curricula. The investigation of these models has affected the development of ICT curricula in recent years.

However, individual universities usually decide the contents, principles, models, processes, strategies and assessments of such ICT-mediated pedagogy courses. Due to a lack of common principles guiding course design and evaluation, individual lecturers mainly decide course content. Thus, educational experts have questioned the quality of these courses due to their low emphasis on technology integration, simple teaching and learning models and lack of opportunities to practise and apply the latest technology (Chen, 2006; Cheng, 2007; Zhao, 2010). Considering their specific situations, some normal universities have begun to redesign or revise the ICT preparation components in their teacher education programmes.

3.7 Three layers of the administration system in Guangxi Normal University (GXNU)



Lim (2002) suggested that the study of ICT in education had to be conducted within the situated sociocultural context. As the current study focuses on the roles of curriculum leadership in developing pre-service teachers' ICT in education competencies at GXNU, it is important to examine this research question within the larger context of the Chinese teacher education system in which it is situated (Lim, Chai, & Churchill, 2010). Therefore, based on the centralised governance system and the autonomy in the policymaking and implementation processes in most Chinese higher education institutions, the three top-down layers of administration were identified, including the MOE, the Guangxi Provincial Department of Education and GXNU. This system was established to bring out the best in the stakeholders from each layer of the community. In Figure 3.1, GXNU sits in the innermost circle. The next circle features the Guangxi Provincial Department of Education. The MOE forms the final circle. The different levels have interdependent effects. Changes in any one component in the system directly affect the other related circles.



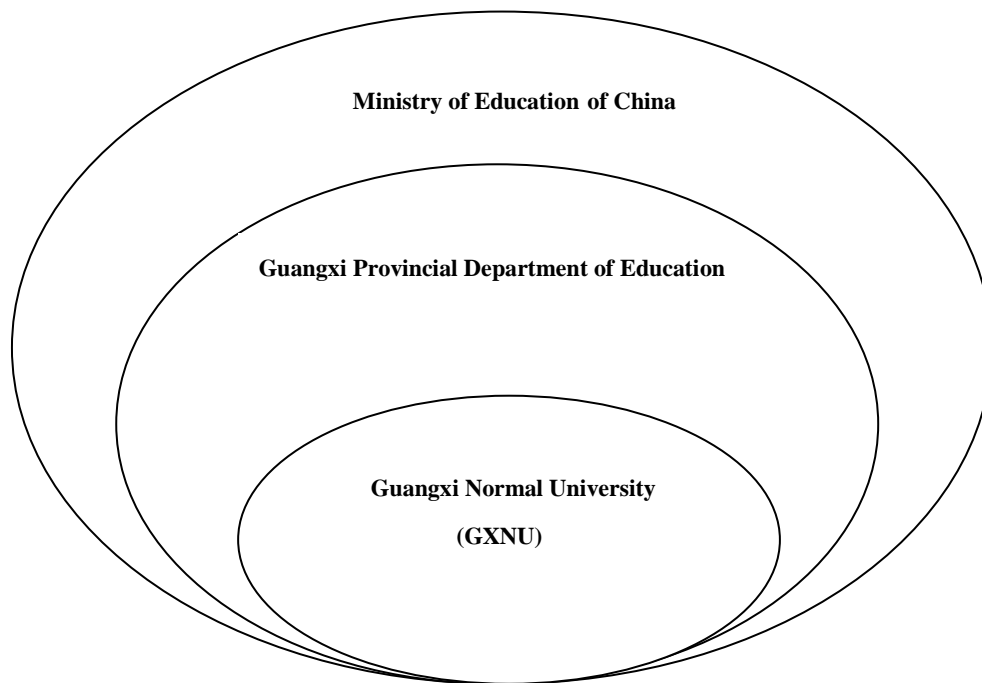


Figure 3.1: Three layers of the administration system (adapted from Lim & Hung, 2003).

3.7.1 Ministry of Education (MOE) of China

The MOE is responsible for national planning, guiding the construction of various schoolteacher teams, drawing up teacher education and management policies and regulations, drawing up teacher qualification standards at various levels, implementing the guiding teacher certification system and providing macroscopic guidance for teacher education and management.

3.7.2 Guangxi Provincial Education Department

The Guangxi Provincial Education Department is run under the direct leadership of the MOE. It is responsible for drawing up provincial educational policies and ICT planning, providing guidance for ICT curriculum and teacher education reforms and teachers' professional training work, organising the implementation of the teacher qualification system and guiding the construction of primary and secondary vocational schoolteacher teams.

3.7.3 Guangxi Normal University (GXNU)

GXNU is a multi-campus comprehensive university located in Guangxi province in south-western China. It is affiliated with the Guangxi Provincial Department of Education in terms of funding and regular administration. GXNU is a provider of teacher, vocational, higher and adult education. Following its internal restructuring, the university is currently made up of 27 subordinate schools. As a key university in Guangxi province, GXNU employs approximately 2,227 staff members and is providing various degrees and education certificates to more than 18,060 full-time undergraduates, 5,160 postgraduate students, 91 PhD students and 10,000 correspondence students. Undergraduates are selected for admission from high school graduates who have passed the National Entrance Examination for Higher Education. About 6,500 students are pre-service teachers from around the country. After



participating in a four-year teacher education programme, most of these students teach in primary or secondary schools throughout the country.

Teacher education has long been one of the university's strengths. Since its founding in 1927, GXNU has educated nearly 200,000 teachers and other professionals. It has played vital roles in teacher education innovation in Guangxi province and has been considered a pioneer in south-western normal education for several decades. During the continuous transformation process, GXNU set its development goal orientation to 'develop into one of the first-rate national provincial key normal universities, and a teaching and research-oriented local university with teacher education as its main characteristic, top-ranking in Guangxi province and influential nationwide' (Zhong, 2008, p. 597).

3.8 Curriculum leadership system in GXNU

The preceding contextual information indicates that curriculum leadership is the core leadership overseeing the academic affairs in a university and that the curriculum leadership structure should complement the university's main top-down administration structure. According to its working responsibilities and power distribution, curriculum leadership at GXNU is mainly distributed at the university, subordinate school and classroom levels.



3.8.1 University level

The curriculum leaders at the university level are the Vice-President (Academic) and Vice-Director (Academic) of the Teaching Affairs Office (TAO). The Vice-President (Academic) is in charge of general teaching and learning work, including full-time regular undergraduate teaching and learning, discipline construction and academic research conducted at the university. He works closely with the TAO to formulate, implement and evaluate teaching and learning strategies at the university level.

The key function of the TAO is to ensure that the teaching and learning practices at GXNU run smoothly in terms of issuing documents or strategies to improve learning outcomes, promoting the university's learning culture, optimising learning resources and even coordinating relationships between schools. Authorised by the Vice-President (Academic), the Vice-Director (Academic) of the TAO is responsible for supervising the teaching and learning practices of individual schools, organising the teaching and learning supervision committee for the annual academic meeting on programme planning and development and providing professional consultations on the annual reports of programme implementation and evaluation presented by the Vice-Deans (Academic).



3.8.2 Subordinate school level

As most subordinate schools have autonomy over professional curriculum implementation and directions for improvement, they have begun to strengthen their curriculum construction (Liu & Bai, 2014). The Vice-Deans (Academic) are curriculum leaders at the subordinate school level. They are in charge of programme planning, consultation and summative evaluation. They must collect feedback or advice from teaching staff members and students to develop programmes and then present an annual report on programme planning and development to the TAO for approval.

3.8.3 Classroom level

The course coordinators and lecturers of the ICT core courses comprise the major curriculum leadership at the classroom level. The coordinators of the ICT core courses are responsible for managing the teaching staff and courses. They must work cooperatively with the lecturers to make decisions related to the course outlines, contents, pedagogies and assessments and support the work of the Vice-Dean (Academic) to improve communication between the classroom and subordinate school.



Although the ICT core course lecturers must follow the course outlines, they sometimes have the flexibility to choose pedagogies and classroom activities. The lecturers are responsible for both lecturing and assessing the learning outcomes of a specific course.

However, some degree of democracy may persist in this centralised system. Mutual interaction may depend on the extent of the democracy or domination of the curriculum leaders. For instance, when a curriculum leader is open to accepting feedback and reflections from a lower level or considering controversial opinions from different stakeholders, two-way communication may be established between two curriculum leadership levels. In contrast, when the upper curriculum leader is conservative, disciplined or even dominant, he seldom opens lines of communication to faculty members or students in the decision-making process. As a result, the feedback and reflections are unlikely to reach the upper administrative level. Therefore, within such a centralised curriculum leadership system, mutual interaction is partly determined by the style and practices of the curriculum leaders.

3.9 Curriculum leadership supports teacher education programmes in GXNU



Teacher education programmes cannot be independent from the curriculum leadership system at GXNU. The following section provides a detailed description of how curriculum leadership supports programme planning, implementation and evaluation.

3.9.1 Programme planning to implementation

Figure 3.2 depicts how curriculum leadership supports programme planning to implementation. In the planning process, the Vice-Dean (Academic) is responsible for drafting a teacher education programme scheme for the coming academic year. Previous programme schemes and reflections from course coordinators are usually considered as important references. The essential factors of a programme may be decided at this stage, such as its purpose and focus, the curriculum structure and even the credit distribution. The Vice-Dean (Academic) then submits the programme scheme to the Annual Academic Meeting of GXNU for consultation. The consultation is supervised by the Teaching and Learning Supervision Committee of GXNU, representing various stakeholders (e.g., educational experts, administrators, provincial education authority representatives). The Committee may provide advice for revisions. The programme scheme is then transferred to the TAO for the final audit. With the official approval of the Vice-Director (Academic) of the TAO, the teacher education programme proceeds to the implementation stage.

In most cases, the annual scheme of a teacher education programme should be consistent with previous schemes. However, due to the changing requirements of the university or school, some adjustments or revisions may be required in the programme planning. When the Vice-Director (Academic) of the TAO cannot cope with uncertainties or significant changes, the Vice-President (Academic) must render a final decision.

Once the teacher education programme is implemented, the involved curriculum leaders, including the Vice-Dean (Academic), course coordinators and lecturers, are transferred to the school and classroom. At this point, the university has less of an influence and the roles of course coordinators and lecturers become more significant. The Vice-Dean (Academic) usually supervises the programme implementation. A course coordinator is normally responsible for managing a specific course in terms of its curriculum planning (content and pedagogy), the selection of teaching materials and the progress and quality of the teaching. In most cases, lecturers are required to follow course outlines. However, they may have the flexibility to choose their teaching contents and pedagogies, organise classroom activities or even arrange assignments or assessments for a specific course.



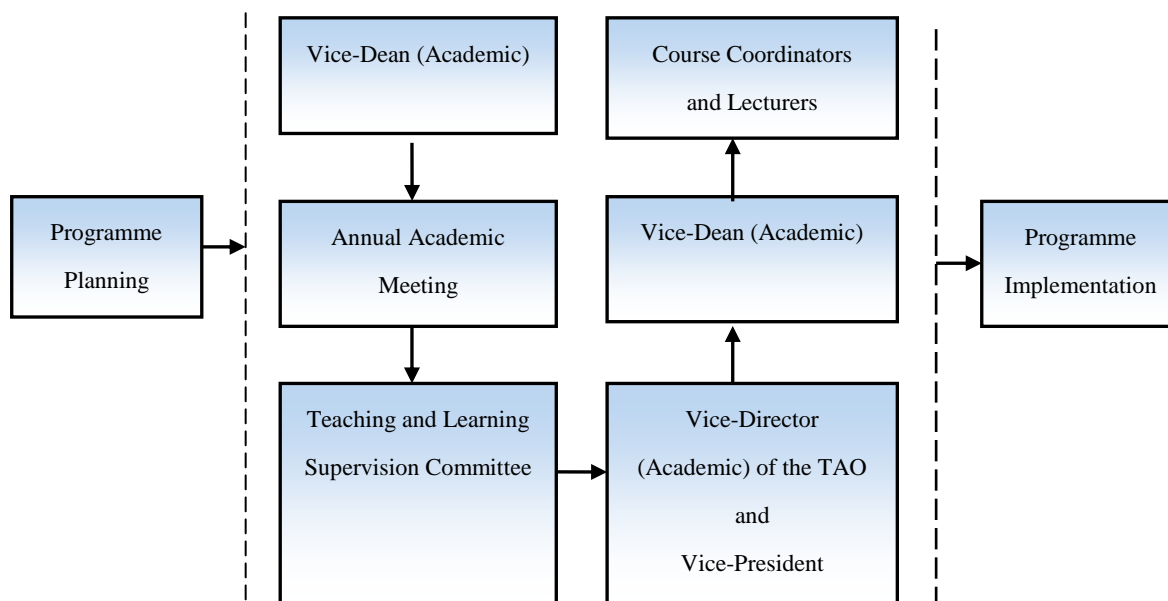


Figure 3.2: Programme planning to implementation

3.9.2 Programme implementation to evaluation

Figure 3.3 shows how curriculum leadership supports programmes from the implementation to evaluation stages. At these stages, the involved curriculum leaders, including the lecturers, course coordinators and Vice-Dean (Academic), are mainly from the classroom and subordinate school level.

At the end of each semester, all of the pre-service teachers are required to complete a feedback form detailing their learning experiences in each course and provide their lecturer scores. It is normal for lecturers to show concern for pre-service teachers' final examination

results and teaching evaluations. The pre-service teacher data are critical for recognising the limitations of current practices, policies or knowledge and for suggesting areas that require attention. Based on the pre-service teachers' learning outcomes, the lecturer should submit a performance report to the course coordinator. The course coordinators collect the lecturers' reflections and submit summative evaluation reports to the Vice-Dean (Academic). The Vice-Dean (Academic) synthesises the course coordinators' reports into a comprehensive annual report to be applied to the programme planning in the next academic year. Applying the evaluation feedback to actual practices may help to generate any new knowledge required to develop a programme.

The policymaking process in Chinese TEIs is more likely to be carried out in a top-down manner. However, according to the researcher's personal teaching experience at GXNU and the interview results, effective programme evaluation depends on the curriculum leaders' working attitudes, visions and approaches and other institutional factors. Furthermore, certain kinds of formalism and bureaucratism at any curriculum leadership level may block the evaluation process, making programme development unlikely.



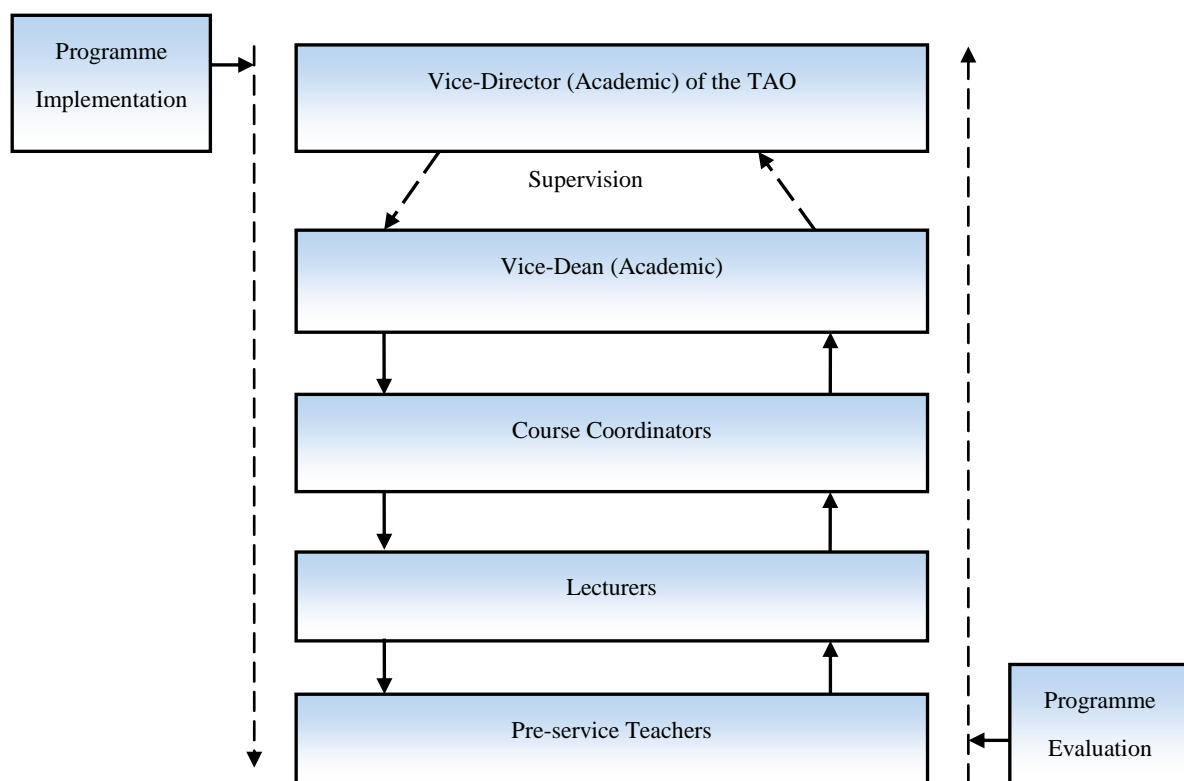


Figure 3.3: Programme implementation to evaluation

In summary, programme planning, implementation and evaluation may constantly change to meet the developing requirements of university administration. Nevertheless, an understanding of curriculum leadership at each stage of the process may serve as an effective starting point for discussing how curriculum leadership supports the effectiveness of teacher education programmes at GXNU.

Furthermore, it is not enough for this study to review the contextual information relevant to developing a holistic understanding. Instead, a conceptual framework must be established to contextualise the key factors into the study context and present the presumed relationships between them (Miles & Humerman, 1994).

3.10 Conceptual framework

This study focuses on GXNU to examine the role of curriculum leadership in developing pre-service teachers' ICT in education competencies. Hence, its conceptual framework should include the educational context of China and the background information of GXNU. According to the literature review, the following relevant areas should also be considered.

First, Lim (2002) proposed that the study of technologies in education must be conducted within the appropriate sociocultural context. To place the focus of this study in the context of the broader teacher education system, the layers of the administration system must be clarified, including the MOE, the Guangxi Provincial Department of Education and GXNU.

Second, as noted in the literature, curriculum leadership in the educational context is interrelated to form a curriculum management system (Robinson, 2007). The curriculum



leadership system at GXNU, which includes relevant curriculum leaders at the university, subordinate school and classroom levels, is necessary because it clarifies the power distribution and interactions of curriculum leadership.

Third, it is generally accepted in the literature that curriculum leadership is particularly relevant to supporting teacher education programmes (Robinson, Lloyd, & Rowe, 2008) and responsible for both programme maintenance and improvement (Wiles, 2009). Thus, it is also important to investigate the roles of curriculum leaders in programme planning, implementation and evaluation.

Based on the findings of previous literature reviews and the contextual background, Figure 3.4 provides the conceptual framework of this study, which specifies the focus and context of the study and the elements essential to investigating the interrelationship between curriculum leadership, teacher education programmes and pre-service teachers' ICT in education competencies. Contextualised in the three layers of the administration system, this framework reveals that curriculum leaders at the university, subordinate school and classroom levels constitute the curriculum leadership system at GXNU. They play interactive roles in programme planning, implementation and evaluation to develop pre-service teachers' ICT in education competencies.



The conceptual framework may be appropriate for bridging curriculum leadership with pre-service teachers' ICT in education competencies and guiding the following research processes.



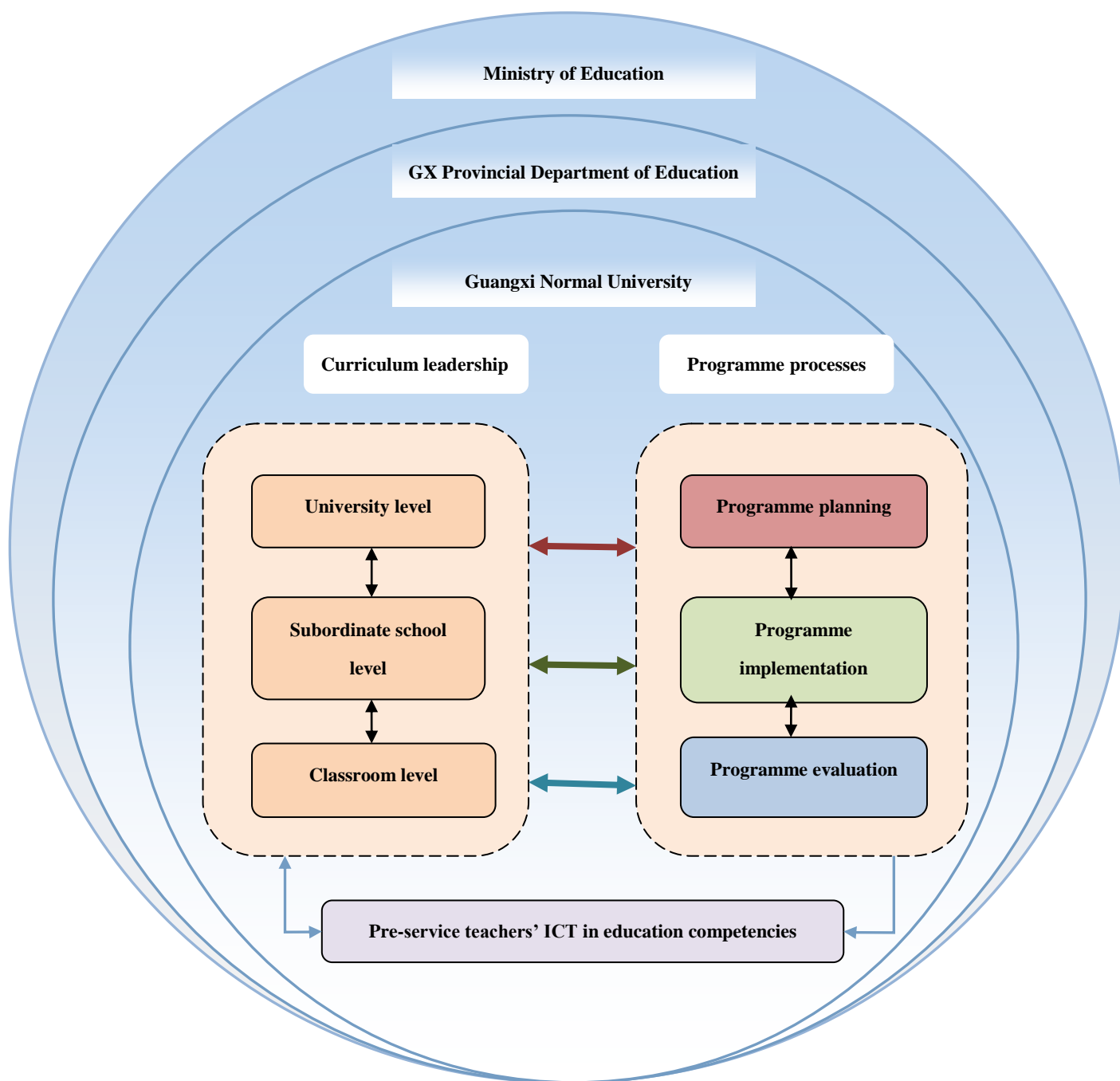


Figure 3.4: Conceptual framework of the study

3.11 Summary

This chapter explores the contextual background of this study. It considers the Confucian-influenced effects and transformation trends related to the administration of Chinese higher education, curriculum structures and ICT preparation in teacher education programmes; the three layers of the administration and curriculum leadership systems at GXNU; and how curriculum leadership supports teacher education programmes. These key factors are indispensable in forming the conceptual framework of this study. The framework provides a general guide to the tools and parameters required for data collection and analysis. The following chapter elaborates the study design and methods.



CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

This chapter describes the research design and methodology used in this study. Along with its driving questions and conceptual framework, the purpose of this study guided the impetus of its design and methodological considerations. This chapter begins by introducing the study's mixed-methods design, which incorporated both quantitative and qualitative data collection methods, followed by the case study research strategy and the main sources of evidence. It then explains how the data were collected and analysed. The final section deals with the study's ethical considerations and issues of trustworthiness.

4.2 Methodological considerations

The study intended to derive or build major categories and propositions based on the data collected to determine the role of curriculum leadership in developing pre-service teachers' ICT in education competencies. Although it did not aim to test theory, any categories,



patterns or relationships generated from the research results are expected to establish a framework for further theory building. Two commonly used methodological approaches, i.e., qualitative and quantitative research, are presented as follows to justify the approach adopted in this study.

Rubin (1983) defined the qualitative approach as follows:

[It is an] excellent way of gaining an overview of complicated and poorly understood social phenomena...and through qualitative research, a social scientist can uncover many layers of truth, or different perceptions of a situation by different individuals or group members. In learning about each layer of truth, the researcher becomes more sensitised to the situation, as well as gains a better understanding of complex social processes (p. 348).

Qualitative research focuses on the quality or nature of human experience and what it means to individuals. It also seeks to understand and explain beliefs and behaviour according to the contexts in which they occur, or to understand the full multidimensional, dynamic picture of the subject under study (Draper, 2004). In general, the qualitative approach is more likely to start from data that shape the researcher's theory (Cheng, 1995). The strength of the



qualitative approach lies in its richness, holism and strong potential for revealing complexity (Miles & Huberman, 1994). The key challenges facing the qualitative approach are instrument development and data collection, interpretation and analysis (Denzin & Lincoln, 2000).

Creswell (1994) defined the quantitative approach to the inquiry process as follows:

[It is] based on testing a theory composed of variables, measured with numbers, and analysed with statistical procedures in order to determine whether the predictive generalisations of the theory hold true (p. 2).

Quantitative researchers collect facts and study the relationship of one set of facts to another. They use ‘numerical data and, typically...structured and predetermined research questions, conceptual frameworks and designs’ (Punch, 2005, p. 28). The strength of the quantitative approach is that it is theoretically based and describes factors using scientific techniques that are likely to produce quantifiable, reliable data and generalised conclusions (Creswell, 2003). However, Patton (1990) argued that the quantitative approach could not capture feelings, thoughts or reasoning. The complexity of reasoning can hardly be statistically manipulated. Denzin and Lincoln (2000) also noted that it was a particularly weak method for seeking an



in-depth understanding of the reasons for or results of a problem.

Each approach has its strengths and weaknesses and is particularly suitable for a particular context (Bell, 2010). Bryman (1988) observed the following:

Quantitative research can be a more efficient way of forging connections and gleaning underlying patterns while qualitative evidence can allow the processes which link the variables identified to be revealed, and establish the structural features of social life in many instances (p. 142).

Therefore, the choice of research method largely depends on the nature of the study and the research questions that drive it (Bryman, 2006).

4.3 Mixed-methods research design

According to Leedy and Ormrod (2001), quantitative research is used to identify the relationships between variables with the purpose of explaining, predicting and controlling circumstances, and qualitative research is typically used to explore the complex nature of circumstances. A quantitative design seeks to explain, predict, confirm and validate, whereas



a qualitative design strives to describe, explain, explore and interpret. According to Johnson and Onwuegbuzie (2004), combining the two into a mixed-methods design constitutes ‘the class of research where the researcher mixes or combines both quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study’ (p. 17) to gain a better understanding of research questions or problems.

According to Creswell, Goodchild and Turner (1996), the integration of quantitative and qualitative research serves three purposes. First, this type of design uses specific characteristics of both quantitative and qualitative approaches to research and serves as a complementary strategy to balance the strengths and weaknesses inherent in each methodology. Second, it creates a level of flexibility that allows for the adaptation of diverse methods to investigate a particular issue and provides a triangulation of data sources, which is an important benefit. Third, from a philosophical perspective, mixed-methods research adopts deductive and inductive methods to obtain quantitative and qualitative data and attempts to corroborate and arrive at complementary findings. One of the important benefits of a mixed-methods design is that it decreases inappropriate certainty (Robson, 1993).

Rather than testing theory, this study sought to explore the roles of curriculum leadership in developing pre-service teachers’ ICT in education competencies in teacher education



programmes. Therefore, the mixed-methods model was appropriate for this study for two major reasons.

First, as this study was exploratory in nature, the mixed-methods research design allowed for the use of both quantitative and qualitative methods within a single stage or across various stages of the research process. The development of ICT in education competencies within a teacher education programme is process oriented. The roles of curriculum leadership in teacher education programmes are complex and comprise a multitude of elements and factors. The quantitative approach can hardly be applied to statistically ‘gain an overview of complicated social process’ (Rubin, 1983, p. 348). Rather, it is preferable to adopt a qualitative method to ‘uncover the layers of truths from different perceptions of a situation by different individuals or group members’ (p. 343) and generate an in-depth understanding of the problem.

Second, the mixed-methods model creates a level of flexibility that allows for the adaptation of different methods (Creswell, Goodchild, & Turner, 1996) and triangulates the research results to analyse the interrelationships between pre-service teachers’ ICT in education competencies, teacher education programmes and the roles of curriculum leadership.

Therefore, in view of the nature and purpose of this study, the mixed-methods research



design was considered suitable for exploring and capturing a deeper understanding of the roles of curriculum leadership in developing pre-service teachers' ICT in education competencies.

Both quantitative and qualitative methods have important components that were useful for this study, and combining the two methods proved to be significantly important. The researcher preferred to adopt a quantitative method to find commonalities and differences in the data obtained in relation to pre-service teachers' ICT in education competencies in the sampled teacher education programme, and a qualitative method to examine how the programme supported the development of these competencies and to clarify the inter-related facets of the roles of curriculum leadership, especially during the programme processes.

4.4 Case study as a research strategy

In essence, a case study attempts to illuminate a decision or a set of decisions, including why the decisions were made, how they were implemented and the results (Schramm, 1971). Yin (1994) observed the following:

[T]he case study approach, as a comprehensive research strategy, allows an



investigation to retain the holistic and meaningful characteristics of real-life events...as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis (p. 14).

A research strategy should be determined based on the type of research questions asked. In the current study, the major research question about the role of curriculum leadership in supporting teacher education programmes to develop pre-service teachers' ICT in education competencies was divided into three sub-questions to ensure a deeper understanding of the issue. First, how do teacher education programmes support the development of pre-service teachers' ICT in education competencies? Second, how does curriculum leadership shape teacher education programmes, and how do those programmes shape it in turn? Third, what are the interactions within the curriculum leadership system? In general, the 'what' question provided a justifiable rationale for conducting an exploratory study, and the 'how' questions were more exploratory and likely to favour the use of case studies. The exploration of such 'what' and 'how' questions in this study required an inquiry process to understand the interrelationship between pre-service teachers' ICT in education competencies, teacher education programmes and curriculum leadership. This kind of exploratory process typically deals with operational links, draws on a wider array of information and must be traced and

contextualised systematically (Yin, 2003).

The case study approach is often chosen as a research strategy because it permits the use of various information sources and offers an ‘in-depth study of instances of a phenomenon in its natural context and from the perspective of the participants involved in the phenomenon’ (Gall et al., 1996, p. 545). In addressing the purposes of this study, the case study strategy allowed for a detailed examination of pre-service teachers’ ICT in education competencies and teacher education programmes, especially the major ICT used in education courses and the supporting curriculum leadership system and its interrelationships, to portray the complex interactions of events, relationships and other factors (Bogdan & Biklen, 1998). The case study approach can be particularly appropriate for individual researchers (Bell, 2010) because it provides an opportunity to study the problems associated with decisions, programmes, the implementation process and organisational change (Yin, 1994).

Therefore, the case study approach was the most appropriate strategy for obtaining the rich data and evidence necessary to identify the various interactive processes involved in developing pre-service teachers’ ICT in education competencies. It was also used to uncover the complex relationships between curriculum leaders and how they affected the processes of teacher education programmes and ultimately influenced the development of pre-service



teachers' ICT in education competencies.

4.5 Multiple-case-study design

This study implemented a multiple-case-study design for the following reasons.

First, it aimed to determine how the roles of curriculum leadership from different levels collectively affected teacher education programmes in developing pre-service teachers' TPACK perceptions. These relationships are typically interactive and complex, and looking at only one case was unlikely to provide evidence sufficient for arriving at meaningful conclusions. In this case, the multiple-case-study design offered more compelling evidence and lent itself to generalisation far more readily than a single case study.

Second, the multiple-case-study design facilitated cross-case analysis and permitted deeper investigation by allowing cases to be compared and contrasted, revealing general patterns and specific differences (Miles & Huberman, 1994). It also allowed multiple sources of data to be highly complementary (Yin, 2003). These different sources of data were integrated to establish case profiles and present information systematically for the purposes of combining and comparing (Miles & Huberman, 1994).



Third, as Yin (1994) noted, the multiple-case-study design was helpful for establishing a theoretical framework and supporting deeper analysis of the aforementioned interrelationships for further theory building. It permitted an intensive and in-depth inquiry into the roles of curriculum leaders in developing pre-service teachers' TPACK perceptions via teacher education programmes.

4.6 Research sample

4.6.1 Selection of site

As this study focused on pre-service teachers' ICT in education competencies, the selected site had to be a normal university that offered pre-service teacher education. GXNU was selected because it was the largest teacher education institution in Guangxi province in south-western China. This study did not consider school size, student population, location or other demographic characteristics deemed of little consequence. GXNU was a typical representative of the 89 mid-sized provincial normal universities in China. Its use in this study constituted an example of critical case sampling that permitted 'logical generalisations and maximum application of information to other cases' (Patton, 1990, p. 243). It was



thought that using an educational system with such a significant influence would yield information that could be applied to a range of situations relevant to different teacher education contexts.

The researcher had more than 10 years of teaching experience at GXNU and was therefore more likely to ‘have the firsthand acquaintance with the sphere of social life she proposes to study’ (Blumer, 1969, p. 35). This position made it easier for the researcher to establish a rapport with the participants and establish mutual trust and confidence, making the participants more likely to express their deep thoughts and feelings in person. These advantages seemed to facilitate the research efforts.

4.6.2 Permission and access to the site

The TAO at GXNU was responsible for supervising and coordinating the teaching and learning affairs at the university. The Vice-Director of the TAO was initially approached via an e-mail that identified and explained the research aims and nature of the study, its timespan and the targeted participants. After receiving formal approval, the researcher sent inquiry e-mails to the Vice-Deans (Academic) from 11 subject-based subordinate schools at GXNU.

Two weeks later, the researcher received approval e-mails from five schools, including the



Schools of Chemistry; Education; Mathematics and Statistics; Chinese Studies; and History and Tourism.

4.6.3 Defining a case

The study's research purposes guided the case selection process and criteria of the participant groups. Consistent with the research purposes, three case studies were conducted. Each case consisted of three interactive components: curriculum leadership, teacher education programmes and pre-service teachers' TPACK perceptions. Comparing the individual cases was more conducive to revealing their similarities and differences in terms of the teacher education programmes and curriculum leaders' practices. It helped to determine the roles of the curriculum leaders involved in facilitating the development of pre-service teachers' TPACK perceptions via teacher education programmes. Given that each teacher education programme was contextualised in each subordinate school, it was important to identify three sampled subordinate schools for subsequent case studies.

The teacher education programmes served as the units of analysis. Conducting analyses at the teacher education programme level allowed the researcher to determine the pre-service teachers' TPACK perceptions by programme and to investigate the curriculum leaders'



practices in the programmes. To obtain a holistic picture of each case and facilitate cross-case analyses, teacher education programmes were considered the most suitable units of analysis.

4.6.4 Sampling strategy

4.6.4.1 Purposive sampling

Purposive sampling was adopted as the major method in this study because the researcher aimed ‘to discover, understand, and gain insight and therefore...select a sample from which the most can be learned’ (Merriam, 2001, p. 61). In the course of this purposive sampling, the researcher determined the specific characteristics of the targeted subordinate schools and then located individual schools with those particular characteristics (Johnson & Christensen, 2004). Within the five targeted schools, consideration was given to the study discipline, curriculum leadership structure, ICT curriculum structure and population of pre-service teachers. This preliminary work helped the researcher to identify suitable potential candidates for the study.

4.6.4.2 Maximum variation sampling

The strategy of maximum variation sampling was also adopted at this stage because it provided possibilities for a broad range of cases to be selected ‘so that all types of cases along one or more dimensions are included in the research’ (Johnson & Christensen, 2004, p. 220). The three schools selected from the five targeted schools had to offer the greatest possibility for the researcher to ensure the representation and diversity of the teacher education programmes at GXNU. The subordinate schools were selected according to the ICT curriculum structures of their teacher education programmes.

After repeated comparisons, the three subordinate schools were chosen because they generated broad enough profiles given the variation in their specific attributes and backgrounds. These included the School of Mathematics and Statistics, which offered a Mathematics programme; the School of Chemistry, which offered a Chemistry programme; and the School of History and Tourism, which offered a History programme. Graduates from these programmes were targeted for employment by secondary schools to teach a single subject. The sampling of individuals or settings may have consequences for the internal validity of research findings (Tashakkori & Teddlie, 1998). There were several reasons for choosing such a sampling arrangement. First, the selected subordinate schools had to include both Science and Liberal Arts study disciplines. Second, the ICT curriculum structures in the selected programmes had to share similarities yet exhibit their own characteristics and were



more likely to be representative of typical structures at GXNU. Third, the targeted populations of pre-service teachers in the three selected subordinate schools represented the largest, mid-range and lowest populations at GXNU, respectively. This decision was based on the belief that the three selected cases could yield richer data ‘to maximise information, not facilitate generalisation’ (Lincoln & Guba, 1985, p. 202).

4.7 Data collection and analysis

4.7.1 Linking qualitative and quantitative data

This study adopted Miles and Huberman’s (1994) design for linking qualitative and quantitative data (see Figure 4.1). This design alternates the two kinds of data collection, including exploratory fieldwork and quantitative instrumentation. The quantitative findings can be further developed and tested with the next round of qualitative work.



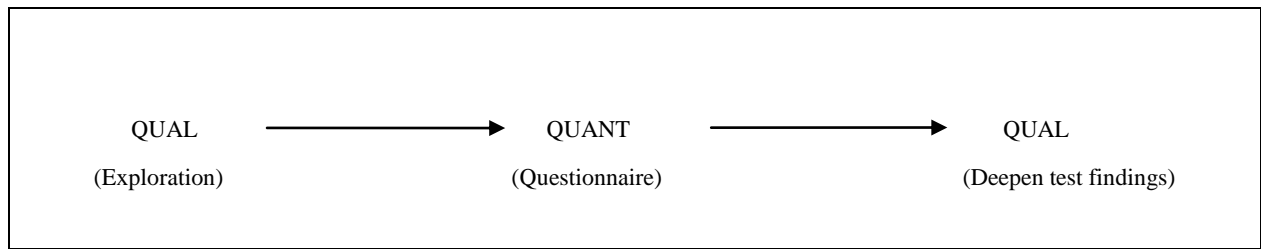


Figure 4.1: Illustrative design for linking qualitative and quantitative data (Miles & Huberman, 1994).

4.7.2 Combining methods

An important element of case study research is the use of multiple sources of evidence in the data collection process (Stake, 1995; Yin, 1994). In this study, the data collection process was based on the belief that the results of a former research method should inform the implementation of subsequent methods, and that those of a later method should provide detailed explanations for the former methods. Consequently, the results from each research method interacted to address the research questions. Ivankova, Creswell and Stick (2006) argued that a ‘graphical representation of the mixed-methods procedures helps a researcher visualise the sequence of the data collection, the priority of either method, and the connecting and mixing points of the two approaches within a study’ (pp. 14-15). In the current study, the researcher applied Ivankova, Creswell and Stick’s (2006) model to guide the mixed-methods design (see Table 4.1).

Table 4.1: The model for guiding data collection and analysis (Ivankova, Creswell, & Stick, 2006).

	Procedure	Product
Qualitative data collection	• Documentation	Text data
Qualitative data analysis	• Coding	
<i>Connect Qual. & Quant. Phases:</i> inform the subsequent phases		
Quantitative data collection	• Survey	Numeric data
Quantitative data analysis	• Descriptive statistics	
<i>Connect Quant. & Qual. Phases:</i> inform the qualitative data collection		
Qualitative data collection	• Interviews	• Initial categories
Qualitative data analysis	• Coding	• Core concepts
	• Constant comparative analysis	• Interrelationships
<i>Integrate Quant. & Qual. Phases</i>		

After the three teacher education programmes had been sampled, documentation was collected and analysis was conducted as early as April 2013 to provide an account of each programme and to equip the researcher with the contextual background required by the subsequent data collection process. The subsequent survey of pre-service teachers aimed to compare their perceptions of TPACK. Focus group interviews were conducted with the aim to collect richer data related to the teachers' ICT learning experiences, further explain the statistics described in the survey results and gain insights into the roles of curriculum

leadership. Furthermore, it was thought that the results from the pre-service teachers' surveys and focus group interviews would be useful in adjusting the interview questions for the curriculum leaders, whose standpoints would provide a practical interpretation of the relevant documentation.

Another consideration involved in this arrangement was the timeline of the participating pre-service teachers and curriculum leaders. As the fourth-year cohort of pre-service teachers were busy with graduation and unlikely to participate in surveys or interviews, this study focused on the third-year cohort of pre-service teachers, who had already completed all of their required courses except their practicums. They were still located on campus and easy to organise for the survey and focus group interviews. To comply with the specific timeline of the third-year pre-service teachers, the survey and focus group interviews were conducted before practicums in approximately May and June. As it was unlikely that the curriculum leaders would be available for interviews over the summer vacation from July to August, the interviews had to be conducted after the new semester began in September 2013. All of the raw data in this study, such as the transcripts, documents and coding notes, were dated and stored systematically to facilitate later retrieval.



Data collection and analysis were conducted simultaneously. Data analysis within and between the methods was conducted along with the data collection and processing. The researcher collected data and then conducted preliminary analysis, which led to a refocusing of the questions for the next round of data collection. The results were then analysed and the process continued until no new information was gathered. The data were then deemed to be ‘saturated’ (Dimmock & Lam, 2012). In the qualitative part, there was a need to continuously focus and refocus the research questions and address validity threats. It was expected that performing the data collection and processing simultaneously would facilitate validation and enhance the trustworthiness of the research.

4.7.2.1 Documentation

As ‘the object of explicit data collection plans’ (Yin, 2003, p. 87), documentary information may be primarily used as a data collection strategy for case studies. This type of evidence can take many forms, such as regulations, policy, official statistics and internal reports, and provide public narration and insight into how organisations and institutions work and which values and practices guide the decision-making process (Fitzgerald, 2012).



The researcher collected and examined a range of documents to gain a comprehensive understanding of the teacher education programme context and curriculum design. The collected documents were assembled together and divided into three sections (see Table 4.2). The first section included the national- and university-level documents. The Education Technology Competency Standards for Primary and Secondary Teachers (Trial) were reviewed to clarify the ICT in education competencies required for pre-service teachers in China. The ICT policies and regulations included information about how the university intended to develop teacher educators' capacity to model the use of ICT, develop pre-service teachers' ICT in education competencies and formulate development strategies for ICT infrastructure management. The second section included the subordinate-school-level documents. The school's handbook and official website provided background information that clarified its management philosophy; teacher education programmes; pre-service teachers; and development and evolution. They were reviewed as supplementary evidence and crosschecked with the curriculum leaders' interviews. The third section included the programme- and course-level documents. The schemes of the teacher education programmes were reviewed to clarify the contents and objectives of the programmes. The education course syllabi explained how the ICT-related courses collectively developed pre-service teachers' ICT in education competencies via weekly learning activities.



The documents were mostly downloaded from the official website or copied from original documents with the help of administrative offices at GXNU. All of the documents allowed the researcher to compare and contrast the ICT curriculum structures of the different teacher education programmes, add richness to the evidence, corroborate and augment any evidence obtained from other sources and triangulate the data (Yin, 2003).

Table 4.2: Data collection from documentation

Types	Sources and Contents
1) National and university level	<ul style="list-style-type: none"> • <i>National level:</i> Education Technology Competency Standards for Primary and Secondary Teachers (Trial) (2004) • <i>University level:</i> Relevant ICT policies and regulations
2) School level	<ul style="list-style-type: none"> • School handbook/website
3) Programme and course level	<ul style="list-style-type: none"> • Programme website • Overview/scheme of programme • Education course syllabi detailing use of ICT

Documentation analysis

A range of documents was put together and reviewed throughout the entire data collection and analysis process. Collecting, collating and analysing data in documentary research are iterative processes that require checking, rechecking and refining key themes, concepts or ideas (Fitzgerald, 2012). When an uncertainty was found, the researcher had to refer back to the relevant documents to double-check or confirm the data. The researcher generally undertook the following stages to analyse the collected documents. First, documents were classified into three types: ICT policy information, subordinate school background information and scheme or syllabus information. Second, coding was used to extract the themes from the documents. During this stage, the researcher listed the analytical emphasis for each document, including the key ideas, themes and issues, and noted which questions were answered and left unanswered. Third, the evidence was interpreted to explain what had occurred and why. The researcher tried to analyse these documents in a systematic, critical and informed way to triangulate the information provided by the interviews and surveys (Fitzgerald, 2012).

4.7.2.2 Survey

A survey was conducted in the first phase to represent the quantitative aspect of this study.

The quantitative phase of data collection intended to compare the levels of ICT in the



education competencies of pre-service teachers from three sampled subordinate schools and to gain initial insights into the teacher education programmes at each school.

A survey research design is characterised by the use of a standard questionnaire form (Muijs, 2012). The researcher adopted the survey (English and Chinese versions) developed by Chai et al. (2013) to identify a suitable instrument for eliciting the selected pre-service teachers' perceptions of TPACK (see Appendix 2). This survey was designed to complement the TPACK framework and was created for general educational technology courses. The TPACK constructs were divided into the following seven knowledge factors.

Factor 1 - Content knowledge (CK)

Factor 2 - Knowledge about teaching methods (PK)

Factor 3 - Knowledge about teaching my teaching subjects (PCK)

Factor 4 - Knowledge about technology (TK)

Factor 5 - Knowledge about using technology to teach (TPK)

Factor 6 - Knowledge about the technology used in my teaching subject (TCK)

Factor 7 - ICT integration knowledge (TPCK)



The TPACK factor items in the survey conducted by Chai et al. (2013) were originally adopted from the Survey of Pre-service Teachers' Knowledge of Teaching and Technology conducted by Schmidt et al. (2009). Chai et al. (2013) translated the survey into Chinese and validated it using a group of 550 pre-service teachers from China, Hong Kong, Singapore and Taiwan. The data were factor analysed via confirmatory factor analysis (CFA) and the survey items reportedly showed good internal consistency. All of the factors had reliability coefficients greater than 0.8. The respective coefficients were CK (0.88), PCK (0.92), PK (0.90), TPCK (0.92), TCK (0.90), TPK (0.91) and TK (0.92). All of the items were located on their respective factors with factor loadings greater than 0.8. CFA indicated that the survey instrument was valid and reliable for measuring all seven of the knowledge factors related to pre-service teachers' TPACK perceptions. As Chai et al. (2013) identified the seven knowledge factors of the TPACK framework, the survey was deemed valid and reliable for adoption in this study.

The survey consisted of three sections. The first section contained demographic information including gender, age, major, teaching experience above six months and completed educational technology courses. The second section included 50 items focusing on the 7-factor TPACK model. The participants were asked to indicate how they self-assessed their perceptions of TPACK and confidence in applying ICT to their learning and teaching



practices according to the following seven scale items: 1='Strongly Disagree', 2='Disagree', 3='Slightly Disagree', 4='Neutral', 5='Slightly Agree', 6='Agree' and 7='Strongly Agree'. The final section was open-ended and required the participants to share their experiences in applying ICT to their teaching and learning practices.

According to Fink and Kosecoff (1998), relatively larger samples must be used to decrease sampling errors. The survey involved all of the pre-service teachers from the third-year cohort of the three teacher education programmes. It was printed and distributed to the pre-service teachers, who were required to complete it within 40 minutes. The participants were given instructions on completing the survey and important items were explained to them. The valid data gathered in this process (see Table 4.3) were presented with statistical tests before the focus group interviews to provide general information about the participants' TPACK perceptions. Thus, the data were analysed first. The themes that emerged from the survey provided a basis for collated description or comparison (Johnson, 1994) and fine-tuned the discussion questions in the follow-up qualitative part of the study.



Table 4.3: Data collection from survey

Survey: International Survey of Technology, Pedagogy and Content Knowledge of Pre-service Teachers (2012, English and Chinese version) (Chai et al., 2013)				
Participants: Third-year cohort of pre-service teachers in the three programmes.				
		Mathematics programme	Chemistry programme	History programme
Total		57	112	42
Valid		53	82	39
Timeline	Data collection	May 2013	May 2013	June 2013
	Data analysis	SPSS 17.0		
		July-September 2013		

Analysis of the survey data

The valid quantitative data obtained from the surveys were subjected to statistical analysis.

As the statistical analysis provided insights into the subsequent qualitative data analysis, the survey data had to be analysed first. According to Johnson and Christensen (2004), researchers use descriptive statistics in an attempt to ‘convey the essential characteristics of the data by arranging the data into a more interpretable form’ (p. 434). The survey data were analysed using SPSS 17.0 for both descriptive and inferential purposes. Descriptive analysis provided information about the response distributions for each question covered by the

survey. Inferential analysis investigated how the survey variables were related to one another and drew conclusions that could be applied to the population beyond the sample.

4.7.2.3 Focus group interviews with pre-service teachers

Interviews are a suitable method for a sole researcher to gain relatively rapid insight into a particular problem or issue (Coleman, 1999). More importantly, interviews play a vital role in collecting raw data, analysing words, exploring facts and relationships and representing detailed views of informants (Creswell, 1998). Interviews can be conducted in various forms, such as one-to-one or in focus groups and either formally or informally. There are three different interview formats: structured, semi-structured and unstructured. According to Fontana and Frey (1994), a structured interview is a fixed format interview that allows little flexibility in the way questions are asked or answered and can also limit the information provided by the interviewee. A semi-structured interview is based on a list of questions. In this case, the interviewer can maintain a reasonable amount of control over the interview, and the interviewee has a measure of freedom in answering the questions. In unstructured interviews, the interviewer does not ask a set of questions in a predetermined order. This style is conversational and information is gained through free-flowing discussion. Two types of interviews were used as the major means of qualitative data collection in this study: focus

group and formal interviews. The pre-service teachers participated in focus group interviews and the results are discussed as follows. The curriculum leaders participated in formal interviews and the results are presented later.

Focus group interviews conducted under proper guidance allow group members to ‘describe the rich details of complex experience and the reasoning behind their actions, beliefs, perceptions and attitudes’ (Carey, 1994, p. 226). In the current study, focus group interviews facilitated group discussion in which the researcher asked minimal open-ended questions that required the group members’ participation. As the focus group interviews were conducted after the survey was completed, the survey served as the basis of discussion during the interviews. The researcher tried to find out how the participants responded to the survey; what other data they would add to the survey results; and what kinds of relationships, if any, the participants saw between their ICT in education competencies, teacher education programmes and curriculum leadership. The focus group interviews served the following purposes.

- 1) They allowed for in-depth analysis of the data obtained from the survey.



- 2) They allowed the pre-service teachers to talk about their perceptions, learning experiences in applying ICT to their teaching and learning practices and which ICT-related course interested them most and why.
- 3) They revealed how the pre-service teachers believed the curriculum leaders behaved and interacted in the ICT learning process.

To complement the surveys, four pre-service teachers who had completed the questionnaire were conveniently selected from each sampled teacher education programme. Twelve pre-service teachers were organised into three gender-balanced focus groups. Each group underwent a 30-minute interview session. The selection of pre-service teachers required consideration of the teachers' genders, majors, native places and perceptions of TPACK (taken from the survey). The topics of the focus group interviews were similar to those of the survey and tailored to further clarify the participants' attitudes, perceptions and knowledge of ICT in their teaching and learning practices. The interviews were conducted in vacant classrooms on the campus to avoid background noise. The pre-service teachers were briefed on the purpose of the interviews and how they could help with the research objectives. The interviews were audiotaped and notes were taken to keep track of any instances that might have been important for the study. The researcher used the guided approach to start each

interview topic (Gall, Gall, & Borg, 2007) and encouraged everyone to participate to prevent any single person from dominating the session.

Although the interviews were semi-structured, the pre-service teachers soon began to talk freely about their opinions, allowing for richer data to be obtained. The interviews were structurally based on the survey, which had similar objectives. Some of the topics included the self-assessment of ICT in education competencies, learning experiences involved in applying ICT to the education curricula in relation to the TPACK framework, roles of lecturers and curriculum structures of the teacher education programmes. These topics were essentially based on the study's conceptual framework and research questions. The findings seemed to be consistent throughout and provided valuable data for later analysis. The audiotaped interviews were transcribed and analysis of the pre-service teachers' interview sessions was carefully triangulated with the curriculum leaders' interviews. This helped to further clarify the perceptions and objectives of the development of pre-service teachers' ICT in education competencies in addition to the effectiveness of the current teacher education programmes. All of the focus group interviews involving the targeted pre-service teachers were conducted in July before the teachers graduated.

4.7.2.4 Interviews with curriculum leaders



The data produced from the interviews with curriculum leaders were expected to be comprehensive and in-depth, as these interviews were the only way to obtain information about curriculum leadership. Referring back to the research purposes and questions, the researcher conducted face-to-face semi-structured interviews as the chief means of collecting curriculum leadership data. The curriculum leaders were selected via purposive sampling. The selection criteria were based on the reviewed literature and the conceptual framework principle that curriculum leaders were more likely to work as a team. As the curriculum leadership system had been established at the university, subordinate school and classroom levels, the selection of interviewed curriculum leaders had to fully account for the continuity of the power distribution within the system. The following attributes of the selected interviewees were also included: their individual ICT-related teaching or work experience, roles in shaping the teacher education programmes and effects on developing ICT in education curricula. Table 4.4 summarises the curriculum leaders' involvement at the university, subordinate school and classroom levels.

- (1) University level: Vice-President (Academic) and Vice-Director (Academic) of the TAO.

(2) Subordinate school level: Vice-Deans (Academic) from the School of Computer and Science, School of Education and three sampled subordinate schools.

(3) Classroom level: TK, TPK and TPCK course coordinators and lecturers.

Table 4.4: Data collection from curriculum leaders' interviews

Interviewees		Purposes
University level	Vice-President (Academic)	To determine the curriculum leadership distribution, the requirements for pre-service teachers' ICT in education competencies from the policy and administration perspectives, what had been done and was expected to be done at the university level.
	Vice-Director (Academic) of TAO	To determine how programmes were planned and implemented at the university and the flexibility of the curriculum design for subordinate schools.
Subordinate school level	Vice-Deans (Academic) from the School of Computer and Science, School of Education and three sampled subordinate schools	To determine the working responsibilities, actions, constraints and supports provided in developing pre-service teachers' ICT in education competencies in addition to what had been done and was expected to be done at the school level.
Classroom level	TK, TPK and TPCK course coordinators and lecturers	To determine their expectations and experiences with applying ICT to education courses and their perspectives of curriculum leadership and its effects.

The interviews with curriculum leaders were scheduled from September 2013 to March 2014 during the data collection period. The interviewees were roughly divided into two categories according to their specific working responsibilities, i.e., administrators and teaching staff

members. The researcher prepared the lists of topics and questions as guides to facilitate dialogue with the interviewees (see Appendix 3). The interview questions were designed to focus on the interviewees' work responsibilities, the ICT areas in their teacher education programmes, their comments on the survey results and their programmatic or curricular challenges. During the interviews, the researcher followed the guides while exploring any area of interest the participants mentioned and attempting to 'exert minimal topic control' (Chenitz & Swanson, 1986, p. 69). Probes were adopted to encourage the interviewees to describe their perceptions and experiences in detail. During the interviews with curriculum leaders, the researcher particularly discussed their major roles, actions and constraints and the support they were provided. During the interviews with course tutors, the researcher discussed their stance on the use of ICT in teaching and learning practices and their experiences with leadership action and its effects. When the interviewees offered no new angles, views or perspectives on curriculum leadership, it was assumed that the saturation level had been reached and that adequate data had been collected to support the curriculum leadership study.

As both schools were located on the same campus, the interviews with the Vice-Dean and lecturers in the School of Mathematics and Statistics and School of Chemistry were conducted in September and November 2013, respectively. Analysis of the interview data



began shortly after these two rounds of interviews and continued concurrently with the on-going interviews (Dimmock & Lam, 2012). Based on the previous interviews, the researcher revised some of the questions asked during subsequent interviews conducted in the School of History and Tourism in March 2014. In particular, the researcher raised several new questions related to curriculum leaders' practices to extend the reach of the curriculum leadership study to encompass both theory and practice.

All of the interviews were scheduled by appointment and lasted 40-60 minutes. As most of the curriculum leaders were working on campus during the semester, all of the interviews were conducted at their offices with their consent and audiotaped. The tapes were transcribed to facilitate coding afterwards. Copies of the transcripts were sent back to the interviewees for checking so that they could make corrections via supplementary remarks during subsequent interviews if needed. Appendix 4 provides a transcription sample of the interview with the Vice-Dean (Academic) from the School of Chemistry.

Analysis of the interview data

In qualitative analysis, coding is a central process by which theories are built from data (Strauss & Corbin, 1990). Interview analysis in this study began with open coding, which



involved ‘the naming and categorising of phenomena through close examination of data’ (Strauss & Corbin, 1990, p. 62). The transcripts of the interviews were broken down into ‘discreet parts, closely examined, compared for similarities and differences’ (p. 62) and ‘[c]oncepts were located and named while related ones were grouped to form categories’ (p. 65). Coding notes were written about the identified categories and relevant concepts. Appendix 5 provides an example of how open coding was applied to the interview data. Axial coding, which is a process by which the data obtained in open coding are organised ‘in new ways by making connections between the category and its sub-categories’ (Strauss & Corbin, 1990, p. 97), was conducted following the open coding to identify themes. The researcher followed the two coding procedures carefully.

During the two coding procedures, the researcher also adopted the ‘constant comparative method’ (Glaser & Strauss, 1967), which involved two general processes:

(1) unitising, or breaking the text into units of information what will serve as the basis for defining categories, and (2) categorising, or bringing together into provisional categories those units that relate to the same content, devising rules that describe category properties, and rendering each category set internally consistent and the entire set mutually exclusive (Lincoln & Guba, 1985, pp. 347-351).



In this study, analysis was conducted after each interview and used to inform the subsequent interview and so on. This implies that the formal analysis was almost complete by the end of the data collection process. The interview and analysis sequence is illustrated as follows:

Interview 1 → Analysis 1 → Interview 2 → → Interview 5 → Analysis 5

In the constant comparative analysis processes of comprehension and synthesis, the concepts and categories relevant to curriculum leadership were identified and investigated until saturation was reached and carefully woven into descriptions of the participants' experiences or practices. Chapter Five provides a full account of how the categories were generated, how the core concepts were developed and how the categories were interrelated following data collection and analysis.

4.8 Data analysis between methods

In terms of case studies, Yin (1994) suggested that the analytical strategy provides the researcher with a system for setting data analysis priorities. Bogdan and Biklen (2007) further explained that the strategies used to analyse data relied on the data collection methods used.



They defined data analysis as a process of ‘working with data, organising them, breaking them into manageable units, coding them, synthesising them, and searching for patterns’ (p. 159).

Two types of data were obtained in this study: qualitative and quantitative. The quantitative data were obtained via survey to provide an initial understanding of the pre-service teachers’ perceptions of TPACK, which reflected their ICT in education competencies. It was adequate to use descriptive statistics to present the survey results.

An inductive approach was adopted to analyse the qualitative data. Analysis was conducted after each interview and used to inform the subsequent interview and so on. The interview data were open and axial coded to identify the curriculum leadership categories and relationships.

Combining both quantitative and qualitative methods for triangulation is an important benefit of a mixed-methods model. The findings are triangulated from the data derived from documentary analysis, surveys and focus group and one-on-one interviews. In this study, data triangulation was constantly conducted to enhance the depth of the research findings. The findings were cross-examined and triangulated from the data derived from the documentation,

surveys and interviews. For instance, documentation analysis was crosschecked with the curriculum leader interviews, and the survey responses were triangulated with the curriculum leader and pre-service teacher interviews. These interviews also had to be crosschecked. The multiple data sources were highly complementary (Yin, 2003) and could be integrated to enhance the validity of the conclusion.

Example of data analysis between methods

The aim of the study guided the data analysis process. When the researcher adopted open coding to analyse the curriculum leader interview data, a number of broad categories emerged. The researcher identified and grouped the emerging categories. Some categories related to the personal traits of the curriculum leaders whereas others focused on the context in which they worked. Both personal and contextual factors appeared to affect the curriculum leaders' approaches and the consequences of such approaches. Similar categories were pulled together to form more abstract major categories. The quantitative data presented one major category related to pre-service teachers' perceived knowledge of TPACK. The qualitative data presented two major categories, with one relating to the effects of personal or contextual factors on the curriculum leaders and the other focusing on the teacher education programmes. The key themes related to the roles of curriculum leadership in developing pre-service



teachers' ICT in education competencies were identified from these three major categories (see Chapter Six).

4.9 Overview of the data collection and analysis phases

Although time constraints, administrative restrictions and social factors combined to restrain the extensive use of these data collection methods, the triangulation seemed to enhance the validity and reliability of the conclusion. Table 4.5 summarises the research methods, data sources and data collection and analysis processes adopted in this study. It compares and systematically displays the findings presented in Chapters Five and Six.



Table 4.5: Summary of the research methods, data sources and data collection and analysis processes

Research Method	Data Source	Data Collection Process	Data Analysis Process
Documentation	1. ICT policies and regulations 2. Background of subordinate schools 3. Scheme of programme and course outlines	1. Copies and downloaded from official websites <u>April 2013</u>	Coding and reviewing from a contextual background perspective <u>April-July 2013</u>
Pre-service teacher survey	Survey	1. 40-minute session during pre-service teachers' free period 2. Administrated by the researcher <u>April-June 2013</u>	Descriptive Statistics (SPSS) <u>July-September 2013</u>
Focus group interviews with pre-service teachers	Interview transcripts	1. One 30-minute session per group 2. Focus groups comprised four students 3. Conducted in the classroom at GXNU 4. Interviews were audiotaped <u>July 2013</u>	1. Coding of interview transcripts 2. Constant comparative analysis <u>July-October 2013</u>
Interviews with curriculum leaders	Interview transcripts	1. 1-hour semi-structured face-to face interviews 2. Conducted in their offices at appointed time 3. Interviews were audiotaped <u>September 2013-March 2014</u>	Coding of interview transcripts <u>September 2013-April 2014</u>

4.10 Ethical considerations

There are two guidelines that dominate ethical research involving human participants: the informed consent of participants and protection of participants from harm (Bogdan & Biklen, 2007). This study was sensitive to these ethical considerations, and the following actions were taken to ensure that they were met. First, the researcher received formal approval from the TAO at GXNU and adhered to all of its research guidelines. Second, before the data collection process began, each participant was provided with an informed consent form (see Appendix 1 for a sample) to sign. They were informed about the purpose and scope of the study, its procedures and the confidentiality and anonymity guaranteed to participants. Third, the researcher ensured that the participants' anonymity was maintained throughout the entire study. All of the data collected were kept confidential. The participants received the interview transcripts for correction during the on-going reflection on the responses to the data interpretation. The involved Vice-Deans (Academic), curriculum administrators and teaching staff members were informed that they could withdraw with no penalty at any time during the process and that their identities would remain confidential and undisclosed whether verbally or in publications based on the study.

4.11 Validity, reliability and trustworthiness

4.11.1 Validity and reliability of the survey

In the quantitative phase of a study, good and convincing research must meet validity and reliability standards (Bloomer & Vople, 2008). To measure the pre-service teachers' perceptions of TPACK, the researcher adopted the self-reported survey used by Chai et al. (2013), an instrument that had already been identified for its validity and reliability according to Cronbach's alpha measure of internal consistency. More importantly, in 2012, the instrument was validated among 550 Asian pre-service teachers from China, Hong Kong, Singapore and Taiwan (Chai et al., 2013). The quality and validity of the survey were maintained during the current study. Maintaining its reliability was straightforward. Asking all of the targeted pre-service teachers the same standardised questions made it possible to obtain a high level of reliability in the responses (Robson, 1993).

4.11.2 Trustworthiness of the case studies

Qualitative evaluation criteria usually focus on how well the researcher proves that descriptions and analysis represent the reality of the situation or people studied (Bloomer & Vople, 2008). In the qualitative part of the current study, the researcher adopted Lincoln and



Guba's (1985) four criteria, including credibility, transferability, dependability and conformability, to determine the study's trustworthiness.

Credibility

Credibility is the degree to which the interpretations of a study's findings are accurate and truthful. Credibility depends on the richness of the data gathered and the analytical capabilities of the researcher (Patton, 1990).

Transferability

Transferability is the degree to which a study's findings can be transferred to other contexts or settings. Although qualitative findings are not as transferable or generalisable as quantitative findings, Chenitz and Swanson (1986) insisted that 'the greater the range and the variation sought through theoretical sampling, the more certain that the data is generalisable to other members of the same class or units as the phenomena under study' (p. 13).

Dependability

Dependability is the degree to which the stability and trackability of data are ensured (Lincoln & Guba, 1985). A researcher must lead readers to follow the data collection and



analysis processes and thereby witness the consistency of the approaches taken to answering research questions.

Conformability

Conformability refers to the degree to which a researcher can demonstrate the neutrality of a study's interpretations (Lincoln & Guba, 1985) and thereby infer that 'the data and their interpretation are not figments of the researcher's imagination' (Mertens, 1998, p. 185).

The following strategies were considered to contribute to the trustworthiness of the research outcomes in this study. As a senior lecturer with more than 10 years of work experience at the university, the researcher's professional engagement with the participants, the well-designed timeline for pre-service teachers and the use of multiple data collection and interpretation methods established the credibility of the study. Multiple variation sampling was used to represent the diversity of the larger population and to satisfy the transferability requirements.

An assistant lecturer at GXNU assisted with organising the survey. The researcher revised the interview questions several times according to the feedback of several experts. The researcher reviewed the interview transcripts many times to check for errors and ensure their accuracy before sending them to the participants. Adjustments were made based on the participants' responses. The researcher importantly sought to enhance the robustness of the findings



through triangulation (Green et al., 1989). The convergence of multiple data sources and the simultaneous data collection/processing process might have decreased biases or errors and ensured the accuracy and validity of the research findings.

4.12 Summary

This chapter presents the methodological considerations, context, research instruments and data collection and analysis processes of the current study. The case study strategy was adopted to support quantitative and qualitative data analysis. This chapter also discusses the validity, reliability and trustworthiness of the research findings. The data analysis findings are elaborated in Chapters Five and Six.



CHAPTER FIVE

PROFILES OF THE THREE CASE STUDIES

5.1 Introduction

The purpose of this chapter is to present the findings of the three case studies to depict the interrelationship between the pre-service teachers' perceived knowledge of TPACK, teacher education programmes and curriculum leadership system. The data are presented to provide the (1) background information and (2) summary profiles of the three case studies. Considering that data presentation should contribute to the aims of a study, the researcher prioritised the presentation of the background data over the presentation of the data provided by the three individual case studies. Presenting the data in a general-to-specific fashion provides a more complete picture of the roles of curriculum leaders in developing pre-service teachers' perceptions of TPACK. Meanwhile, the three case study profiles are presented in a similar contextual sequence to facilitate comparison of the same datasets.

5.2 Pre-service teachers' perceived knowledge of TPACK



The survey was the main data source for exploring the pre-service teachers' perceived knowledge of TPACK (see Appendix 1 for the complete survey samples). As stated in Chapter Four, Cronbach's alpha justified the survey instrument used by Chai et al. (2013), indicating its validity and reliability for this study. The survey data were analysed using SPSS 17.0 to produce descriptive statistical results. This section presents the results.

5.2.1 Survey response rate

The survey was conducted in May for the Mathematics and Chemistry pre-service teachers and in June for the History pre-service teachers. The survey was distributed to the entire third-year cohort of 211 pre-service teachers in the 3 teacher education programmes. Of the 211 distributed surveys, 174 were returned completed and valid, 35 were returned incomplete and 2 were not returned. The overall response rate was 82.5%. Compared with the 20% average response rate for surveys with no incentive (Bourque & Fielder, 1995), the response rate was considered high. A sample size of this percentage allowed for some generalisations to be made about the responses related to the pre-service teachers' perceptions of TPACK at GXNU. Table 5.1 summarises the survey response rates for the sampled teacher education programmes.



Table 5.1: Survey response rate (N : valid questionnaires=174).

Category	Distributed	Returned and valid
Mathematics	57	53
Chemistry	112	82
History	42	39
Total	211	174
Survey response rate		82.5%

5.2.2 Results of pre-service teachers' perceived knowledge of TPACK

The 174 survey responses were valid and the data were subjected to statistical analyses. Table 5.2 presents the means and standard deviations of the samples. All of the factors had reliability coefficients greater than 0.8. The respective coefficients were CK (0.93), PCK (0.93), PK (0.90), TPCK (0.89), TCK (0.80), TPK (0.88) and TK (0.86). The ANOVA test results show that $F_{(2)}=12.07$, $p=0.000$, indicating that there were significant differences between the three groups of pre-service teachers' perceived knowledge of TPACK. The relatively higher mean scores of the Mathematics pre-service teachers indicate that they were more self-satisfied with their TPACK perceptions than the Chemistry and History pre-service teachers.

Based on the survey data, the mean scores of each factor of the Mathematics pre-service teachers' knowledge indicate that the participants rated their perceptions of the three factors

significantly higher than neutral (5): PK ($M=5.35$, $SD=.93$), TPCK ($M=5.20$, $SD=.88$) and TPK ($M=5.11$, $SD=.96$). This implies that the Mathematics pre-service teachers perceived a certain high degree of self-confidence in integrating ICT into their teaching and learning practices. Nevertheless, the Chemistry pre-service teachers had slightly higher TCK ($M=5.10$, $SD=.96$) and TK ($M=4.93$, $SD=.90$) scores than their counterparts from the Mathematics teacher education programme. However, the History pre-service teachers faced a different situation, as they seemed to be insufficiently confident in their perceived knowledge of TPACK, especially for the TK ($M=3.95$, $SD=.66$) and TPK ($M=3.95$, $SD=.85$) knowledge constructs.

Table 5.2: Pre-service teachers' perceived knowledge of TPACK (N : Mathematics=53, Chemistry=82, History=39).

Knowledge category	Mathematics pre-service teachers		Chemistry pre-service teachers		History pre-service teachers	
	Mean	SD	Mean	SD	Mean	SD
Factor 1 - CK	4.81	1.18	4.66	1.22	3.99	1.06
Factor 2 – PK	5.35	.93	4.97	.98	4.60	1.01
Factor 3 – PCK	4.98	1.04	4.77	.96	4.37	1.05
Factor 4 – TK	4.83	.95	4.93	.90	3.95	.66
Factor 5 – TPK	5.11	.96	4.93	1.04	3.95	.85
Factor 6 – TCK	4.92	.99	5.10	.96	4.53	1.11
Factor 7 - TPCK	5.20	.88	4.84	.97	4.20	1.10

Notes. CK: Content knowledge; PK: Knowledge about teaching methods; PCK: Knowledge about teaching my teaching subjects; TK: Knowledge about technology; TPK: Knowledge about using technology to teach; TCK: Knowledge about the technology used in my teaching



subject; TPCK: ICT integration knowledge.

5.2.3 Results of pre-service teachers' perceived knowledge of Factor 7-TPCK

The survey was designed to identify pre-service teachers' TPACK perceptions based on seven factors. In this study, the pre-service teachers' perceptions of CK, PK, PCK, TCK and TPK were crosschecked with relevant qualitative data (i.e., from documentation and interviews) as background references for on-going analysis. The researcher focused on the pre-service teachers' perceptions of TPCK for the following three reasons.

First, unlike the basic factors of TK, PK and CK or the interwoven parts of PCK, TCK and TPK, TPCK is the synthesised knowledge of technology, pedagogy and content. It represents neither current knowledge nor techniques that can be taught directly. Therefore, pre-service teachers must be nurtured to teach using ICT through the CK perspective. In this sense, the researcher was more interested in exploring the pre-service teachers' perceived understanding of TPCK, which was more likely to represent their ICT competency.

Second, in terms of the purpose of the study, understanding the interrelationship between the three categories of pre-service teachers' ICT in education competencies, teacher education programmes and curriculum leadership required the researcher to ascertain the TPCK



perceptions developed by the pre-service teachers from the current teacher education programmes, especially their perception of ICT in education core courses. This allowed the researcher to gain further insights into the roles of curriculum leadership in the teacher education programmes.

Third, a search of academic databases revealed that a number of researchers proposed the successful implementation of teacher education programmes or courses as a means of nurturing pre-service teachers' knowledge of TPACK. Furthermore, as in the case of ICT integration knowledge, the TPCK perceptions of pre-service teachers have become a viable and important approach to improving current teacher education (Lin, Tsai, Chai, & Lee, 2012). However, this exploratory study was unable to examine all seven factors of pre-service teachers' TPACK perceptions due to limited research time, funds and labour.

Therefore, the researcher focused on the TPCK perceptions of pre-service teachers, applying the Factor 7-TPCK results to the three groups of teachers. Descriptive statistical analyses of the Factor 7-TPCK for each group were provided as important sections in the profiles of each case study.

The Factor 7-ICT integration knowledge (TPCK) included the following six items.



TPCK1: I can formulate in-depth discussion topics about the CK and facilitate students' on-line collaboration using appropriate tools (e.g., Google Sites, discussion forums).

TPCK2: I can craft real-world problems related to the CK and represent them using computers to engage my students.

TPCK3: I can structure activities to help students construct different representations of the CK using appropriate ICT tools (e.g., Webspiration, mind maps, wikis).

TPCK4: I can create self-directed learning activities involving the CK using appropriate ICT tools (e.g., blogs, Web quest)

TPCK5: I can design inquiry activities to guide students to make sense of the CK using appropriate ICT tools (e.g., simulations, Web-based materials).

TPCK6: I can design lessons that appropriately integrate content, technology and pedagogy for student-centred learning.

The quantitative data obtained from the Factor 7-TPCK survey were processed via descriptive statistical analyses. As presented in Table 5.3, the ANOVA test results show that $F_{(2)}=6.06$, $p=0.003$, indicating that there were significant differences between the TPCK perceptions of the three groups of pre-service teachers. Post-hoc testing showed that there were significant differences between the TPCK perceptions of the Mathematics ($M=4.84$,



SD=.97) and History pre-service teachers ($M=4.49$, $SD=1.10$) and between the Chemistry ($M=5.20$, $SD=.88$) and History pre-service teachers ($M=4.49$, $SD=1.10$). However, the ANOVA tests found no significant difference between the TPCK perceptions of the Mathematics and Chemistry pre-service teachers.

Table 5.3: Pre-service teachers' perceived knowledge of Factor 7-TPCK ($N=174$).

Category	N	Mean	SD
Mathematics pre-service teachers	53	5.20	.88
Chemistry pre-service teachers	82	4.84	.97
History pre-service teachers	39	4.49	1.10
Total	174	4.87	1.00

5.3 Teacher education programmes

The sampled pre-service teachers were educated in teacher education programmes during the 2010 academic year at GXNU. These teacher education programmes were based on the National Undergraduate (Pre-service Teacher) Curriculum Scheme (2005) crafted by the MOE, the Scheme for Credit System in Higher Education Institutions of Guangxi (2004) and the Regulations for Full-time Undergraduate Student Status Management System at GXNU (2005). Furthermore, referring to the Annual National (Provincial) Education Working Conference in 2010, the guiding ideology of the teacher education programmes was also in

agreement with the Outline of China's National Plan for Medium and Long-term Education Reform and Development (2010-2020) and the Outline of Guangxi's Provincial Plan for Medium and Long-term Education Reform and Development (2010-2020). Therefore, in the 2010 academic year, the teacher education programmes fine-tuned their curriculum structures, credit distribution and practicum arrangements to better align the local educational resources with the requirements of the market economy.

Under the centralised controlled of the MOE, the teacher education programmes at GXNU were representative of many of those in mid-sized Chinese provincial normal universities. At GXNU, a teacher education programme was composed of four parts: (1) 40 credits of general education courses, which included college English, Computer, History, Politics and Physical Education; (2) 90 credits of specialised courses, which included fundamental studies, core courses, extended studies and practical studies related to the specialisation; (3) 30 credits of teacher education courses, which included educational psychology, educational research, extended studies of education and educational courses related to the specialisation; and (4) a practicum, which was mainly a final-year teaching practice at secondary schools (Semesters 7-8).

5.3.1 Curriculum structures of teacher education programmes



Due to the features and requirements of the different specialisations, the Chemistry, Mathematics and History programmes relied on different curriculum structures (see Table 5.4) to determine their course quantities, ratios of compulsory and optional courses and practicum timelines. Different from the relatively fixed curriculum structure of compulsory courses, the optional course arrangements in these three programmes were more diverse. Within the limitation of 165 credits, the Chemistry and History programmes provided more optional courses with fewer credits for each, and the Mathematics programme offered fewer optional courses with more credits for each. The Chemistry programme offered the most optional courses per teacher education session, and the History programme offered the most per specialisation education session.



Table 5.4: Curriculum structure of the teacher education programmes

Curriculum structure of the teacher education programme		Mathematics programme		Chemistry programme		History programme	
		Credits	Percent (%)	Credits	Percent (%)	Credits	Percent (%)
General education	Compulsory	31.5	19.1	31.5	19.1	30.0	18.8
	Optional	8.0	4.9	8.0	4.8	8.0	5.0
Specialisation Education	Compulsory	51.5	31.2	47.0	28.5	52.0	32.5
	Optional	25.0	15.2	20.0	12.1	27.0	16.9
Teacher education	Compulsory	11.0	6.7	11.0	6.7	13.0	8.1
	Optional	8.0	4.9	10.0	6.1	8.0	5.0
Practicum + thesis		30.0	18.2	37.5	22.7	27.0	13.8
Total		165	100	165	100	165	100
Total credits required							165

The schemes of the Mathematics, Chemistry and History programmes for the 2010 academic year demonstrated the requirements for pre-service teachers' professional capabilities after four years of full-time study at GXNU, respectively. In particular, all three of the schemes identified the necessity to strengthen the application of educational technologies:

To develop computer competencies in designing application programme, especially to apply educational technology in learning and teaching and research process...

(Excerpted from the 2010 Mathematics teacher education programme scheme, p. 13)

To apply modern educational technologies, especially multimedia, network educational technology, and related technological pedagogy... (Excerpted from the 2010 Chemistry teacher education programme scheme, p. 37)

To apply modern educational technologies, especially multimedia, network educational technology in order to adapt to the learning and teaching strategies development... (Excerpted from the 2010 History teacher education programme scheme, p. 2)

However, none of the three programme schemes provided specific instructions for integrating ICT into teaching and learning practices, nor did they provide specific standards for pre-service teachers' ICT preparation.

5.3.2 TPACK-related curriculum structure

Angeli and Valandies (2009) suggested that the growth of each factor underlying the TPACK construct did not automatically contribute to increasing the overall TPACK. It was therefore important to systematically add ICT to the education curriculum in a way that would fully integrate technology, pedagogy and subject into the curriculum structure.



To identify the course content of each TPACK-related course in the sampled teacher education programmes, the researcher initially collected the programme schemes, course outlines and syllabi to categorise the courses. To avoid uncertainty or ambiguity, the researcher crosschecked the findings from the interviews with the Vice-Dean (Academic) and course coordinator/lecturer and from the focus group interviews with pre-service teachers to confirm the objects, contents and pedagogy of each TPACK-related course. Table 5.5 summarises the TPACK-related curriculum structure in the three teacher education programmes. Contemporary teacher education programmes feature no TCK-related courses.

Table 5.5: TPACK-related curriculum structure in the teacher education programmes

TPACK-related curriculum structure	Mathematics programme		Chemistry programme		History programme	
	Credits	Percent (%)	Credits	Percent (%)	Credits	Percent (%)
Course content						
Content knowledge (CK)	86.0	52.1	82.0	49.7	80.0	48.5
Knowledge about teaching methods (PK)	8.0	4.8	8.0	4.8	8.0	4.8
Knowledge about technology (TK)	7.0	4.2	3.0	1.8	3.0	1.8
Knowledge about teaching my teaching subjects (PCK)	21.0	12.7	23.0	13.9	24	14.5
Knowledge about using technology to teach (TPK)	2.0	1.2	3.0	1.8	2.0	1.2
ICT integration knowledge (TPCK)	3.5	2.1	2.0	1.2	0.0	0.0
Total	127.5	77.1	121	73.2	117	70.8
Total credits required						165

5.3.3 The ICT core courses in teacher education programmes

Referring to the TPACK-related curriculum structure in Table 5.5, the pre-service teachers had three ICT core courses. The first course was ‘Computer fundamentals’, a compulsory three-credit general education course designed to develop students’ ICT skills. The second course was ‘Application of educational technology’, an optional two-credit teacher education course related to ICT in education and organised by the School of Education. The third course was ‘Comprehensive teaching skills of pre-service teachers’, a compulsory two- or three-credit course offered by each school that included ICT as an element.



Table 5.6: The ICT core courses in the teacher education programmes

Course name	Aims	Content	Teaching and learning strategies	Assessment	Course provider
Computer fundamentals (Compulsory)	To develop the students' basic computer knowledge and applications for information access, processing and release	TK	Lecturing + computer practice Unified course outline, content, pedagogy and assessment	Provincial Test of Computer L1	School of Computer and Science
Applications of educational technology (Optional)	To develop the students' capability of applying educational technologies to learning and teaching	TPK	No unified textbook Curriculum outline is decided by the course coordinator Course content and pedagogy are decided by the individual lecturer	Individual lecturer	School of Education
Comprehensive teaching skills of pre-service teachers (Compulsory)	To develop the students' capability of applying classroom teaching skills, pedagogies and educational technologies	TPK	No lecturing Supervised by the Vice-Dean (Academic)	Individual subordinate school	Individual subordinate school

5.3.3.1 Computer fundamentals

The School of Computer and Science offered the compulsory 'Computer fundamentals' course to all undergraduate students. The course was positioned as a course for developing TK. Although they came from different backgrounds across the country, the pre-service teachers' ICT in education competencies varied greatly. Some of the students from the

regressive west or villages had never before operated a computer, and others from affluent areas had plenty of experience using computers. Therefore, it was necessary to differentiate the courses to cater to different learning needs (Lim, Chai, & Churchill, 2010). Beginning in 2010, a pre-test of computer knowledge and skills was administered to all students to determine their competency levels and divide them into classes at three different levels: low level A, intermediate level B and high level C. The majority of the students (about 60%) fell into intermediate level B, with the rest divided between low level A and high level C. Different courses were offered at each level. Each level had a unified course outline, textbook and teaching and learning strategies. At levels A and B, the goal of the course was to equip students with basic computer competency and introduce them to the basics of computer science. At level C, students who had already acquired basic computer competency learned more advanced content related to programming and databases. After one semester of lectures, the undergraduate students at all three levels were expected to participate in the Provincial Test of Computer L1 to assess their basic computer knowledge and applications of information access. Their test scores reflected their performance in the courses. According to the MOE and Guangxi Provincial Department of Education, students who did not pass this test were not granted bachelor's degrees upon graduation.

5.3.3.2 Application of educational technology



‘Application of educational technology’ was an optional two-credit course offered to pre-service teachers. It was developed and delivered by the School of Education. The course coordinator drafted the course outline, including the content, pedagogy and assessment. The goals of the course were set against the Educational Technology Competency Standards for Primary and Secondary Teachers (Trial). The course especially aimed to develop pre-service teachers’ awareness of how they may apply educational technology to their teaching and learning practices. It comprised eight sessions that focused on an overview of educational technology, educational technology theory, modern teaching media, digital teaching resources, network applications, teaching design theory and practice, teaching evaluation and the modern teaching system, respectively. It was impossible for such a TPK course to involve too much subject knowledge in its content given the variety of the pre-service teachers’ study disciplines. The course assessments were based on attendance (worth 10%), reflections on personal blogs (worth 20%) and assignments (worth 70%). The assignments included on-line artefacts (worth 30%), a PowerPoint presentation (worth 50%) and website design and management (worth 20%).

In fact, the course was not offered to all of the schools for several reasons. First, the School of Education was unlikely to provide sufficient lecturers, e-classrooms or other supporting



learning resources for the course. Second, the relevant school leaders neither attached much importance to the course nor arranged sufficient credits to open it to their pre-service teachers. Third, to balance the workloads of the staff members, the school leaders sometimes preferred to offer a subject-related educational technology course taught by their own teaching staffs rather than invite lecturers from the School of Education. In most cases, the Vice-Deans (Academic) made the decision whether to include the course in their teacher education programmes.

5.3.3.3 Comprehensive teaching skills of pre-service teachers

‘Comprehensive teaching skills of pre-service teachers’ was a two-credit compulsory course offered by the individual schools to all pre-service teachers. The course was positioned as a TPK course that focused on PK practices involving ICT. However, due to restrictive conditions, not every school was able to arrange suitable lecturers. Consequently, the course was usually designed as a PCK course or even a PK course in different teacher education programmes. The course consisted of four sub-courses, ‘Microteaching’, ‘Calligraphy and blackboard design’, ‘Teaching practice’ and ‘Multimedia courseware application’. Pre-service teachers were expected to pass all four of the sub-courses to obtain the total two credits offered by the course. The assessments of these sub-courses were arranged in



Semesters 5 or 6 of Year 3. No classroom lecturing was required for the sub-courses. The assessment standards were provided in advance to prepare the pre-service teachers. The assessments were usually organised by several lecturers from relevant disciplines in each school.

Both ‘Computer fundamentals’ and ‘Application of educational technology’ had fixed course outlines, content, pedagogies and assessments. Therefore, no further explanation of these two courses is provided in the case study profiles. In the next section, the relevant curriculum leaders in these two courses are discussed separately following analysis of curriculum leadership at the university level.

‘Comprehensive teaching skills of pre-service teachers’ was designed and implemented differently in terms of its content, pedagogy and assessment in the sampled teacher education programmes. Moreover, some of the programmes arranged an ICT core course for pre-service teachers on how to teach subject knowledge with ICT. Therefore, guided by the research questions, the researcher focused on exploring the differences in the ICT core courses and how the curriculum leaders created these differences in the design and implementation of the programmes. These explorations comprised the key discussions in each case study profile.



5.4 Four dimensions of curriculum leadership

The researcher used Hallinger's (2011) synthesised model to guide the interview data and frame them more explicitly. In terms of the purpose of this study, the four dimensions of the model were specified as the sources, values, foci and contexts of curriculum leadership. As shown in the following sections, the researcher focused on these four dimensions while highlighting the effects of curriculum leadership on teacher education programmes at the university, subordinate school and classroom levels.

5.4.1 Curriculum leadership at the university administration level

Curriculum leadership at the university level was similar across all of the teacher education programmes at GXNU. As the senior managers in curriculum administration, the Vice-President (Academic) and Vice-Director (Academic) of the TAO served as the authorities in ICT policymaking at the university. Their in-depth interviews served as a good starting point for exploring their roles in developing pre-service teachers' ICT in education competencies and helped to clarify the philosophy behind the use of ICT in teacher education at GXNU.



Sources of curriculum leadership:

- Vice-President (Academic)
- Vice-Director (Academic) of the TAO

Values of curriculum leadership:

The curriculum leaders at the university level confirmed that developing pre-service teachers' ICT in education competencies was an important task for teacher education at GXNU. The basic principles supporting the use of ICT in teacher education at GXNU were centralised supervision by the university and distributed autonomy for subordinate schools (Liang, 2009). This means that the university provided policies or strategies to support the use of ICT in teacher education and supervised the programme implementation and evaluation processes. The subordinate schools were also granted the autonomy to fine-tune certain parts of their programmes to extents permitted by the university.

Curriculum leadership focus:

The Vice-President (Academic) was in charge of general teaching and learning at the university, especially in terms of full-time undergraduate teaching and educational research. The Vice-President (Academic) supervised the Vice-Director (Academic) of the TAO in making the final staffing, resource allocation and programme adoption decisions:



We need to articulate a shared vision for our university and further to formulate strategic planning for the development of ICT in education. We should integrate resources from policy, technology, finance and staff members to support the strategic planning.

(Interview with the Vice-President (Academic))

ICT in teacher education has always been one of the focuses of my work. We have been improving the effectiveness of the teacher education programmes by updating some ICT core courses. In recent years, we have attached importance to pre-service teachers' practicum and encouraged more collaboration with primary or secondary schools in the province. (Interview with the Vice-President (Academic))

The primary task of the TAO was to maintain normal teaching and learning practices at the university. The Vice-Director (Academic) of the TAO handled the administrative work for the supervision, examination and consultation involved in the programme planning and development processes. As developing pre-service teachers' ICT in education competencies was an important task for teacher education at the university, the Vice-Director (Academic) of the TAO focused on the following:

- fostering an ICT learning culture;

- optimising the technological environment;
- coordinating the teaching quality of the ICT core courses;
- encouraging the fine-tuning of the ICT core courses; and
- coordinating the relationships between schools, technology centres and relevant administrative offices.

Limited by the current situation, no significant reforms were made to the teacher education programmes or teacher education strategies involving ICT at GXNU. The Vice-Director (Academic) of the TAO mentioned the following:

We have a heavy workload. I must normally address the Vice-President's order immediately. In terms of developing the ICT in education competencies of pre-service teachers, we just conducted almost the same thing as the other normal universities have done. Without policy support or existing successful experience, there was unlikely to be innovations in the ICT strategies of teacher education at GXNU. And at this stage, I don't think there will be significant changes in the existing teacher education programmes either. (Interview with the Vice-Director (Academic) of the TAO)

Context for curriculum leadership:

The participants identified cultural traditions, educational systems, local economic development, resource conditions and the visions and beliefs of leaders and staff members as the factors blocking innovations in ICT teacher education and creating contextual barriers. They also identified (1) the ambiguous requirements for pre-service teachers' ICT in education competencies, (2) the absence of national policies or standardised examinations and (3) the high requirements of the employment markets as the main issues:

I think the contradiction between the requirement to develop pre-service teachers' ICT in education competencies and the insufficient support from educational policies, funds, human resources, strategies, etc., has become an increasingly obvious issue. (Interview with the Vice-President (Academic))

Unfortunately, the current requirements for ICT in teacher education are rather ambiguous. There are still no national policies or standardised examinations to direct the development of ICT in teacher education for normal universities, whereas the requirements for pre-service teachers from the employment markets are becoming increasingly higher. Meanwhile, some of the negative effects of culture, tradition and even economic development are more likely to block the innovations in ICT teacher education. (Interview with the Vice-Director (Academic) of the TAO)



Therefore, curriculum management at the university level seemed to be relatively stable and conservative. Without policy support or successful experience, there was unlikely to be innovations in or significant reforms of the teacher education programmes and ICT strategies at the university.

5.4.2 Curriculum leadership in the School of Computer and Science

As all three of the sampled teacher education programmes included the ‘Computer fundamentals’ course, there was a need to investigate the role of curriculum leadership in this ICT core course in the School of Computer and Science.

Sources of curriculum leadership:

- Vice-Dean (Academic)
- Course coordinator
- Lecturers

Values of curriculum leadership:

Helping undergraduate students to pass the Provincial Test of Computer Level 1 was the primary task in designing and implementing the ‘Computer fundamentals’ course.

Curriculum leadership focus:

The course outline was formulated by the provincial education department. The course coordinator and lecturers in the School of Computer and Science had to follow the course outline to implement their teaching and learning practices for all of the undergraduate students enrolled in the various study disciplines. The standardised test not only put a great deal of pressure on the lecturers, but also discouraged innovation and restrained development:

Frankly speaking, this course is designed and implemented for students to pass the Provincial Test of Computer Level 1. Fortunately, we have now raised the annual passing rates to above 96.7%. Therefore, we don't have additional time or energy to link this course to other relevant courses or add up more content irrelevant to this standardised test. If the Provincial Test of Computer Level 1 is not changed, I don't think there will be any changes in this course either. (Interview with the ‘Computer fundamentals’ course coordinator)

Context for curriculum leadership:



There was a lack of mutual support and communication between the School of Computer and Science and other subordinate schools for this course:

In terms of this course, we seldom communicate with other schools. We must work hard to ensure that all of our students pass the standardised test, no matter what they are majoring in. (Interview with the Vice-Dean (Academic))

5.4.3 Curriculum leadership in the School of Education

The Mathematics and History programmes offered the ‘Application of educational technology’ course. Thus, there was a need to investigate the role of curriculum leadership in this ICT core course in the School of Education.

Sources of curriculum leadership:

- Vice-Dean (Academic)
- Course coordinator
- Lecturers

Values of curriculum leadership:



The relevant curriculum leaders believed that the aim of this course was to improve the TK and PK of pre-service teachers:

It is unlikely that we will integrate technology with their subject and pedagogical knowledge simultaneously. In the current stage, we can only integrate technology with pedagogy for all of the participating pre-service teachers, whether they are studying in the arts or sciences. (Interview with an 'Application of educational technology' course lecturer)

Curriculum leadership focus:

The 'Application of educational technology' course outline was drawn up collectively by the course coordinator and lecturers in the School of Education. The lecturers followed the course outline to implement their teaching and learning practices for pre-service teachers from various study disciplines:

It is difficult to look after the pre-service teachers from various study disciplines. To ensure the teaching quality, I particularly propose the relatively fixed lecturers' arrangement for pre-service teachers from related study disciplines. Then it is easier for lecturers to know about the pre-service teachers' ICT in education competencies and to



embed a suitable pedagogy into their lecturing. (Interview with the 'Application of educational technology' course coordinator)

Context for curriculum leadership:

There was a lack of mutual support and communication between the School of Education and other subordinate schools for this course:

However, I think that we do need more communication with other schools. We do need their support and advice in terms of their pedagogical requirements and content knowledge. (Interview with the Vice-Dean (Academic))

In summary, curriculum leadership at the university level and in the School of Computer and Science was stable and similar to that involved in all of the teacher education programmes. The 'Application of educational technology' course in the School of Education was also relatively similar to that in the teacher education programmes. However, the curriculum leadership within the subordinate schools might have varied in terms of their sources, values, foci and contexts. Therefore, the researcher established a profile for each programme to analyse the interrelationships between pre-service teachers' TPACK perceptions, ICT core



courses and the relevant curriculum leadership. These profiles are presented in the next section.

5.5 Profile of the Mathematics teacher education programme

5.5.1 Mathematics pre-service teachers' TPCK perceptions

The survey was distributed to 57 Mathematics pre-service teachers, and 53 valid surveys were returned. As shown in Table 5.7, 48 (90.6%) and 47 (88.8%) of the Mathematics pre-service teachers were confident in their capabilities of crafting real-world situations (Item 2) and designing lessons (Item 6) with TPCK, respectively. Eight (15%) of the teachers responded that they had low levels of confidence in formulating content topics to facilitate on-line collaboration with ICT (Item 1). This indicates that the Mathematics pre-service teachers had a high degree of confidence in integrating ICT into their teaching and learning practices.



Table 5.7: Summary statistics for Mathematics pre-service teachers' TPCK perceptions

($N=53$).

Factor TPCK / Items	Disagree		Neutral		Agree	
	F	P (%)	F	P (%)	F	P (%)
TPCK-1	8	15	6	11.3	39	73.5
TPCK-2	5	9.5	0	0.0	48	90.6
TPCK-3	4	7.6	8	15.1	41	77.4
TPCK-4	5	9.5	13	24.5	35	66.1
TPCK-5	5	9.4	6	11.3	42	79.3
TPCK-6	4	7.6	2	3.8	47	88.8

Note: F=Frequency, P=Percent.

5.5.2 The ICT core courses in the Mathematics programme

To develop the Mathematics pre-service teachers' ICT in education competencies, the School of Mathematics and Statistics offered five ICT core courses in its Mathematics programme in 2010. These courses were distributed in the general, specialisation and teacher education areas in Years 1 and 3 (see Table 5.8).



Table 5.8: The ICT core courses in the Mathematics programme

	Course name	Aims	Content	Teaching and learning strategies	Assessment	Time
General education	‘Computer fundamentals’ (Compulsory)	To develop the students’ basic computer knowledge and applications for information access, processing and release	TK	Lecturing + computer practice Unified course outline, content, pedagogy and assessment	Provincial Test of Computer Level 1	S1, Y1
Specialisation education	‘C-language’ (Optional—Compulsory)	To develop the students’ intermediate computer knowledge in relation to C-language applications	TK	Lecturing + computer practice Unified course outline, content, pedagogy and assessment	Provincial Test of Computer Level 2	S2, Y1
	‘Computer-aided mathematics teaching’ (Optional)	To develop capability of the integration of technology and pedagogy into subject knowledge	TPCK	Lecturing + computer practice Course contents and pedagogy were decided by the lecturer	Pre-service teachers’ artefacts	S5, Y3
Teacher education	‘Comprehensive teaching skills of pre-service teachers’ (Compulsory)	To develop the students’ capability of classroom teaching skills and ICT integrated with pedagogies	TPK-- TPCK	Classroom lecturing	Pre-service teachers’ artefacts and teaching practices	S6, Y3
	‘Application of educational technology’ (Optional)	To develop the students’ capability of applying ICT to their learning and teaching practices	TPK	Lecturing + computer practice Course contents and pedagogy were decided by the lecturer	Pre-service teachers’ artefacts	S6, Y3

‘C-language’

The School of Computer and Science offered its ‘C-language’ course for those interested in the field. It was an optional TK course offering four credits to undergraduate students. The purpose of the course was to strengthen students’ intermediate computer capability in relation to C-language applications. Students were required to pass the Provincial Test of Computer Level 2 to receive the course credits. Although the course was optional, the Vice-Dean of the School of Mathematics and Statistics required all of the Mathematics pre-service teachers to participate in it to enhance their TK and skills.

‘Computer-aided mathematics teaching’

‘Computer-aided mathematics teaching’ was originally an optional course offering two credits. However, the Vice-Dean (Academic) and course coordinator decided to split off 0.5 credit via the ‘Applied educational technology’ course for pre-service teachers. Therefore, the ‘Computer-aided mathematics teaching’ course was arranged to offer 1.5 credits. As a TPACK course, it aimed to develop pre-service teachers’ awareness of the integration of technology and pedagogy into subject knowledge. The assessment focused on the pre-service teachers’ artefacts, which involved ICT tools taught in the course. The course was deliberately offered in Semester 5 of Year 3 with the purpose of enhancing the pre-service teachers’ ICT in education competencies for their practicums and graduate design projects in



the coming Year 4. To maintain consistency with the ‘Comprehensive teaching skills of pre-service teachers’ course, both courses had the same course coordinator and lecturer, who had more than five years of experience teaching Mathematics with ICT.

Enhanced ‘Comprehensive teaching skills of pre-service teachers’ course

According to the 2010 Mathematics programme scheme, ‘Comprehensive teaching skills of pre-service teachers’ was designed as a TPK course with three sub-courses, including ‘Internship at a middle school and microteaching’ (one credit), ‘Standard Chinese and its oral expressions’ (0.5 credit) and ‘Calligraphy and multimedia courseware’ (0.5 credit). However, given that no additional ICT core course credit was offered to the pre-service teachers, the Vice-Dean (Academic) and course coordinator decided to enhance one of the sub-courses, i.e., ‘Calligraphy and multimedia courseware’. The course content embodied the integration of ICT tools into Mathematics teaching and learning practices. The course coordinator added classroom lecturing to this sub-course. Therefore, the enhanced course was developed from a TPK course into an integrative TPACK course. The assessments for the three sub-courses were intensively organised in Semester 6 of Year 3. Pre-service artefacts and teaching practices were adopted as the major assessment components. In particular, ICT integration was a key component in the assessment standards.



Based on preceding analysis, the five ICT core courses in the Mathematics programme included TK, TPK and TPCK courses. The two TK courses, i.e., ‘Computer fundamentals’ and ‘C-language’, were arranged in Semesters 1 and 2 of Year 1. These two courses served as technological preparation for the following synthetic courses. The other three synthetic courses were successively arranged in Semesters 5 and 6 of Year 3. ‘Computer-aided mathematics teaching’ was a TPCK course. As ‘Comprehensive teaching skills of pre-service teachers’ was enhanced into a TPCK course, these two courses collectively nurtured the pre-service teachers’ perceptions of TPCK. All of the Mathematics pre-service teachers in the third cohort were required to participate in these two courses. ‘Application of educational technology’ in Semester 6 was offered especially to develop the TPK perceptions of pre-service teachers. These ICT core courses offered in Year 3 were expected to serve as important preparation for the practicums in Year 4.

5.5.3 Role of school curriculum leadership in developing Mathematics pre-service teachers’ ICT in education competencies

Sources of curriculum leadership:

The ICT core courses offered in the Mathematics programme were offered by three schools, including the School of Computer and Science, School of Education and School of Mathematics and Statistics. The three sources of curriculum leadership comprised the curriculum leadership system for the ICT core courses in the Mathematics programme (see Table 5.9). The curriculum leadership in the School of Computer and Science and School of Education was discussed previously. This section focuses on curriculum leadership in the School of Mathematics and Statistics and pays adequate attention to the interrelationships between its three sources (shown in the following profiles).

Table 5.9: Sources of curriculum leadership in the ICT core courses in the Mathematics programme

School of Computer and Science	School of Education	School of Mathematics and Statistics
• Course coordinator and the lecturer of ‘Computer fundamentals’ (TK)	• Course coordinator and the lecturer of ‘Application of educational technology’ (TPK)	• Vice-Dean (Academic) • Course coordinator and lecturer of ‘Computer-aided mathematics teaching’ (TPCK) and ‘Comprehensive teaching skills of pre-service teachers’ (TPCK)

In the School of Mathematics and Statistics, the major curriculum leaders of the ICT core courses were the Vice-Dean (Academic) and Dr Tang, who served as course coordinator and lecturer for two ICT core courses including ‘Computer-aided mathematics teaching’ and the

‘Calligraphy and multimedia courseware’ sub-course. Figure 5.1 summarises the interrelationship between the curriculum leaders. The thick lines demonstrate the strengthened roles of the curriculum leaders, and the thin lines refer to their routine administration (also shown in the figures of the following profiles). Bold lines with arrows are used to emphasise Dr Tang’s two leading roles in revising the ICT core courses and influencing the Vice-Dean’s (Academic) ICT decisions. Dr Tang provided feedback related to the pre-service teachers’ ICT learning outcomes to the Vice-Dean (Academic) to propose the development of ICT core courses. With approval and support from the Vice-Dean (Academic), Dr Tang enhanced the ICT core courses.



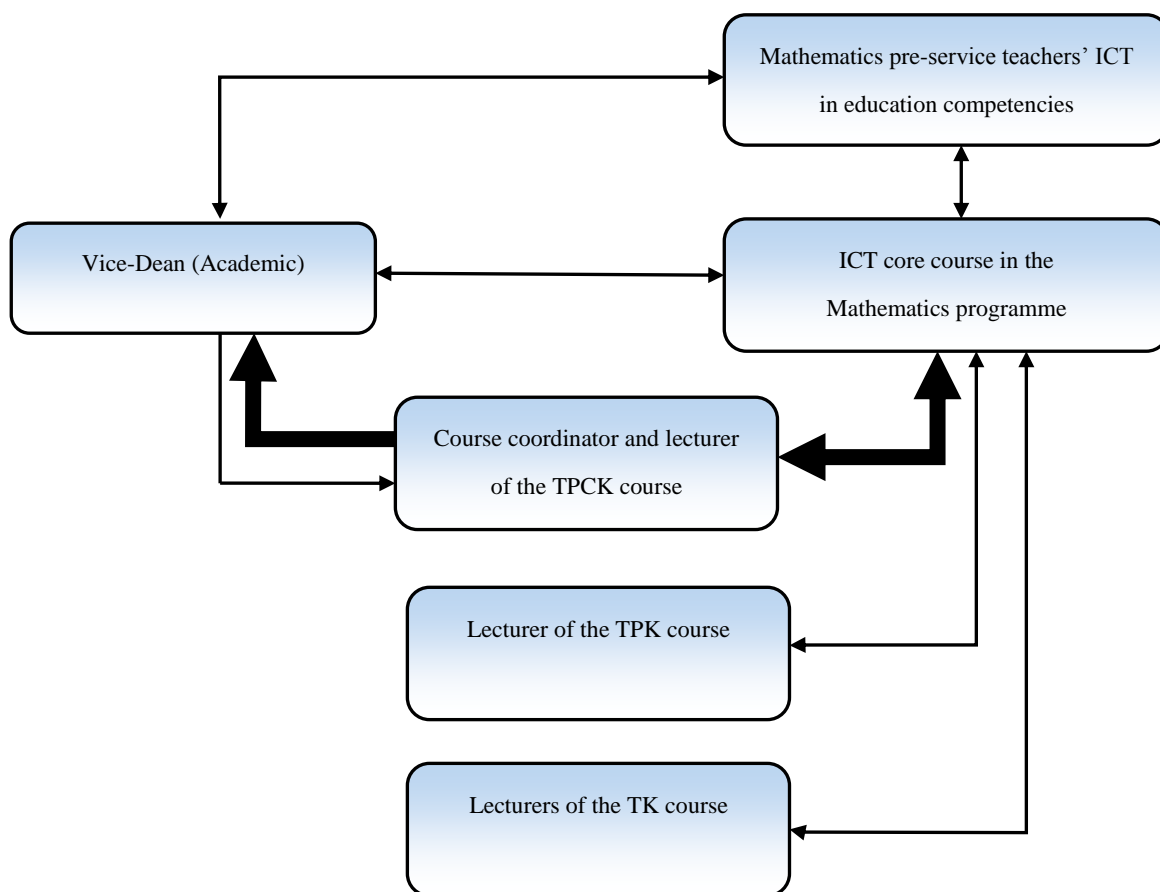


Figure 5.1: Role of curriculum leadership in developing Mathematics pre-service teachers' ICT in education competencies

ICT in education competencies

Values of curriculum leadership:

The Vice-Dean (Academic) perceived that the tasks related to pre-service teachers' ICT teaching and learning practices were very important, but did not imply that these tasks would be handled as the first priority. Rather, he believed that tasks should be prioritised according to the urgency and significance of the consequences. He also noted that teaching and learning with ICT should not decrease the rate of specialised courses or exceed the maximum credits.

During his interview, the Vice-Dean (Academic) showed his appreciation for Dr Tang's contribution to developing the use of ICT in teaching and learning in the School of Mathematics and Statistics:

The enhancement of ICT core courses greatly improved our pre-service teachers' ICT in education competencies. Our pre-service teachers had won prizes in various teaching skills competitions. The research project entitled 'High school mathematics curriculum and teaching theory' led by Dr Tang won first prize in the Annual Research Project Competition in the Higher Education Institutions of Guangxi province in 2012. We also noted that even some young teaching staffs participated in Dr Tang's class to improve their ICT capabilities. (Interview with the Vice-Dean (Academic))

As a coordinator and lecturer for ICT core courses, Dr Tang paid close attention to the effectiveness of teacher education programmes in developing pre-service teachers' ICT in education competencies. He was highly experienced in designing and teaching TPCK courses for Mathematics pre-service teachers. He introduced his work experience as follows:

I had been a secondary school Mathematics teacher for more than eight years. And I also have been the practicum coordinator for the past three years. So I am familiar with



Mathematics teaching and learning in secondary schools and the ICT in education competencies of our pre-service teachers.

In terms of pre-service teachers' ICT in education competencies, Dr Tang demonstrated his passion for integrating ICT into Mathematics teaching and learning during his interview. His efforts to empower pre-service teachers with ICT educational experience in their apprenticeships were evident in his attitudes towards the enhancement of ICT core courses for pre-service teachers. The feedback from pre-service teachers in the focus group echoed Dr Tang's views. When asked why one of the sub-courses had been revised, Dr Tang provided the following reason:

During the practicum in secondary schools, we noted that our current ICT curriculum no longer met the requirement for secondary school teaching. It was urgent for us to revise the ICT curriculum to develop pre-service teachers' ICT in education competencies comprehensively. Based on the Standards (2004), we conducted a comprehensive investigation of pre-service teachers' ICT knowledge and skills and their beliefs in ICT learning. Finally, we revised one of the sub-courses into the current form in 2010.

Moreover, Dr Tang added the following:

Pre-service teachers need more opportunities to experience ICT applications in their apprenticeships. For this reason, I proposed the enhancement of our current ICT curriculum for pre-service teachers. And I also undertook the responsibility of lecturing two successive ICT core courses. I believe that systematic ICT learning may enable pre-service teachers to construct their own ICT educational ideal, which they can integrate into their future teaching practices.

Curriculum leadership focus:

The Vice-Dean (Academic) emphasised Dr Tang's leading role in the management of ICT core courses in the Mathematics programme:

I am a supporter or sponsor at best. However, Dr Tang was the person who really designed and implemented the ICT curriculum for our pre-service teachers.

The Vice-Dean (Academic) summarised that his support for ICT should aim to:

- supervise the enhancement of ICT core courses;
- establish an ICT learning culture by organising various multimedia courseware competitions to arouse students' fervour and interests;

- encourage more young teaching staffs to become involved in the teaching groups of ICT core courses; and
- update ICT infrastructure, hardware and learning resources.

Meanwhile, Dr Tang emphasised that his focus areas involved:

- applying to split credits to arrange one more ICT core course;
- drafting the outlines of the two courses, including their purposes, contents, pedagogies and assessments;
- enhancing the ‘Calligraphy and multimedia courseware’ course by adding TPCK content and classroom lecturing; and
- coordinating and lecturing for the ‘Calligraphy and multimedia courseware’ and ‘Computer-aided mathematics teaching’ courses.

Therefore, the two curriculum leaders worked collaboratively. Dr Tang’s innovative contribution and the supportive leading approach of the Vice-Dean (Academic) were the key curriculum leadership components in developing Mathematics pre-service teachers’ ICT in education competencies.

Context for curriculum leadership:

The curriculum leaders faced various barriers such as the pressure of academic evaluation, students' learning habits shaped by traditional teaching, high competition in the job market and insufficient ICT infrastructure and hardware. The Vice-Dean (Academic) complained that the school evaluation criteria were market oriented in response to the high pressure of graduate employability. Despite its importance, pre-service teachers' ICT in education competencies were not involved in any evaluation criteria and no explicit assessment standards were provided. Therefore, the manpower and material resource supports provided by the university were so insufficient that each school had to formulate its own plan to develop its pre-service teachers' ICT in education competencies.

5.6 Profile of the Chemistry teacher education programme

5.6.1 Chemistry pre-service teachers' TPCK perceptions

The survey was distributed to 112 Chemistry pre-service teachers and 82 valid surveys were returned. Table 5.10 displays the Chemistry pre-service teachers' perceptions of TPCK. More specifically, 60 (73.1%) and 59 (71.9%) of the Chemistry pre-service teachers were confident in their capabilities of designing lessons (Item 6) and crafting real-world situations (Item 2) with TPCK. The percentage of groups that disagreed or were neutral was slightly higher than



that of the Mathematics pre-service teachers. For instance, 25 (30.5%) participants were neutral about formulating content topics to facilitate on-line collaboration with ICT (Item 1) and 15 (18.3%) participants were unconfident in their ability to structure activities to construct CK (Item 1) and create self-directed learning activities involving the CK (Item 4) using appropriate ICT tools, respectively. This indicates that the Chemistry pre-service teachers reached a mediate level of their TPCK perceptions and had moderately high levels of confidence in their ability to apply ICT to their teaching and learning practices.

Table 5.10: Summary statistics for Chemistry pre-service teachers' TPCK perceptions ($N=82$).

Factor TPCK/Items	Disagree		Neutral		Agree	
	F	P (%)	F	P (%)	F	P (%)
TPCK-1	13	15.8	25	30.5	44	53.7
TPCK-2	6	7.3	17	20.7	59	71.9
TPCK-3	15	18.3	19	23.2	48	58.5
TPCK-4	15	18.3	12	14.6	55	67.1
TPCK-5	13	15.9	15	18.3	54	65.9
TPCK-6	9	10.9	13	15.9	60	73.1

Note: F=Frequency, P=Percent.

5.6.2 The ICT core courses in the Chemistry programme

According to the 2010 Chemistry programme scheme, the School of Chemistry offered three ICT core courses to their pre-service teachers. These courses were mainly distributed in general and teacher education sessions in Years 1 and 3, respectively (see Table 5.11).

Table 5.11: The ICT core courses in the Chemistry programme

	Course name	Aims	Content	Teaching and learning strategies	Assessment	Time
General education	‘Computer fundamentals’ (Compulsory)	To develop the students’ basic computer knowledge and applications for information access, processing and release	TK	Lecturing + computer practice Unified course outline, content, pedagogy and assessment	Provincial Test of Computer Level 1	S1, Y1
Teacher education	‘Comprehensive teaching skills of pre-service teachers’ (Compulsory)	To develop the students’ classroom teaching skills, pedagogies and applications of educational technologies	TPK	No classroom lecturing	Pre-service teachers’ artefacts and teaching practices	S5, Y3
	‘Secondary-school chemistry multimedia courseware’ (Optional—Compulsory)	To develop the students’ capability of integrating ICT with the Chemistry pedagogy to improve their Chemistry teaching and learning practices	TPCK	Lecturing + computer practice Course contents and pedagogy are decided by the lecturer	Pre-service teachers’ on-site artefacts	S6, Y3

‘Comprehensive teaching skills of pre-service teachers’

‘Comprehensive teaching skills of pre-service teachers’ was positioned as a TPK course. The course offered three credits, including ‘Microteaching’ (one credit), ‘Calligraphy and blackboard design’ (one credit) and ‘Teaching practice with multimedia courseware’ (one credit). It aimed to develop pre-service teachers’ classroom teaching skills, pedagogies and applications of educational technologies. There were no lectures delivered for this course. Pre-service teachers’ artefacts and teaching practices were elements of the major assessment method. The assessments were arranged in Semester 5 of Year 3 to prepare pre-service teachers with a TPK foundation for the optional ‘Secondary-school chemistry multimedia courseware’ TPCK course in Semester 6.

‘Secondary-school chemistry multimedia courseware’

‘Secondary-school chemistry multimedia courseware’ was a two-credit optional TPCK course offered to Chemistry pre-service teachers. The course aimed to develop pre-service teachers’ ability to integrate ICT into the Chemistry pedagogy to improve their Chemistry teaching and learning practices. The course began in 2000 and was revised into its current form in 2011 after the Vice-Dean (Academic) and course coordinator had conducted instructional analysis of pre-service teachers’ ICT knowledge, skills and aptitude for learning and Chemistry curriculum reform in secondary schools. This enhanced course adopted the



Educational Technology Competency Standards for Primary and Secondary Teachers (Trial) (2004) to clarify its objectives, contents and assessments. The course coordinator and lecturer, who was the same person, adopted a case-based learning strategy of explanation, demonstration and modelling. In the final examination, pre-service teachers had to draw lots to choose their assessment topics. The assessments were primarily based on the teachers' on-site artefacts. This was considered a new attempt to integrate technology with pedagogy and Chemistry CK. Based on the focus group interviews conducted with Chemistry pre-service teachers, this course was considered the most useful for developing their ICT in education competencies.

According to previous analysis, the Chemistry programme offered three ICT core courses to their pre-service teachers, including TK, TPK and TPCK courses. In Semester 1 of Year 1, the compulsory 'Computer fundamentals' course (TK) offered in the general education session provided pre-service teachers with basic computer knowledge and skills as a technological foundation. In the teacher education session of Year 3, the compulsory 'Comprehensive teaching skills of pre-service teachers' course offered in Semester 5 developed pre-service teachers' perceptions of TPK. This course was also arranged to prepare pre-service teachers for the 'Secondary-school chemistry multimedia courseware' TPCK



course in Semester 6. The ‘Application of educational technology’ TPK course was not offered in this programme.

5.6.3. Role of school curriculum leadership in developing Chemistry pre-service teachers’ ICT in education competencies

Sources of curriculum leadership

The ICT core courses in the Chemistry programme were offered by two schools, including the School of Computer and Science and School of Chemistry. The curriculum leaders involved in the two schools formed the curriculum leadership system for the ICT core courses in the Chemistry programme (see Table 5.12).

Table 5.12: Sources of curriculum leadership on the ICT core courses in the Chemistry programme

School of Computer and Science	School of Chemistry
• Course coordinator and lecturer of ‘Computer fundamentals’ (TK)	• Vice-Dean (Academic)
	• Course coordinator and lecturer of ‘Secondary-school chemistry multimedia courseware’ (TPCK)

In the School of Chemistry, the major curriculum leaders for the ICT core courses were the Vice-Dean (Academic) and Dr Zeng, the course coordinator and lecturer of

‘Secondary-school chemistry multimedia courseware’. In terms of improving pre-service teachers’ ICT in education competencies, Figure 5.6 summarises the interrelationship between the curriculum leaders in an illustrated diagram. The thick lines with arrows emphasise the two leading roles of the Vice-Dean (Academic), who worked collaboratively with Dr Zeng to revise the ICT core courses while also managing the ICT curriculum.

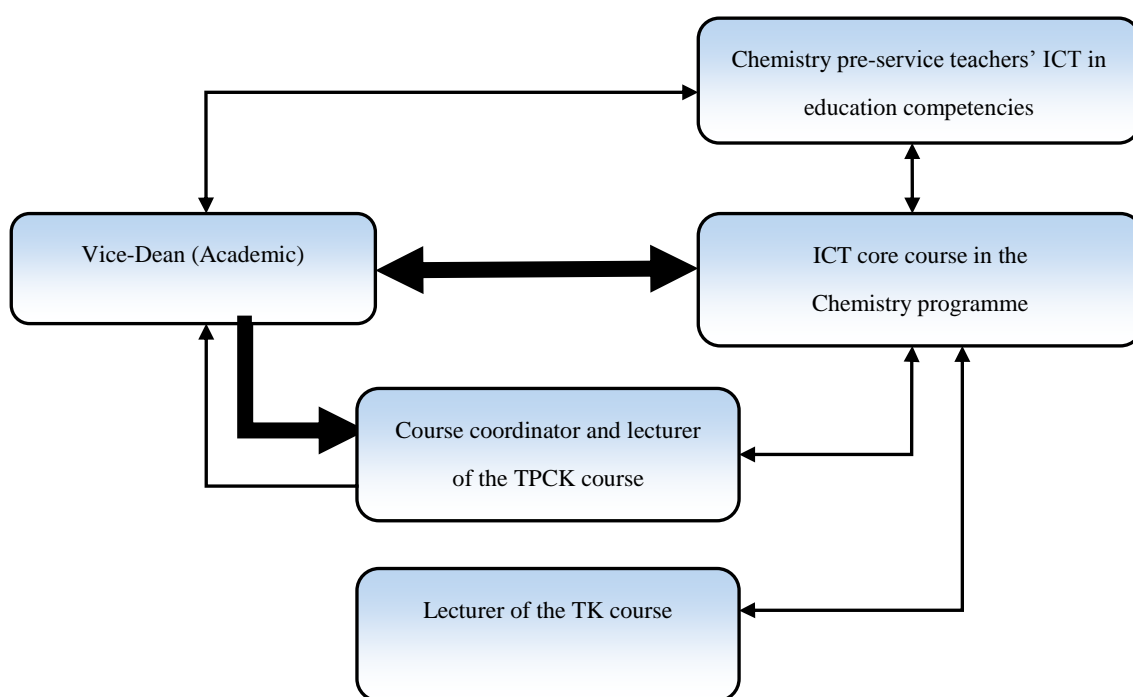


Figure 5.2: Role of curriculum leadership in developing Chemistry pre-service teachers’ ICT in education competencies

Values of curriculum leadership:

The Vice-Dean (Academic) attached great significance to pre-service teachers’ ICT in education competencies. She considered the tasks related to curriculum planning important,

especially most ICT-related curriculum management. Her work emphasised the role of the curriculum manager:

Developing pre-service teachers' ICT in education competencies has always been my working priority. The development of ICT in teacher education has increasingly highlighted its importance over the past 2 or 3 years. At present, the main channel to educate such competency is classroom teaching, that is to say, on the curriculum. However, the credit management system will not provide more credits for ICT core courses. Therefore, we have to enhance the content of the current ICT core courses to maximise the learning outcomes within limited class hours. (Interview with the Vice-Dean (Academic))

When asked how to update the ICT core course 'Secondary-school chemistry multimedia courseware', the Vice-Dean (Academic) noted the importance of learning from others, investigation and drawing on learners' feedback:

The original course content was too old to keep up with the social development, and the teaching was focused too much on theory instead of practice. So we learned from the updated ICT core course for Chemistry pre-service teachers in South China Normal



University. We talked with experienced lecturers and conducted investigations on behalf of our pre-service teachers' interests, beliefs and teaching practices to understand their ICT competencies. Then I worked collaboratively with Dr Zeng to revise our course structures, contents, pedagogies and assessments to make them more suitable for our pre-service teachers. We collected pre-service teachers' feedback and reflections after each semester to ensure the teaching quality and fine-tune parts of the content if necessary. (Interview with the Vice-Dean (Academic))

To effectively improve the application of ICT in teaching and learning outcomes, the Vice-Dean (Academic) delivered an administrative instruction that required all of the Chemistry pre-service teachers in the third cohort to participate in the course, despite it being optional during the teacher education session. She also strongly encouraged young teaching staffs to audit this course for the sake of their professional learning.

As the coordinator and lecturer of 'Secondary-school chemistry multimedia courseware', Dr Zeng shared a similar value and vision with the Vice-Dean (Academic) in relation to this enhanced course. He thought that enhancing the course would prove fruitful as it could develop pre-service teachers' ICT in education competencies more effectively and broaden his own views about teaching Chemistry with ICT.



However, Dr Zeng also mentioned his own difficulties in teaching this ICT core course and providing intensive technical support for the school. Due to the shortage of lecturers in the ICT core course, his workload increased and threatened to weaken his teaching role:

I think teaching is the most important thing. However, I am the only lecturer for this course. Besides teaching, I have to handle all the ICT-related administration and coordination in the school, which costs me half of my working time. It is hard for me to focus on the teaching preparation work. Importantly, this course is updated continuously and I need to work overtime to ensure the teaching quality, sometimes beyond my own capabilities.

Moreover, evaluations of teachers' professional qualifications for promotions and the awarding of academic titles failed to recognise teaching contributions and encourage the enhancement of teaching quality. Dr Zeng emphasised that the high demand for publication blocked staff members' passion to teach. Due to the lack of time available for writing academic papers, Dr Zeng expressed his reluctance to spend too much time teaching the course:



It is not easy to find a lecturer with highly integrated Chemistry, technology and pedagogy knowledge. Even if some lecturers had the capabilities, they would not like to take this course. It is really time-consuming preparing teaching materials, and the salary is the same as that in other easier courses. Under the heavy pressure to publish academically for promotion, few people would like to spend more time on this course. Without suitable guidance and standards, lecturers sometimes feel lost.

Curriculum leadership focus:

The Vice-Dean (Academic) was basically satisfied with the current level of the pre-service teachers' ICT in education competencies. She summarised her major roles as including:

- designing and managing the ICT core course;
 - supervising the course coordinator and lecturer in the implementation of the ICT core course;
 - supervising the learning outcomes related to the pre-service teachers' ICT in education competencies; and
 - supporting young teaching staffs in their professional learning of ICT.
- Dr Zeng defined his mixed roles as a curriculum leader, a technical manager, an ICT coordinator and an ICT core course lecturer. He was responsible for:
- drafting the course outline, including its purpose, contents, pedagogy and assessment;



- coordinating and lecturing for the ‘Secondary-school chemistry multimedia courseware’ course;
- providing technical support and managing the computer rooms; and
- handling ICT-related administrative work.

Context for curriculum leadership:

As the teacher evaluation system put too much emphasis on academic publication, lecturers had to spend a great deal of time and energy on research rather than teaching. Therefore, the efforts and achievements made in developing pre-service teachers’ ICT in education competencies were likely to be underestimated or overlooked. In addition, due to the rapid development of technology, the ICT core course had to be updated continuously, presenting a potentially big challenge to the curriculum leaders. The Vice-Dean (Academic) exerted a great deal of effort in this field as a result. However, the heavy lecturer workload, insufficient funds and lack of qualified lecturers collectively influenced the effectiveness of the ICT core course.

5.7 Profile of the History teacher education programme

5.7.1 History pre-service teachers’ TPACK perceptions

The survey was distributed to 42 History pre-service teachers and 39 valid surveys were returned. Table 5.13 reveals the History pre-service teachers' perceptions of TPCK. Only 23 (59%) and 21 (53.9%) of the responding pre-service teachers were confident in their capability of crafting real-world situations (Item 2) and designing lessons (Item 6) with TPCK, respectively. The percentage of groups that disagreed or were neutral was significantly higher than those of the Mathematics and Chemistry pre-service teachers. For instance, 20 (51.3%) participants were neutral about engaging in structuring activities to help students construct different representations of the CK using appropriate ICT tools (e.g., Webspiration, mind maps, wikis) (Item 3). Furthermore, 12 (30.7%) participants disagreed with their ability to create self-directed learning activities related to the CK with appropriate ICT tools (Item 4). This demonstrates that the History pre-service teachers' perceptions of TPACK remained at a relatively lower level and that the teachers were not sufficiently confident in their ability to apply ICT to their teaching and learning practices.



Table 5.13: Summary statistics for History pre-service teachers' TPCK perceptions ($N=39$).

Factor TPCK/Items	Disagree		Neutral		Agree	
	F	P (%)	F	P (%)	F	P (%)
TPCK-1	9	23.1	13	33.3	17	43.6
TPCK-2	7	17.9	9	23.1	23	59.0
TPCK-3	10	25.7	20	51.3	9	23.0
TPCK-4	12	30.7	11	28.2	16	41.0
TPCK-5	7	17.9	15	38.5	17	43.6
TPCK-6	10	25.6	8	20.5	21	53.9

Note: F=Frequency, P=Percent.

5.7.2 The ICT core courses in the History programme

Based on the 2010 History programme scheme, the School of History and Tourism offered three ICT core courses to its pre-service teachers. These courses were mainly distributed in the general and teacher education sessions in Years 1, 3 and 4, respectively (see Table 5.14).

Revised 'Comprehensive teaching skills of pre-service teachers' course

'Comprehensive teaching skills of pre-service teachers' was a two-credit compulsory course.

According to the 2010 History teacher education programme scheme, it should have been a TPK course. However, no lecturer in the School of History and Tourism specialised in TPK courses. Therefore, the Vice-Dean (Academic) had to design the course as a PCK course and

focused only on PCK theory and practice. The three sub-courses were ‘Microteaching’ (one credit), ‘Calligraphy and blackboard design’ (0.5 credit) and ‘Teaching practice’ (0.5 credit). The assessments for these sub-courses were arranged in Semesters 5, 6 and 7, respectively, from Years 3 to 4. Although no classroom lectures were delivered for these sub-courses, the course assessment standards were provided in advance to prepare the pre-service teachers. The lecturers at the school were responsible for the assessments. Pre-service teaching practices comprised the major assessment method. Only those who passed the course were able to participate in the practicums in Year 4.

Therefore, the History programme offered three ICT core courses to pre-service teachers, including TK, PCK and TPK courses. In Semester 1 of Year 1, the ‘Computer fundamentals’ course in the general education session developed pre-service teachers’ ICT literacy as a technological foundation. In the teacher education session, the three sub-courses under the ‘Comprehensive teaching skills of pre-service teachers’ course were offered in Semesters 5, 6 and 7, respectively. These sub-courses were expected to develop the pre-service teachers’ perceptions of PCK. Furthermore, the ‘Application of educational technology’ course offered in Semester 6 aimed to nurture the pre-service teachers’ perceptions of TPK. According to the History pre-service teachers’ responses, this sub-course was the most effective at developing their ICT in education competencies.



Table 5.14: The ICT core courses in the History programme

	Course name	Aims	Content	Teaching and learning strategies	Assessment	Time
General education	'Computer fundamentals' (Compulsory)	To develop the students' basic computer knowledge and applications for information access, processing and release	TK	Lecturing + computer practice Unified course outline, content, pedagogy and assessment	Provincial Test of Computer Level 1	S1, Y1
Teacher education	'Comprehensive teaching skills of pre-service teachers' (Compulsory)	To develop the students' classroom teaching skills and pedagogies	TPK-- PCK	No classroom lecturing	Pre-service teachers' artefacts and teaching practices	S 5-7, Y 3-4
	'Application of educational technology' (Optional)	To develop the students' capability of applying educational technologies to their learning and teaching practices	TPK	Lecturing + computer practice Course contents and pedagogy are decided by the lecturer	Pre-service teachers' artefacts	S 6, Y3

5.7.3 Role of school curriculum leadership in developing History pre-service teachers'

ICT in education competencies

Sources of curriculum leadership:

The ICT core courses in the History programme were offered by two schools, including the

School of Computer and Science and School of Education. However, the School of History

and Tourism offered no ICT core course. As the decision maker in matters of curriculum management for History pre-service teachers, the Vice-Dean (Academic) was also involved in the curriculum leadership system. The three sources of curriculum leadership comprised the curriculum leadership system for the ICT core courses in the History programme (see Table 5.15).

Table 5.15: Sources of curriculum leadership on the ICT core courses in the History programme

School of Computer and Science	School of Education	School of History and Tourism
• Course coordinator and lecturer of 'Computer fundamentals' (TK)	• Course coordinator and lecturer of 'Application of educational technology' (TPK)	• Vice-Dean (Academic)

In terms of developing History pre-service teachers' ICT in education competencies, Figure 5.3 summarises the interrelationship between curriculum leaders in an illustrated diagram.

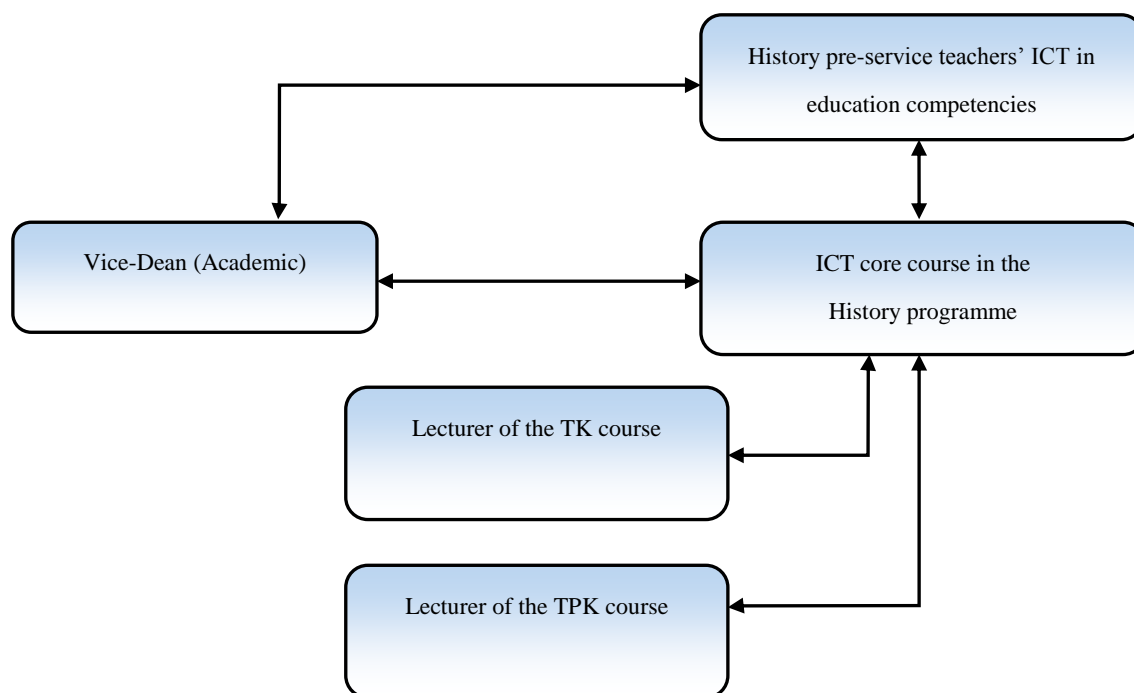


Figure 5.3: Role of curriculum leadership in developing History pre-service teachers' ICT in education competencies

Values of curriculum leadership:

The Vice-Dean (Academic) considered it important for History pre-service teachers to grasp basic ICT knowledge and skills and to integrate such knowledge into their teaching and learning practices. However, this was not the priority. The ICT-related courses in the History teacher education programme could afford to develop the pre-service teachers' ICT in education competencies. The views of the Vice-Dean (Academic) coincided with the results of the focus group interviews with the pre-service teachers, who were confident in their ability to teach history in a secondary school using ICT:

I don't think history pre-service teachers should have highly developed ICT in education competencies. According to the practicum reflections from our pre-service teachers, the current ICT-related courses, especially 'Application of educational technology', may be effective at equipping them with ICT knowledge and skills. It may not seem like a problem for our graduates to teach history using basic technology. (Interview with the History Vice-Dean (Academic))

I think I can handle teaching History using ICT in the practicum. Sure, most of us can make PowerPoint slides or insert pictures or Flash into our slides... I do not think it is a big problem for us. We can learn from capable peers or from the Internet. (Focus group interview with the History pre-service teachers)

The lack of suitable lecturers for the PCK and TPCK courses seemed to be the major reason for revising the 'Comprehensive teaching skills of pre-service teachers' course. When asked why this course was revised from a TPK course into a PCK course, the Vice-Dean (Academic) shrugged and stated the following:



The teaching staff in our school majored in liberal arts. They are not very skilful in technology, and especially not in teaching history professionally with ICT. Meanwhile, they don't think they need too much technology knowledge to support their current teaching practices. There is no suitable lecturer in our school to teach PCK or TPCK courses for our pre-service teachers, so we had to focus on pedagogical knowledge assessment in this course. (Interview with the Vice-Dean (Academic))

Curriculum leadership focus:

The Vice-Dean (Academic) emphasised that History pre-service teachers should be equipped with a strong subject and PK. Therefore, his preferences for curriculum management mainly focused on profound subject knowledge and a strong foundation of PK, skills and experience. He also confessed that he did not spend sufficient time on ICT-related issues:

The primary task for a history pre-service teacher is to develop strong professional and pedagogy knowledge to be competitive in the job market and qualified for their future job. This is my central focus in curriculum management. (Interview with the Vice-Dean (Academic))

Context for curriculum leadership:

Although the Vice-Dean (Academic) admitted that high levels of ICT in education competencies should be an advantage for pre-service teachers when applying for jobs, he explained that the lack of credits and qualified lecturers made it impossible to offer more ICT core courses at the school. He also explained that the competition for employability was the main reason he did not set ICT-related tasks as the priority:

There is no doubt that most of our pre-service teachers will be employed to teach History in a secondary school. However, because of the characteristics of liberal arts and some historic reasons belonging to the education system, the employment situation for history pre-service teachers is becoming increasingly serious. Therefore, more than half of our graduates have to take the national postgraduate enrolling examination to avoid the employment pressure temporarily. To support our graduates, we have to strengthen their professional knowledge in their apprenticeships, whether for the sake of their employment or further study. (Interview with the Vice-Dean (Academic))

5.8 Summary

By synthesising the results of the qualitative and quantitative research methods, this chapter displays the profiles of the three case studies. According to the research questions, the three



profiles followed the same sequence of pre-service teachers' perceptions of TPCK, curriculum structures for ICT core courses and support from curriculum leadership. The relevant curriculum leaders in the Mathematics and Chemistry programmes attached much importance to developing pre-service teachers' ICT in education competencies by offering TPCK courses or enhancing TPK courses. Although restricted by certain subjective and objective factors, the curriculum leaders in the History programme faced some difficulty in offering TPCK or TPK courses to History pre-service teachers. Although some of this difficulty arose out of the differences between the liberal arts and science disciplines, ICT knowledge foundations and employment requirements, the curriculum leaders' different approaches to their teacher education programmes were more likely to contribute to the higher ICT in education competencies of the Mathematics and Chemistry pre-service teachers compared with the History pre-service teachers.

In conclusion, the profiles of the three case studies supported the proposition to compare the roles of curriculum leadership. Furthermore, the profiles were generalised to develop a preliminary empirical-based understanding of the role curriculum leadership played in developing pre-service teachers' ICT in education competencies. The next chapter discusses the core themes that emerged from the generalisation and comparison of these profiles.



CHAPTER SIX

FINDINGS FROM THE THREE CASE STUDIES

6.1 Introduction

This chapter summarises the core themes that emerged from the three case studies.

The summary is mainly based on comparisons and contrasts of the three case study profiles presented in Chapter Five. The first section compares the effectiveness of teacher education programmes in developing pre-service teachers' ICT in education competencies by referring to the survey results, which provide a firm base for discussing the differences in ICT usage in the education curriculum structures of teacher education programmes. The second section explores curriculum leaders' practices according to the sources, values, foci and contexts of curriculum leadership. In the third section, the roles of curriculum leadership in teacher education programmes are investigated at the university, subordinate school and classroom levels. The interrelationships between curriculum leaders are presented to depict the operations of the curriculum leadership system. The final section proposes a



framework for the curriculum leadership system in developing pre-service teachers' ICT in education competencies.

6.2 Comparing pre-service teachers' ICT in education competencies

6.2.1 Comparing the TPACK factor scores

Pre-service teachers' self-assessed perceptions of TPACK are likely to be good predictors of their ICT in education competencies (Tschannen-Moran & Hoy, 2001; Voogt et al., 2012; Zelkowski et al., 2013). Chapter Five considers Mathematics, Chemistry and History pre-service teachers' TPACK perspectives according to seven constructs to compare their ICT in education competencies. The methodology and data analysis method adopted in this study provided a consistent protocol for examining pre-service teachers' TPACK. Upon closer inspection of the ANOVA test results, a comparison of the scores for all of the TPACK factors revealed two major findings.

First, there was a significant difference between science pre-service teachers (e.g., Mathematics and Chemistry) and their liberal arts counterparts (e.g., History) and no



significant difference between science pre-service teachers (e.g., Mathematics and Chemistry). This study is unique given its focus on pre-service teachers in a provincial university in China. Its findings provide evidence in support of previous studies that identified the contributions of subject-related factors to the difference in pre-service teachers' TPACK perceptions (Mishra et al., 2009; Koh, Chai, & Tsai, 2010; Lin et al., 2012; Chai et al., 2013; Zelkowski et al., 2013).

Second, science pre-service teachers were more confident and competent in their technology-related knowledge than liberal arts pre-service teachers. Mishra et al. (2009) and Stoddard (2010) obtained similar results. However, this study found that liberal arts pre-service teachers were more likely to maintain a greater interest in their PK than science pre-service teachers.

6.2.2 Discussing the quantitative and qualitative findings

The qualitative findings provided further support for the pre-service teachers' self-rated results. Most of the science pre-service teachers were increasingly knowledgeable about and skilled in the use of ICT. They perceived a certain degree of self-confidence in applying ICT to their teaching and learning practices and were



willing to learn more about and apply various kinds of ICT to their future classes to maximise learning outcomes. This finding was somewhat consistent with an earlier study of Chinese pre-service teachers' general and pedagogical ICT in education competencies (Martinovic & Zhang, 2012; Dong et al., 2015). However, although liberal arts pre-service teachers had a lower level of confidence in their TK, they were confident in their PK and inclined to believe that they required less TK than their science counterparts to teach liberal arts subjects. Most of the liberal arts pre-service teachers were basically satisfied with their TPCK and believed that their current ICT in education competencies were sufficient to meet the secondary school teaching requirements. Due to the lack of TPCK lecturers, these teachers preferred to seek help from peer coaching or the Internet when they found it difficult to apply ICT to their teaching practices.

The preceding findings may support the common view that science pre-service teachers' higher ICT in education competencies are derived from their stronger TK background. More importantly, they highlight the specific necessity of investigating what contributes to this difference in pre-service teacher education, the difficulties that may be encountered in teaching subject knowledge with ICT and how to arrange teacher education programmes to make liberal arts pre-service teachers more



competent and confident in applying ICT to their learning and teaching practices, rather than focusing solely on how to develop their ICT application skills. In terms of the design of teacher education programmes, the findings also explain why empowering pre-service teachers to engage in technology-enhanced learning for subject factors should be the new focus of ICT preparation for teacher education programmes.

Beyond comparing pre-service teachers' perceived TPACK, there is a need to compare how ICT is integrated into curriculum structures and how such ICT supports the development of pre-service teachers' ICT in education competencies.

6.3 Comparing the three teacher education programmes

6.3.1 Two categories of ICT in the education curriculum structure

Given the many variables involved, teacher education programmes are unlikely to be the sole determinants of how pre-service teachers develop their ICT in education competencies (Lim, Chai, & Churchill, 2010, Govender, & Naicker, 2014). However, as the core part of a teacher education programme, the effective use of ICT in



education curriculum structures tends to provide a foundation for the development of such competencies (Anderson & Maninger, 2007; Lu, Tsai, & Wu, 2015).

The ICT in education curriculum structures consists of TPACK-related courses to develop pre-service teachers' TPACK perceptions. Pre-service teachers' perceived TPACK is more likely to reflect their ICT in education competencies. Therefore, comparing the levels of pre-service teachers' ICT in education competencies requires a comparative review of the ICT in the education curriculum structure. This may be a meaningful way to understand how ICT in education competencies are developed in programmes, the curriculum leaders' thoughts about and actions towards those programmes and even the macro-links between the programmes and the surrounding institutional and social contexts.

In this study, the ICT in education curriculum structures fell into two main categories. Category one contained TK, TPK and TPCK courses. Category two included TK and TPK courses. Table 6.1 includes the Mathematics and Chemistry programmes in Category one and the History programme in Category two.

6.3.1.1 Category one: TK, TPK and TPCK courses

Both the Mathematics and Chemistry programmes consisted of TK, TPK and TPCK courses. However, these two programmes did not have to adopt similar numbers of ICT core courses. In fact, the number of ICT courses offered in a teacher education programme always depended on the credits allowed. The credit distribution and course content design were influenced by multiple internal factors such as the knowledge, vision, personal and professional characteristics of the curriculum leaders.

In the Mathematics programme, pre-service teachers were tasked with constructing their ICT integration knowledge from two TK courses, one TPK course and two TPCK courses. When reflecting on their learning experiences with ICT courses, the majority of the interviewed pre-service teachers reported that the two TK courses provided them with a more sound technological foundation. Meanwhile, the two enhanced TPCK courses and TPK course provided them with interconnected sources of TPK and TPCK. The teachers considered these ICT courses as stronger building blocks in the development of their ICT in education competencies (Mishra & Koehler, 2006; Ng & Lai, 2010; Chai et. al, 2013). In particular, the Mathematics pre-service teachers fully affirmed the effectiveness of two TPCK courses and expressed their appreciation for the TPCK course lecturer. The qualitative evidence provided good



support for the quantitative result that the Mathematics pre-service teachers were more confident in their TPK and TPCK.

Although the Chemistry programme also included TK, TPK and TPCK courses, it did not offer as many ICT core courses as the Mathematics programme. Given the preparation provided by the TK and TPK courses, the enhanced TPCK course was considered most effective in nurturing the Chemistry pre-service teachers' ICT in education competencies. According to the survey results, the Chemistry pre-service teachers rated their TCK perceptions higher than neutral. However, there was no TCK course targeting any explicit effort in this area. According to a crosscheck of the focus group interviews, the Chemistry pre-service teachers emphasised the significance of learning Chemistry-related drawing tools to teach the chemical change process in the TPCK course. This result may be attributed to the TCK items. These items had merged with TPCK, possibly because the TPCK course lecturer overemphasised TCK or failed to draw sufficient attention to the pedagogical arrangement within the TPCK course. Archambault and Barnett (2010) explained that the TPACK domains were complicated and connected. Hence, the pre-service teachers might have found it difficult to distinguish the factors.



The results were in general agreement with recent studies in that the TCK items merged with not only TPCK but also other knowledge constructs (Koh et al., 2010; Lee & Tsai, 2010; Chai et al., 2011a; Deng et al., 2014). The pre-service teachers might not have been able to clearly distinguish their TCK from their TPK or TPCK. As a result, some effects might have carried over from the TPK or TPCK courses, which would have contributed to the increase in the Chemistry pre-service teachers' confidence in their perceived TCK.

6.3.1.2 Category two: TK and TPK courses

The History programme presented a different situation. Due to a lack of lecturers for the TPCK course in the School of History and Tourism, the History pre-service teachers were offered only one TK course and one TPK course in their apprenticeships. As such, these two courses seemed to play important roles in nurturing the History pre-service teachers' ICT in education competencies.

However, according to the survey results, the gains in TK and TPK courses were the lowest among the factors reported by the History pre-service teachers. According to a crosscheck of their focus group interviews, learning technology-related courses (e.g.,

TK or TPK courses) seemed to present a challenge to the teachers. Many of the teachers did not achieve good grades in these courses, which made them unconfident in their TK and TPK perceptions. The lack of TPCK courses might have also contributed to these results.

No course targeted explicit TPCK efforts in this curriculum structure. However, the History pre-service teachers considered the gains in TPCK as moderate. There are two potential explanations for this. First, as researchers have suggested, some effects might have carried over from other courses. The pre-service teachers attended pedagogical courses concurrently with the TK and TPK courses, which might have helped increase their confidence in the subject matter (Zhao et al., 2011; Lin et al., 2012; Dong et al., 2015). Second, applying ICT to the education curriculum structure was an important way to develop the pre-service teachers' ICT in education competencies, but it was not the only way (Kale & Goh, 2014). Given a certain level of other knowledge constructs (e.g., TK, TPK and PCK), the pre-service teachers' notion of TPCK could have been formed and synthesised via on-line mentoring or peer coaching.



Table 6.1: Two categories of ICT in the education curriculum structure

Category one: TK+TPK+TPCK		Category two: TK+TPK
Mathematics programme	Chemistry programme	History programme
Computer fundamentals (TK)	Computer fundamentals (TK)	Computer fundamentals (TK)
Computer C language (TK)		
Application of educational technology (TPK)	Comprehensive teaching skills of pre-service teachers (TPK)	Application of educational technology (TPK)
Comprehensive teaching skills of pre-service teachers (TPK → TPCK)	Secondary-school chemistry multimedia courseware (TPCK)	
Computer-aided mathematics teaching (TPCK)		

Researchers have reached the broad consensus that as one of the core parts of teacher education programmes, applying ICT to education curricula has a significant effect on the development of ICT in education competencies. This study confirmed that course content, teaching and learning strategies and teacher educators were influential factors, as previous studies have identified (Hammerness et al., 2005, Koehler & Mishra, 2005; Chai et al., 2010, 2011a; Koh & Divaharan, 2011; Chien et al., 2012). More importantly, based on an integration of the survey results, documentation analysis and interview findings, the use of different ICT in education curriculum structures might have resulted in pre-service teachers achieving different levels of ICT in education competencies.

6.3.2 Challenges in the current teacher education programmes

In the context of authentic teacher education, addressing the factors that affect the ability of teacher education programmes to nurture pre-service teachers' TPACK perceptions has never been a simple task. Focusing on curriculum structures, course content, teaching and learning strategies or teacher educators alone may fall short of addressing the gaps between the processes of planning and implementing the use of ICT in education curricula in a real-world setting, as teacher education programmes may face many constraints. Despite this, the specific necessity of investigating the challenges faced by current teacher education programmes must be highlighted. The problematic areas include (1) curriculum sequencing, (2) academic credits and lesson hours, (3) the capacity of lecturers and (4) course linkage and coherence. These factors should receive greater attention when designing ICT learning experiences for pre-service teachers.

6.3.2.1 Curriculum sequencing

In Chinese higher education institutions, students usually perceive optional courses as being of less value than their compulsory courses. ICT core courses are positioned as



optional courses in most teacher education programmes. Like other optional courses, optional ICT core courses are reportedly restricted by their positioning. For instance, optional courses always have loose examination requirements and cover a lot of content but are assigned relatively few lesson hours. These courses may not be the priority for curriculum resource allocation. Their teaching quality may not appear to be an important criterion for a lecturer's teaching capability. More importantly, given the heavy study loads of compulsory courses, pre-service teachers may not be able to spend sufficient time and energy on these optional ICT core courses. Therefore, when ICT core courses are positioned as optional courses, their effectiveness is more likely to decrease.

6.3.2.2 Academic credits and lesson hours

According to the curriculum leaders interviewed, the academic credits and lesson hours for the ICT core courses were insufficient. Due to the barriers and gaps in the current institutional system, more than 75% of the credit courses in the sampled teacher education programmes were compulsory and required by the university, province and MOE. Consequently, the academic autonomy of each subordinate school was limited in terms of its own curriculum development.



The ICT core courses were usually content rich. When the courses were positioned as optional, achieving ICT integration given the limited academic credits and lesson hours presented a challenge. The credits were insufficient to offer enough ICT core courses, and it was difficult to maintain the coherence of the ICT curricula in the teacher education programmes (see Section 5.6.2). It was also stressful for the lecturers to compress their teaching content and adjust their teaching and learning practices and curriculum resource allocations according to the tight course schedule. In addition, the pre-service teachers felt pressured by the heavier study loads (see Section 5.7.2).

6.3.2.3 Capacity of lecturers

This study confirmed Zhou, Zhang and Li's (2011) statements about the lack of faculty members with expertise in both ICT and subject pedagogy. This issue was more likely to be found in the liberal arts teacher education programmes. Due to their personal educational backgrounds, most of the lecturers in the liberal arts programmes had professional-level subject or subject-related PK. They found it challenging to teach an ICT synthesised course for pre-service teachers. Hence, TK had to be

removed from the course content on occasion, and at times the TPCK course had to be excluded from the programme (see Section 5.8.2). In particular, there was a serious shortage of qualified lecturers for the TPACK courses. Most of the programmes included only one TPCK course lecturer, who was also responsible for coordinating the course. The performance of the lecturer largely determined the teaching quality of the TPCK course.

6.3.2.4 Linkage and coherence of courses

One common criticism of teacher education programmes is that their courses are not linked and lack coherence (Hammerness et al., 2005; Ng & Lai, 2010; Voogt, 2010). This criticism was also confirmed in this study. By crosschecking the course outlines and findings from the interviews conducted with curriculum leaders and pre-service teachers, the researcher found that the contents of some of the ICT core courses were repetitive or the pre-service teachers perceived them as disconnected. For instance, the TK and TPK courses were unconnected, and the TPK and TPCK courses were more likely to be repetitive. Some of the programmes included no TPCK course. It is important for these courses to be designed with an adequate awareness of the general scheme of progression for the pre-service teachers (Lim, Chai, & Churchill, 2010).

Following Drenoyianni's (2004) descriptions of how pre-service teachers' ICT in education competencies should be developed in a four-year programme given the curriculum management in current Chinese teacher education programmes, Table 6.2 proposes a method for integrating ICT into the curriculum structures of these programmes. This proposed curriculum structure seems to fully consider that ICT core courses should build on one another to support the technological and pedagogical learning of pre-service teachers and enhance their ICT in education competencies (Angeli & Valanides, 2005; Lisowski, Lisowski, & Nicolai, 2006; Govender, & Naicker, 2014; Ebisine, 2015).

Table 6.2: The proposed ICT in education curriculum structure for teacher education programmes

Year of study	ICT core course	Content
Year 1 (Semester 1)	Computer fundamentals	TK course
Year 2 (Semester 3 or 4)	Application of educational technology	TPK course
Year 3 (Semester 5)	Comprehensive teaching skills of pre-service teachers	TPK course
Year 3 (Semester 6)	TPCK course	TPCK course
Year 4 (Semesters 7 and 8)	Practicum	Application of ICT to teaching and learning practices

6.3.3 Curriculum leadership shapes and is shaped by teacher education programmes

Lee and Dimmock (1999) pointed out that curriculum leadership encompassed both educational programmes and staff management and that educational programmes were thus directly linked to curriculum leadership. They also presented the findings of two case studies in which curriculum leadership shaped the educational programmes of Hong Kong secondary schools. In the context of teacher education, this is especially true when curriculum leaders manage the planning, implementation and even evaluation of programmes in addition to curriculum resource allocation. Thus, supportive curriculum leadership is essential to providing a meaningful context for the effectiveness of teacher education programmes.

Curriculum leadership is also shaped by teacher education programmes. National and provincial policies or standards, ICT planning and training, ICT facilities and resources, types of pre-service teachers and the quality of a university faculty set the tone for programme schemes. Curriculum leaders should meet the requirements of these schemes. However, programme challenges such as curriculum orientation, academic credits and lesson hours, lecturer capacity and even course linkage and



coherence may restrict the practices of curriculum leadership. Therefore, the practices of curriculum leaders are shaped by teacher education programmes both externally and internally.

Curriculum leadership both shapes and is shaped by teacher education programmes.

This is an important finding that suggests that curriculum leadership is not in itself a solution to the ‘problem’ of programme effectiveness. Changes from the MOE, provincial education department or even higher education institutions may affect teacher education programmes in ways that both limit and facilitate the practices of curriculum leaders. However, few studies have found a clear link between teacher education programmes and curriculum leadership. One necessary condition for fostering such a link is to consider the learning outcomes of pre-service teachers.

In summary, based on the previous literature, curriculum leaders’ efforts to establish a link between teacher education programmes and curriculum leadership are important conditions that support the development of pre-service teachers’ ICT in education competencies. This is discussed further in the following section.

6.4 Comparing and making sense of curriculum leaders’ practices

In this section, Hallinger's (2011) model is used to clarify and compare the practices of curriculum leaders. Hallinger's (2011) model for determining the effect of educational leadership on students' learning outcomes contains four dimensions, including the values, foci, contexts and sources of leadership. To achieve the purposes of this study, 'leadership' was specified as 'curriculum leadership' and 'students' learning outcomes' were specified as 'pre-service teachers' ICT in education competencies'. In addition, the 'sources of curriculum leadership' were made a focus to identify the curriculum leaders involved. The four dimensions were modified and applied to the following analysis as the sources, values, foci and contexts of curriculum leadership, respectively.

6. 4.1 Sources of curriculum leadership

According to the integrated findings taken from the interview data and documentation analysis, the major sources of curriculum leadership in the teacher education programmes mainly came from the university administration level, School of Computer and Science, School of Education and sampled subordinate schools. Due to



their positions and work responsibilities, the key curriculum leaders included the following:

(1) the Vice-President (Academic) and Vice-Director of the TAO (Academic) from the university administration level;

(2) the Vice-Dean (Academic), TK course coordinator and lecturer from the School of Computer and Science;

(3) the Vice-Dean (Academic), TPK course coordinator and lecturer from the School of Education; and

(4) the Vice-Dean (Academic), TPK or TPCK course coordinator and lecturer from the sampled subordinate schools.

6.4.1.1 Two categories of curriculum leadership sources

Different applications of ICT in an education curriculum structure indicate a different curriculum leadership source. The ‘Application of educational technology’ course in the School of Education was not included in every teacher education programme.

According to this specific course, the sources of curriculum leadership in the sampled programmes were divided into two broad categories (see Table 6.3).



One category was created for the Mathematics and History programmes and included the ‘Application of educational technology’ course. There were four sources of curriculum leadership in these two programmes: (1) university administration, (2) the School of Computer and Science, (3) the School of Education and (4) the sampled subordinate schools. The Chemistry programme did not offer this course to its pre-service teachers. The curriculum leadership in the School of Education was excluded. As a result, there were only three curriculum leadership sources for this category: (1) university administration, (2) the School of Computer and Science and (3) the sampled subordinate schools.

Table 6.3 Two categories of curriculum leadership sources

Mathematics and History programmes	Chemistry programme
(1) University administration	(1) University administration
(2) School of Computer Science	(2) School of Computer Science
(3) School of Education	(3) Sampled subordinate schools
(4) Sampled subordinate schools	

6.4.1.2 Curriculum leaders’ practices from different sources

In addition to the two categories of curriculum leadership sources, the findings from the interviews with curriculum leaders indicated the following practices of curriculum leaders from different sources.

- Curriculum leaders from the university administration level were the senior authorities in ICT policymaking at the university. They were responsible for expressing and reinforcing the university's values and strategies in relation to ICT, staffing, resource allocation and programme adoption. They worked to provide a meaningful and supportive context for ICT development at the university. This source of curriculum leadership was similar to that of the subordinate schools at the university.
- Curriculum leaders from the School of Computer and Science were responsible for offering TK courses to build pre-service teachers' TK and capability.
- Curriculum leaders from the School of Education took responsibility for offering TPK courses to develop pre-service teachers' capability of integrating ICT into their pedagogies. Pre-service teachers' TPK perceptions were considered essential to their development of TPCK perceptions. As such, if the TPK courses were not involved in the teacher education programmes, then the curriculum leadership from the School of Education could not have supported the



development of the pre-service teachers' TPK perceptions, creating an important missing link between their TK and TPCK perceptions.

- Curriculum leaders from each sampled subordinate school were responsible for timetabling; programme adoption; ensuring the quality of teaching and learning practice; and staff and resource allocations within the school. In particular, they shouldered more of the responsibility for monitoring the application of ICT in the education curriculum structures, monitoring the programme processes and offering TPK or TPCK courses to pre-service teachers. Therefore, this source of curriculum leadership was the main driving force behind the development of pre-service teachers' synthesised TPCK.

Although both contextual and personal factors might have contributed to the differences in the applications of ICT to education curriculum structures, the Vice-Deans (Academic) in the subordinate schools usually took a stand on curriculum adoption in the teacher education programmes. Therefore, the Vice-Deans (Academic) might have had a direct effect on the applications of ICT to education curriculum structures and an indirect effect on the sources of curriculum leadership in the teacher education programmes.



6.4.2 Values of curriculum leadership

Hallinger (2011) highlighted the role of values in shaping curriculum leadership. It is critical to investigate the values of curriculum leaders, who have collective effects on the provision of support to develop pre-service teachers' ICT in education competencies. In this study, although the Vice-Deans (Academic) agreed that the tasks related to pre-service teachers' ICT teaching and learning practices were very important, this did not imply that the tasks would be handled as the first priority. Rather, the tasks were prioritised according to the urgency and significance of the consequences. The major task for developing the pre-service teachers' ICT in education competencies was allocated to the coordinator and lecturers of the ICT core courses.

6.4.2.1 Factors shaping the values of the curriculum leaders

The values of the curriculum leaders might have been collectively shaped by several major factors. In terms of systematic factors, the institutional bureaucracy and hierarchy not only ensured power and authority to individual positions, but also shaped positional values (see Section 3.2.3). In terms of human factors, the

pre-service teachers' learning outcomes, superiors' requirements and peer competition shaped the curriculum leaders' values. The social competition in the job market and economic development also affected the values of the curriculum leaders. Finally, personal factors such as personal attributes, characteristics, educational backgrounds, work experience, visions, beliefs and knowledge related to ICT were considered sources of the variation in the curriculum leaders' values.

6.4.2.2 How the values of the curriculum leaders guided their foci

The aforementioned factors collectively shaped the values of the curriculum leaders in developing pre-service teachers' ICT in education competencies. In fact, a variety of the values the curriculum leaders perceived they should and did adopt for themselves had significant effects on their priorities and foci in their daily behaviour. The curriculum leaders practised their values through the decisions they made on ICT resource allocation, staffing, ICT problem finding and resolution. This also involved taking a stand on an ICT core course for the programme and determining how to resolve problems in the programme processes or how to use the credits and lesson hours for ICT core courses. Therefore, an understanding of the current values held by curriculum leaders may serve as a good starting point for discussing the philosophy



underlying their foci and furthering their leadership practices in developing pre-service teachers' ICT in education competencies.

6.4.3 Foci of curriculum leadership

6.4.3.1 Understanding the foci of curriculum leaders

It was not a simple task to identify the foci of curriculum leaders in developing pre-service teachers' ICT in education competencies. In most cases, the curriculum leaders seldom adopted only one focus in their real work. Rather, they usually adopted two or more foci, and the intensity of particular foci ranged from strong to weak according to the leaders' positions. Furthermore, the foci of curriculum leaders were interactive or overlapped those of leaders at different levels, and even foci at the same level differed for various reasons such as personal values, professional cognition, knowledge of and work experience with ICT and subordinates' requirements. For instance, the Vice-Deans (Academic) participated in the ICT core course enhancement process and attached great significance to pre-service teachers' learning outcomes. The ICT course coordinators and lecturers were not necessarily involved in the school's ICT administration work. They took on the responsibility of managing



the development of the course, including its contents, pedagogy, learning tasks and assessment. However, their participation in the establishment of ICT visions and goals influenced the effectiveness of the curricula and pre-service teachers' learning outcomes.

6.4.3.2 How curriculum leaders' different values and foci influence their practices

In terms of developing pre-service teachers' ICT in education competencies, the curriculum leaders exhibited different preferences. Their values of importance were broken down into three levels: high, medium and low. The foci of the three Vice-Deans (Academic) included support, participation and neglect, respectively. The two TPCK course coordinators and lecturers focused on enhancing the course either actively or passively. Table 6.4 identifies the relationships between the different values and foci of the curriculum leaders and their practices in developing pre-service teachers' ICT in education competencies.

The Vice-Dean (Academic) in the Mathematics programme was an expert in Statistics rather than Mathematics teaching. Although he valued the ICT capability of Mathematics pre-service teachers, he could not provide much instruction about the

academic structure and processes of the programme. Instead, he supported the teachers by building the ICT learning culture, encouraging their professional development and updating the ICT infrastructure. The TPCK course coordinator and lecturer amassed rich work experience in teaching Mathematics with ICT. He actively played two leading roles that were vital in both revising the ICT core courses and influencing the Vice-Dean's (Academic) ICT decisions.

In contrast, the Vice-Dean (Academic) in the Chemistry programme made pre-service teachers' ICT in education competencies her working priority. She worked collaboratively with the TPCK course coordinator and lecturer in the processes of designing, implementing and evaluating the TPCK course, and even adopted an administrative method to ensure course attendance. In contrast, the TPCK course coordinator and lecturer acted passively in enhancing the course due to his heavy workload.

Things were different in the Chemistry programme. The Vice-Dean (Academic) did not make pre-service teachers' ICT in education competencies his priority. Instead, he attached more importance to the CK and PCK courses. In his opinion, it was more urgent to develop pre-service teachers' CK and PCK perceptions to make the teachers



competitive in the job market. Therefore, although there was no TPCK course in the programme, he believed that the current ICT core courses were sufficient to fill the requirements of History pre-service teachers' future teaching practices.

Table 6.4: Curriculum leaders' practices from different values and foci

		Values of importance	Focus	Practices
Vice-Dean (Academic)	Mathematics programme	Mediate	Support	Providing support for TPCK course enhancement
	Chemistry programme	High	Participation	Participating in the processes of TPCK course enhancement
	History programme	Low	Neglect	Not offering a TPCK course in the programme
TPCK course coordinator and lecturer	Mathematics programme	High	Actively implemented	Two leading roles in both revising the ICT core courses and influencing the Vice-Dean's (Academic) ICT decisions.
	Chemistry programme	Mediate	Passively implemented	Working to meet the requirements of the Vice-Dean (Academic) for course enhancement, solving technological problems and lecturing
	History programme	No	No	No

6.4.3.3 Curriculum leaders' approaches to addressing challenges

Curriculum leaders with different values and foci may adopt various approaches to address the challenges related to curriculum sequencing, insufficient academic credits and lesson hours, lecturer capacities and course linkage and coherence. Table 6.5

summarises the approaches adopted by the curriculum leaders from the sampled teacher education programmes when confronted with these challenges. First, to ensure the pre-service teachers' attendance in the optional TPCK course, curriculum leaders in the Mathematics and Chemistry programmes adopted the administration method and made attendance mandatory. Second, to address insufficient academic credits and lesson hours, the curriculum leaders in the Mathematics programme split the academic credits from the TPCK course to offer an additional TPK course, and the curriculum leaders in the Chemistry programme enhanced the TPCK course in terms of its content, pedagogy and assessment. Third, due to a lack of qualified lecturers for the TPCK course, the TPCK lecturer in the Mathematics programme took on a heavy teaching load. The TPCK lecturer in the Chemistry programme not only taught big class sizes but also provided technical support for the school. In contrast, the Vice-Dean (Academic) in Programme H revised the TPK course into a PCK course and removed the TPCK course from the programme. Finally, to avoid course disconnection and repetition, the same lecturer was responsible for coordinating and lecturing the successive TPK and TPCK courses in the Mathematics programme. In contrast, the Vice-Dean (Academic) and course lecturer in the Chemistry programme seriously examined the content of the TPCK course.



Table 6.5: Curriculum leaders' approaches to addressing challenges

Challenges	Approaches		
	Mathematics programme	Chemistry programme	History programme
(1) Curriculum sequencing	Ensured the students' attendance in optional ICT core courses	Ensured the students' attendance in optional ICT core courses	Revised the TPK course into a PCK course Removed the TPCK course from the programme
(2) Academic credits and lesson hours	Split academic credits	Enhanced course content	
(3) Capacity of lecturers	One lecturer for two ICT core courses	Big class size for TPCK course Technical support	
(4) Linkage and coherence of courses		Serious examination of the TPCK course contents	

In summary, Hallinger (2011) highlighted that personal values shaped the thinking and actions of curriculum leaders and represented potentially useful tools for strengthening a school's learning culture. The current study reaffirmed this conclusion. Curriculum leaders' values may be among the most important contributions to their different foci. Furthermore, the interviewed curriculum leaders reported that the foci they chose for themselves were more likely to indicate their ICT-related curriculum leadership behaviour. Hence, in a similar context, the curriculum leaders' values and foci dictated their roles in developing pre-service teachers' ICT in education competencies.

6.4.4 Contextual factors

The contextual factors affecting the university curriculum leaders' practices came mainly from the traditional teacher education system, educational reform and local economic development and university resource conditions. The curriculum leaders in the three programmes faced similar challenges, including the pressure of academic evaluation, student learning habits shaped by traditional teaching, competition in the job market, insufficient ICT infrastructure and hardware and a lack of qualified lecturers to apply more ICT to education core courses. The contextual barriers of cultural resistance, the education system, local economic development, resource availability and the leaders and staff members' visions and beliefs were highlighted. A key criterion for evaluating the university was the employability of its graduates. ICT in education competencies were not part of the evaluation criteria, nor were any explicit assessment standards for ICT in education competencies provided. Therefore, the manpower and resource support provided by the university were insufficient, as each subordinate school developed its own pre-service teachers' ICT in education competencies.



6.4.5 Curriculum leaders' practices in developing pre-service teachers' ICT in education competencies

Figure 6.1 compares the sources, values, foci and contexts of the practices the curriculum leaders adopted to develop pre-service teachers' ICT in education competencies and summarises the key findings in three flowcharts.

Figure 6.1 shows the sources of curriculum leadership and their relationships to the design, development and implementation of ICT core courses in the three teacher education programmes. The School of Computer and Science, School of Education and subordinate schools applied ICT to their core courses in education. These courses involved the curriculum leaders of the three subordinate schools along with the Vice-President (Academic) and Vice-Director of the TAO (Academic) at the university level. Curriculum leadership at the university level was very similar to that at the subordinate school level. However, the curriculum leaders' practices appeared to differ in the subordinate schools.

Curriculum leaders in the subordinate schools mainly handled the management of ICT core courses. In fact, the Vice-Dean (Academic) or TPCK course coordinator and

lecturer's involvement in enhancing ICT core courses varied across the different subordinate schools. In Figure 6.1, the bold lines represent the strengthened roles of the curriculum leaders and the thin lines refer to routine administration from the leaders. The double-headed arrows refer to the interactions between the two sources of curriculum leadership. In particular, the thick lines with arrows emphasise the dual role of the TPCK course coordinator and lecturer in the Mathematics programme. He played a pivotal role in revising, coordinating and lecturing for the ICT core courses and influenced the Vice-Dean's (Academic) decisions about those courses.

In addition, either the Vice-Dean (Academic) or the TPCK course coordinator and lecturer played an active role in enhancing the ICT core courses. This role was more likely to contribute to the development of pre-service teachers' ICT in education competencies, such as in the Mathematics and Chemistry programmes. In contrast, when there was no dedicated Vice-Dean (Academic) or other ICT-capable teaching staff in a subordinate school, such as in the History programme, the revision of ICT core courses and development of pre-service teachers' ICT in education competencies were rather slow or ineffective.



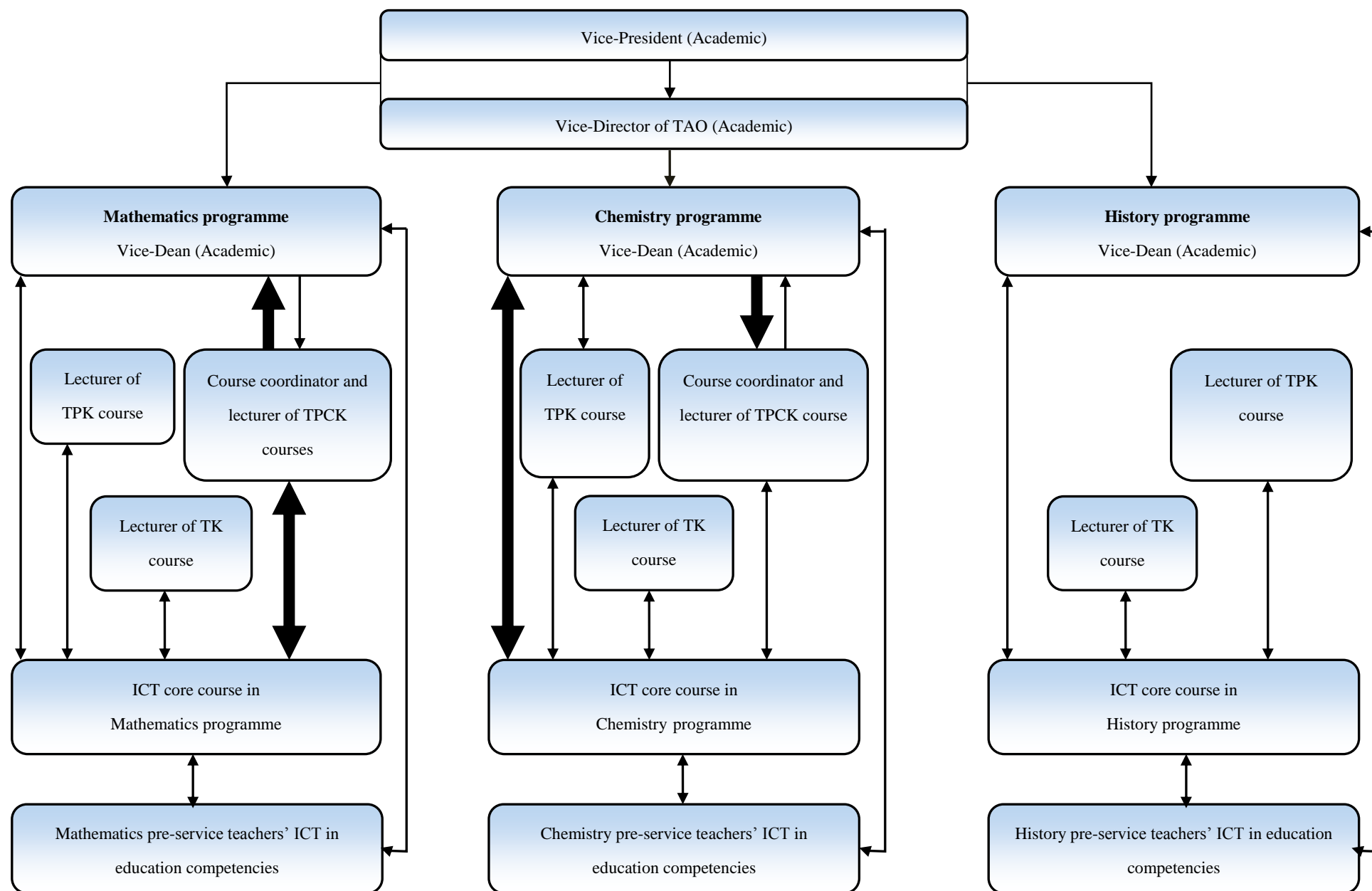


Figure 6.1: Curriculum leaders' practices in developing pre-service teachers' ICT in education competencies

6.5 Role of curriculum leaders

As shown in Figure 6.1, the preceding paragraphs delineate the broad dimensions of curriculum leaders' practices. Within these dimensions, it was important to clarify the roles played by curriculum leaders in equipping pre-service teachers to teach with ICT. Doing so had the potential to advance the ICT teaching and learning experiences of pre-service teachers. Figure 6.1 exhibits the roles played by curriculum leaders at the university, subordinate school and classroom levels.

6.5.1 Curriculum leaders at the university administration level

In terms of developing pre-service teachers' ICT in education competencies, curriculum leaders at the university level (e.g., the Vice-President (Academic) and Vice-Director of the TAO) performed three distinct roles, including ICT policymaker, senior curriculum administrator and relationship coordinator. First, their role as ICT policymaker meant that they formulated policies and strategies that set the tone of ICT development for the university. They also drew up ICT management regulations to foster an ICT-friendly teaching and learning environment on campus. Second, their role as senior curriculum administrator, a role most traditionally adopted by senior



curriculum leaders, meant that they provided instructions for curriculum development and monitored programmes and teaching quality. Third, their role as relationship coordinator meant that they had to coordinate relationships between subordinate schools, technology centres and relevant administrative offices if needed.

6.5.2 Curriculum leaders at the subordinate school level

Data from the three case studies showed that the curriculum leaders in subordinate schools (e.g., the Vice-Dean (Academic)) played mixed roles in curriculum monitoring and innovation. ICT middle manager was the role most commonly identified. These managers had significant effects on bridging ICT course enhancement with the development of teacher education programmes. They not only led the ICT-related teaching and learning activities, but also monitored the application of ICT to education curriculum structures, course objectives, credit management and teaching quality. They took on the role of ICT supporter or sponsor. They also developed an ICT learning culture, supported the professional development of teaching staffs and updated ICT infrastructure and learning resources.

6.5.3 Curriculum leaders at the classroom level



The curriculum leaders at the classroom level (e.g., course coordinators or lecturers) were more likely to be curriculum resource designers, ICT instructors and technical managers. They had a significant effect on course content, pedagogy, assessment tasks, classroom activities and even technical support. In particular, they were crucial in making decisions about the implementation of ICT core courses. This implementation process was carried out with the help of various ICT tools. To a great extent, they had to perceive the affordances of ICT as a prerequisite for selecting ICT tools. These lecturers from the teaching frontier might have had a more direct effect on developing pre-service teachers' ICT in education competencies than their superiors. However, they also complained about the heavy teaching workloads and the pressure of achieving promotion.

In summary, the significance of each role depended on many external and personal factors. However, it was clear that curriculum leaders from different levels had different interpretations of and practices related to their ICT roles. These differences strongly influenced the decisions they made about the facilitation processes of programmes or ICT core courses and in turn played an important role in developing pre-service teachers' ICT in education competencies.



6.6 Interrelationship between components in the curriculum leadership system

Given that curriculum leadership is a process of mutual influence (Hallinger & Heck, 2010), curriculum leaders should work coherently and systematically as a team. Curriculum management should not be split into isolated segments. Based on this standpoint and the previous reports on the roles of curriculum leaders, there was a need to investigate the interrelationship between curriculum leaders when they were playing their roles in the teacher education programmes. The following paragraphs mainly report on how an effective curriculum leadership system was proposed based on the interrelationship between components in the curriculum leadership system.

6.6.1 Interrelationship between components in the current curriculum leadership system

Analysis of the university policies and the interviews conducted with curriculum leaders provided useful data for uncovering the complex interrelationship between curriculum leaders. The framework in Figure 6.2 not only illustrates the interrelationship between components in the current curriculum leadership system in a



sampled subordinate school, but also provides grounds for investigating the issues in this interrelationship. The solid lines refer to the tasks and responsibilities performed by curriculum leaders, and the dotted lines refer to the unimplemented interactions. The one-way arrows represent how the curriculum leader performed the role or influenced others, and the double-headed arrows indicate when this influence tended to be interactive. Figure 6.2 identifies three major issues in the current curriculum leadership system:

- top-down management;
- lack of communication and collaboration; and
- lack of reflection and feedback.



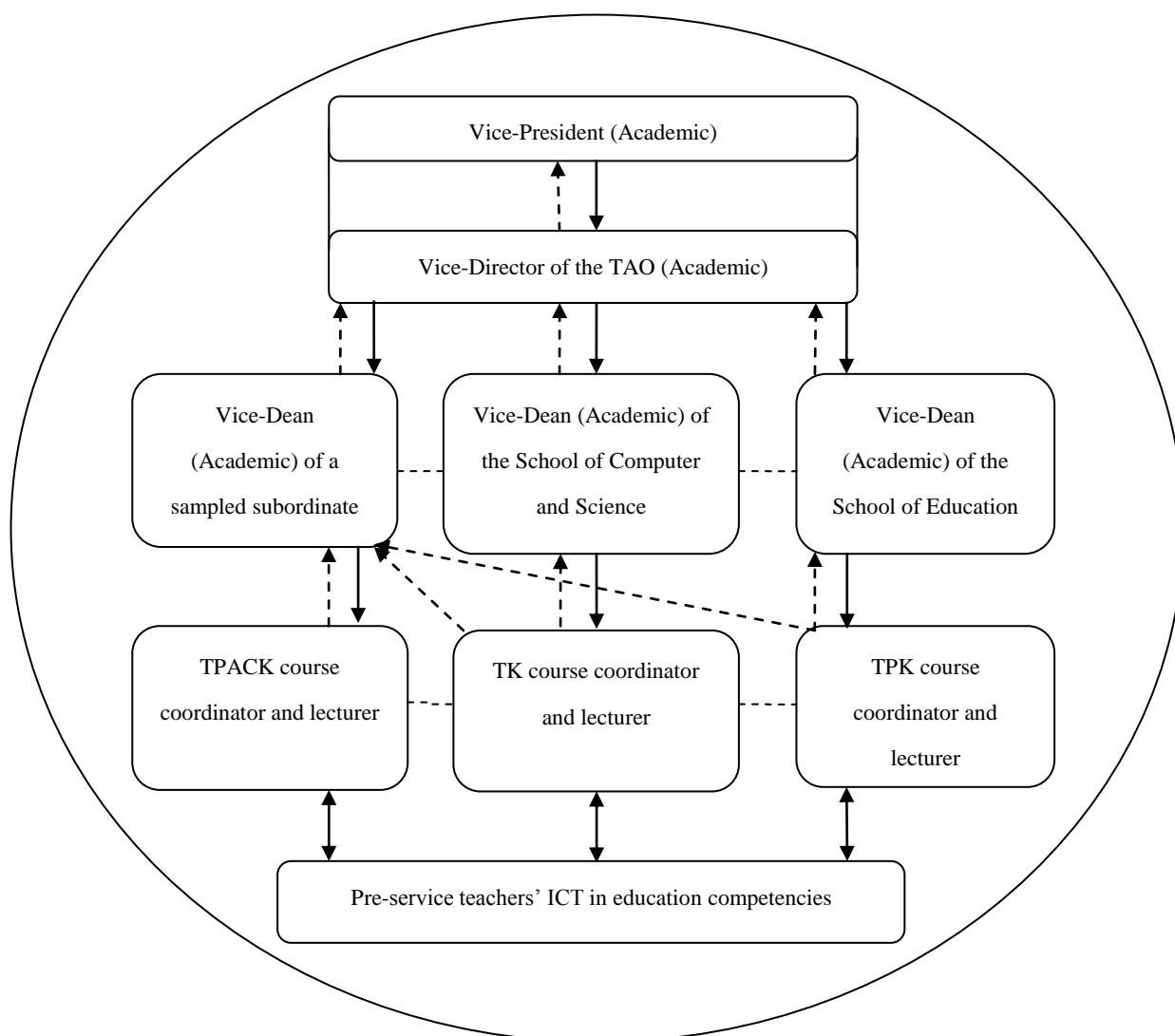


Figure 6.2: The interrelationship between components in the curriculum leadership system

6.6.1.1 Top-down management

It is not surprising that leadership approaches to curriculum management are more likely to be dominant and top-down in the context of Chinese higher education

institutions. A substantial body of research has reported on the positive effects of such curriculum leadership in terms of maintaining harmony and improving the effectiveness of execution. However, it also presents disadvantages in terms of being subjective or one-sided in practice.

In this study, the top-down linkage between university and subordinate schools and within individual subordinate schools seemed to be strong. In contrast, the horizontal linkage between subordinate schools was relatively weak. Moreover, only the linkage between ICT course lecturers and their pre-service teachers were interactive. The lecturers might have been continuously concerned about their pre-service teachers' learning outcomes, particularly in terms of ICT learning.

6.6.1.2 Lack of communication and collaboration

Their posts ensure that curriculum leaders have their own work focus. However, communication and collaboration are two key interdependent pillars that contribute to the effectiveness of teacher education programmes. Communication between curriculum leaders provides a foundation for collaboration. Collaboration is pivotal in building trust and respect between various curriculum leaders to facilitate



communication. However, the current curriculum leadership system was found to lack communication and collaboration from either internal or external subordinate schools.

As the ICT core courses were offered separately by different subordinate schools, sustained efforts were required to coordinate the relationships between the involved curriculum leaders. For instance, communication and coordination between the Vice-Deans (Academic) would have facilitated collaboration between the lecturers of the TK, TPK and TPCK courses. It would have also addressed gaps or omissions and avoided repetition between courses, especially when there was a lack of consistent management or supervision or an absent evaluation system. However, in any subordinate school, communication and collaboration between different levels of curriculum leaders were pivotal to ensuring the effectiveness of academic progress in developing pre-service teachers' ICT in education competencies. Thus, the Vice-Deans (Academic) were recommended to work collectively with the course coordinators and lecturers to co-develop the ICT core courses.

6.6.1.3 Lack of feedback and reflection



Teachers' reflection is a response to programme situations. It helps to modify the understanding and actions necessary to solve the problems with a programme (Dewey, 1997; Wells, 2014). Hence, lecturers' reflections, together with pre-service teachers' feedback, should be seriously considered. These reflections and feedback were likely to affect the practices of curriculum leaders. The Mathematics pre-service teachers shared their willingness to learn more about applying ICT to their teaching and learning practices. Most of them believed that the use of ICT in teacher education programmes should emphasise the integration of TK, PK and CK and the connection between theory and practice. This belief might have been a driving force encouraging the curriculum leaders to enhance the ICT courses for their pre-service teachers. Meanwhile, the Vice-Dean (Academic) and course coordinator admitted that the pre-service teachers' feedback tended to be direct assessments of the ICT core courses. In contrast, the History pre-service teachers were satisfied with their current ICT in education competencies and did not perceive an urgent need for improvement. This might have been an important reason for the Vice-Dean's (Academic) slowness in developing the ICT core courses. Therefore, the feedback and reflections from the pre-service teachers served as important explanations for the practices of the curriculum leaders.



6.6.2 Proposed interrelationship between components in the curriculum

leadership system

The framework portrayed in Figure 6.3 proposes an effective curriculum leadership system for developing pre-service teachers' ICT in education competencies. It not only synthesises the conceptualisation based on the curriculum leaders' practices and roles, but also overcomes the interrelationship issues in the current curriculum leadership system.

The framework in Figure 6.3 reconfirms the assumptions induced from Hallinger's (2011) educational leadership framework, which it further develops by specifying the roles of curriculum leaders in developing pre-service teachers' ICT in education competencies. First, it emphasises that the practices of curriculum leaders are highly contextualised. Curriculum leadership is enacted within not only the institutional system of a university but also the social context. Second, curriculum leaders' practices are moderated by their personal characteristics. In particular, their values, beliefs, ICT knowledge and work experience with ICT are the main sources of variation in their practices. Third, curriculum leadership may not have a direct effect on pre-service teachers' ICT in education competencies. Instead, it influences the



processes of teacher education programmes to develop these competencies. Fourth, curriculum leaders are under pressure to acquire and use effective programme management strategies in applying ICT to education. Support from university senior management is always essential in coordinating subordinate schools to work collaboratively. Finally, effective communication and collaboration between and within subordinate schools in addition to pre-service teachers' feedback and reflections are important driving forces that inform the practices of curriculum leaders.



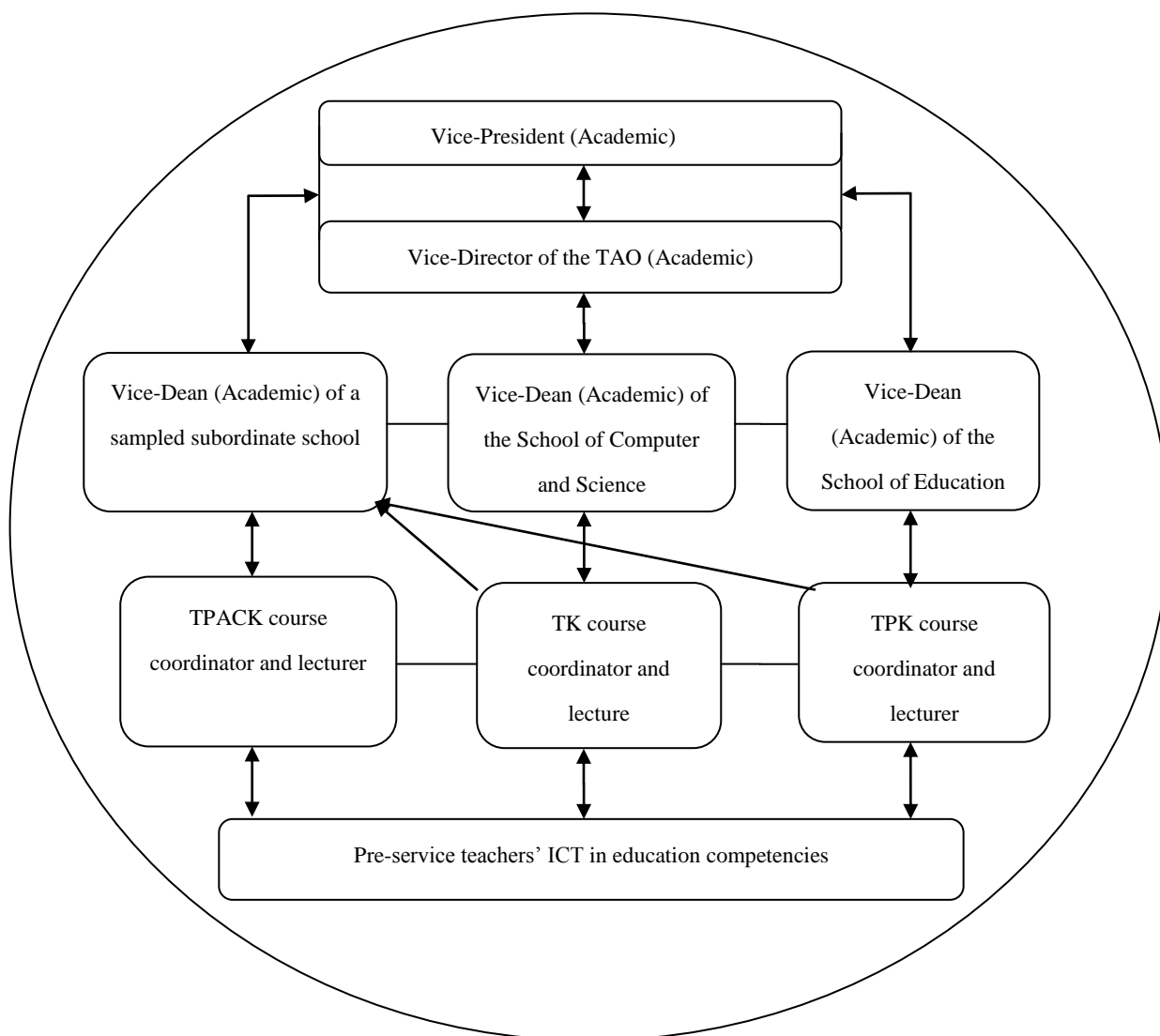


Figure 6.3: The proposed interrelationship between components in the curriculum leadership system

6.7 Summary

This chapter establishes the linkage between the practices of curriculum leaders and pre-service teachers' TPACK perceptions. It compares and contrasts pre-service

teachers' TPACK perceptions, the applications of ICT in education curriculum structures and curriculum leaders' practices according to the sources, values, foci and contexts of curriculum leadership.

First, this chapter finds that curriculum leadership both shapes and is shaped by teacher education programmes. This is an important finding. Second, it provides a deeper understanding of the role of curriculum leaders at the university, subordinate school and classroom levels. Third, it highlights the importance of coordination and communication between curriculum leaders and explains the importance of pre-service teachers' reflections and evaluations, which helps to evaluate and suggest improvements for courses or programmes. Finally, this chapter not only proposes a method for applying ICT to the education curriculum structures of teacher education programmes, but also develops a framework for the interrelationship between the components in the curriculum leadership system.

The next chapter summarises the responses to the research questions and provides a brief overview of the entire study. It concludes with a section devoted to the implications of this study and future research directions.



CHAPTER SEVEN

IMPLICATIONS AND CONCLUSION

7.1 Introduction

This final chapter summarises the research process and the study's major findings.

The first section provides an overview of the study, including a review of the research questions that guided the investigation, and provides a summary of the major findings.

The second section discusses the implications of the findings for curriculum leaders' practices and future research directions. The third section addresses the limitations of the study. Finally, a brief conclusion is presented.

7.2 Overview of the study

7.2.1 Review of the research questions

As pre-service teachers' ICT in education competencies may significantly enhance student learning outcomes, the importance of developing those competencies has



become a social commitment and an important objective of teacher education (Chang et al., 2012; Chai et al., 2014). Nevertheless, pre-service teachers feel unprepared for teaching with ICT and believe they must be trained to effectively integrate ICT into their teaching practices (Batane, 2004; Liang et al., 2013). It is imperative to reshape the current teacher education programmes to equip pre-service teachers with the corresponding competency to integrate ICT into their teaching practices at the apprenticeship stage (Lin et al., 2012).

The TPACK framework is a theoretical framework used to understand the knowledge involved in applying ICT to teaching and learning practices. In recent decades, the TPACK framework has been adopted in many teacher education programmes globally to design, develop and evaluate curricula that help pre-service teachers to effectively integrate ICT into their teaching practices (Chai, Koh, & Tsai, 2010; Jimoyiannis, 2010; Dede & Soybas, 2011). As pre-service teachers' assessments of their TPACK efficacy or confidence may serve as indicators of whether their ICT in education competencies have been developed (Graham, 2011; Koh et al., 2010; Voogt et al., 2012), quantitative efforts have led to the development of various surveys to examine teachers' perceptions of TPACK in general or specific subjects. Furthermore, research has called for the successful implementation of teacher education programmes or

courses to nurture pre-service teachers' TPACK perceptions (Lin et al., 2012).

However, in the context of TEIs, teacher education programmes depend on curriculum leadership, which has been particularly connected with better outcomes of pre-service teachers' learning (Robinson, Lloyd, & Rowe, 2008). Nevertheless, more research related to curriculum leadership must be conducted in China. In the field of higher education, more studies must focus on how curriculum leadership and management occur, who adopts those management and leadership positions, how curriculum leadership may be related to teacher education programmes and how teacher education programmes develop pre-service teachers' ICT in education competencies. This study attempts to explore these questions and address some of the gaps in the knowledge base.

This study focused on and compared three teacher education programmes in a TEI in mainland China. The cases collected embodied both the effects of curriculum leaders' decisions or practices on teacher education programmes and the effects of teacher education programmes on the development of pre-service teachers' TPACK perceptions. As pre-service teachers' TPACK perceptions are good indicators of their ICT in education competencies, the purpose of the study was to explore how



curriculum leadership supported or hindered teacher education programmes in developing pre-service teachers' ICT in education competencies.

This study surveyed pre-service teachers' perceptions of TPACK; examined the findings of interviews with curriculum leaders and pre-service teachers; and conducted documentation analysis of relevant policies, programme schemes and course outlines to collectively address the following specific research questions.

1. How do teacher education programmes affect pre-service teachers' ICT in education competencies?
2. How does curriculum leadership shape teacher education programmes, and how do those programmes shape it in turn?
3. What are the roles of curriculum leaders in developing pre-service teachers' ICT in education competencies?

The quantitative and qualitative data collected from surveys, interviews and documentation analysis were sorted, filed, connected and triangulated. Open and axial



coding methods were used to break down and categorise the data and establish their interrelationships. Code notes, figures and tables were used as aids to facilitate the data analysis and theory development processes. The data analysis results identified the relationships between curriculum leadership, teacher education programmes and the development of pre-service teachers' TPACK perceptions. Meanwhile, findings related to the role of curriculum leaders and the interrelationship between components in the curriculum leadership system emerged. These constitute the major findings of the study and are summarised in the following section.

7.2.2 Summary of the major findings

The major findings of the study are discussed according to the sequence of the research questions asked.

Research question 1: How do teacher education programmes affect pre-service teachers' ICT in education competencies?

As stated in Chapters One and Two, pre-service teachers' ICT in education competencies may be understood as their TPACK perceptions. Hence, this study



based pre-service teachers' ICT in education competencies on their self-perceptions of TPACK. Studies have commonly used the TPACK survey to measure pre-service teachers' TPACK perceptions. In this study, the survey findings not only compared pre-service teachers' performance in each knowledge factor of TPACK, but also provided vivid examples that illustrated the pre-service teachers' self-perceived TPACK according to different academic backgrounds. Based on this understanding, the TPACK framework was used to bridge the survey results with the corresponding ICT-related education curriculum structure in terms of course contents, pedagogies and academic credits.

This study confirmed that teacher education programmes played important roles in shaping the application of ICT to pre-service teachers' learning practices (Mins et al., 2006; Northcote & Lim, 2009). Furthermore, it revealed that teacher education programmes developed pre-service teachers' ICT in education competencies based on the following perspectives. First, the application of ICT to education curriculum structures played a vital role in TPACK construct integration and provided pre-service teachers with systematic ICT-related learning experiences. Second, a range of ICT core courses was designed to enhance one or more of the pre-service teachers' TPACK constructs and abilities. Third, the contents and pedagogies of the ICT core

courses were key factors in the effectiveness of teacher education programmes. Fourth, challenges ranging from curriculum sequencing, insufficient academic credits and lesson hours, course content and even lecturer capacity were identified as factors influencing the pre-service teachers' TPACK perceptions (see Chapter Six).

Therefore, this study extended the TPACK research by providing further evidence of the significance of applying ICT to education curriculum structures when developing pre-service teachers' ICT in education competencies.

Research question 2: How does curriculum leadership shape teacher education programmes, and how do those programmes shape it in turn?

Hallinger's (2011) educational leadership model provides a helpful conceptual structure for comparatively analysing curriculum leaders' practices as they relate to students' learning outcomes in this study. The model contains four dimensions, including the values, foci, contexts and sources of leadership. To achieve the purpose of this study, 'leadership' was specified as 'curriculum leadership' and 'students' learning outcomes' were specified as 'pre-service teachers' ICT in education competencies'. In addition, the 'sources of curriculum leadership' were made a focus

to specify the curriculum leaders involved. The four dimensions were modified into the sources, values, foci and contexts of curriculum leadership. The model contributed to guiding data analysis for curriculum practices. According to the four dimensions, the complex factors that influenced the curriculum leaders' practices were framed and studied systematically at the university, subordinate school and classroom levels, respectively (see Chapter Five).

Curriculum leadership both shapes and is shaped by teacher education programmes. This is an important finding. Curriculum leadership shapes teacher education programmes from the perspectives of providing supporting policies, planning or managing curricula and evaluating pre-service teachers' learning outcomes. Different practices or decisions made by curriculum leaders may be key factors that contribute to the differences in how ICT is applied to education curriculum structures. This finding may help to provide empirical evidence and clarify the effectiveness of teacher education programmes. However, this study also provided potential evidence that teacher education programmes shaped curriculum leaders' practices in terms of the changing requirements of the educational system (e.g., the MOE, provincial education department and higher education institution) and constraints of the current



curricula (e.g., curriculum orientation, insufficient academic credits and lesson hours, lecturer capacity and course linkage and coherence) (see Chapter Six).

This study not only contributed to a growing body of research related to curriculum leadership, but also introduced values into Hallinger's (2011) model. First, curriculum leaders from different sources might have had different values and foci and been affected by different contextual factors. Second, the curriculum leaders' values might have been collectively shaped by systematic factors (e.g., institutional bureaucracy and hierarchy), human factors (e.g., superiors' requirements and peer competition), social competitions (e.g., employment and economic development) and personal factors (e.g., characteristics, educational background and work experience). Third, the mix of values that curriculum leaders perceived in their post had significant effects on their priorities or foci in their daily behaviour. Fourth, different values and foci in addition to the effects of contextual factors might have collectively contributed to the different practices of the curriculum leaders. Finally, this study further verified that Hallinger's (2011) model could be adopted to analyse curriculum leadership in Chinese higher education institutions. Hence, Hallinger's (2011) model may help other researchers to analyse their respective situations and educational contexts and gain further insights into educational leadership (see Chapter Six).



Research question 3: What are the roles of curriculum leaders in developing pre-service teachers' ICT in education competencies?

When discussing the roles of curriculum leaders, it is necessary to classify the curriculum leaders at the university, subordinate school and classroom levels. Therefore, this study identified the roles of curriculum leaders in developing pre-service teachers' ICT in education competencies at those three levels.

First, as the top-level management, the curriculum leaders at the university level (e.g., the Vice-President (Academic) and Vice-Director of the TAO) provided support in terms of policy formulation and resource allocation. Second, as the middle-level management, the curriculum leaders at the subordinate school level (e.g., the Vice-Dean (Academic)) bridged the curriculum management gap between the top and ground levels. They usually prioritised administrative tasks over teaching tasks, especially when ordered to do so by senior management. They took responsibility for applying ICT to education curriculum structures, course objectives and academic credit management. Some also supported developing the ICT learning culture, supervising the enhancement of ICT core courses and updating ICT infrastructure,

hardware and learning resources. Third, the classroom-level curriculum leaders (e.g., course coordinators or lecturers) ranked teaching tasks at the highest level of perceived importance. They had a significant effect on course contents, pedagogies and assessments of pre-service teachers' ICT learning outcomes (see Chapter Six).

The development of pre-service teachers' ICT in education competencies is not a simple task. It requires consistent support and collaboration from all stakeholders along with a commitment to programme improvement. This study clarified the interrelationship between the components in the curriculum leadership system. In particular, it highlighted the importance of coordination and communication between curriculum leaders and the importance of pre-service teachers' reflections on or evaluations of teaching to improve courses or programmes.

7.3 Implications of the study

Drawing on previous analysis, the findings of this study have the following implications for curriculum leaders' practices and future research directions.

7.3.1 Implications for curriculum leaders' practices



7.3.1.1 Implications for the Ministry of Education (MOE)

As reported in Chapter Three, Chinese colleges and universities have long been operating in a centralised curriculum management system controlled by the MOE (Huang & Huang, 2008; Wang, Chang, & Zhao, 2011). The MOE is responsible for drawing up a national teaching planning and programme scheme for undergraduate education (Chen & Xu, 2014). Meanwhile, the MOE formulates teacher management policies and teachers' qualification standards at various levels and provides macroscopic guidance for teacher education and management (Xiao & Tao, 2011). The results of the documentation analysis and interviews conducted in this study suggest that the MOE must re-examine the current national schemes for the application of ICT in teacher education programmes. There are at least two possible approaches from a national perspective, including a top-down approach and an approach that involves distributing the ICT-related policies to the universities. Therefore, it is particularly important to develop ICT in education curriculum guidelines to provide pre-service teachers with comprehensive ICT learning experience. The interview results also reveal that the MOE must formulate national policies or assessment criteria to direct the development of ICT in teacher education

for normal universities.

7.3.1.2 Implications for university curriculum leaders

The important role of curriculum leaders in ICT implementation has been well documented (Yuen, Law, & Wong, 2003). The findings of this study show that curriculum leaders in universities have significant effects on the development of teacher education programmes. Most are unprepared for the complexity and multiplicity involved in integrating ICT with teacher education programmes to develop pre-service teachers' TPACK perceptions. This may be due to the teachers' lack of experience in these ICT areas or the lack of professional support (Zhang, 2013a; Zhao, 2014).

This study considered curriculum leaders' practices at the university, subordinate school and classroom levels. First, the curriculum leaders at the university level (e.g., the Vice-President (Academic) and Vice-Director (Academic) of the TAO) should be aware of the vision and philosophy of the university. The lack of a comprehensive vision from leaders is a barrier to ICT integration in higher education institutions (Churchill & Lim, 2007). Articulating a coherent vision for a higher education

institution in terms of its ICT environments and ICT-pedagogical foundation is a necessary and meaningful practice (Lim, Churchill, & Chai, 2010). It is also important to foster a supportive context for ICT development. For instance, leaders may provide more policy support in terms of enhancing ICT management and formulating assessment criteria for integrating ICT into teaching and learning practices; coordinating relationships between subordinate schools, technology centres and related management offices; and providing more opportunities for teachers' on-going professional learning and development to enhance their ICT in education competencies.

Second, curriculum leaders at the subordinate school level (e.g. the Vice-Deans (Academic)) should coordinate the curriculum teams' consistent support and commitment to programme improvement. For instance, an explicit and effective curriculum structure is critical for developing pre-service teachers' ICT in education competencies. The leaders must work collectively with the course coordinators and lecturers to assess and evaluate the ICT-enriched teaching and learning practices of pre-service teachers. They must also provide more opportunities for feedback and reflection. Meanwhile, they should attach importance to teaching quality and acknowledge the subject effect on pre-service teachers' perceptions of



technology-related knowledge.

Third, classroom-level curriculum leaders (e.g., course coordinators and lecturers) must guide pre-service teachers to develop their synthesised TPACK instead of the core knowledge derived from basic knowledge factors. They must also reconsider what should be taught in these ICT core courses, how it should be taught and how pre-service teachers' perceived TPACK should be assessed. In addition, considering that confusing TPACK constructs may lead to unfavourable curriculum design (e.g., TCK items merged with TPCK) (Chai et al., 2012), the future application of ICT to education curricula should help pre-service teachers to develop their ability to distinguish TPACK constructs.

7.3.1.3 Implications for curriculum leaders' professional learning

The curriculum leaders considered in this study generally lacked the ICT knowledge and skills necessary to design, develop, evaluate and improve curricula. Curriculum leaders' ICT knowledge and skills in the areas of curriculum and instruction require separate treatment, as they are of great importance in today's educational context (Hong & Songan, 2011). Given the rapid development of ICT in teacher education,

professional training programmes for curriculum leaders are more important now than ever.

The findings of this study provide recommendations as to what may be included in the training and development programmes for university curriculum leaders. As curriculum leaders may have different work foci in applying ICT to teacher education programme development, there is a need to provide a different focus in professional training programmes according to curriculum leaders' working responsibilities. For example, training programmes for administrators and policymakers should focus on broadening their visions and enhancing their administrative skills in relation to ICT in teacher education, and programmes for teacher educators should facilitate their ability to integrate ICT into their teaching and learning practices.

In addition to these practical implications for curriculum leaders' practices, this study unveils multiple facets of curriculum leadership in developing pre-service teachers' TPACK perceptions that should be considered in further studies. The next section addresses these research possibilities.

7.3.2 Implications for future research directions

This study examines the role of curriculum leadership in developing pre-service teachers' ICT in education competencies. However, it takes only the first step in examining curriculum leaders' practices with its specific focus on three teacher education programmes. Following this study, several research areas call for further investigation.

First, this study contributes to an important future direction for TPACK, such as subject matter differences and the contextual reasons for the differences due to curriculum leadership. Based on a range of previous research related to surveying teachers' self-perceptions of TPACK (Chai et al., 2011a, 2012; Koh, Chai, & Tsai, 2010; Sahin, 2011; Lux, Bangert, & Whittier, 2011; Zelkowski et al., 2013) and the successful implementation of programmes or courses (Chai et al., 2010, 2011b; Jang & Chen, 2010; Jimoyiannis, 2010; Koh & Divaharan, 2011), future research should examine TPACK at the programme and course levels with a focus on curriculum leadership.

Second, this study provides a detailed description of pre-service teachers' TPACK perceptions and curriculum leaders' practices in teacher education programmes based



on a combination of quantitative and qualitative data. The findings suggest that empowering pre-service teachers to engage in technology-enhanced learning for subject factors should be the new focus of ICT preparation for teacher education programmes. Future studies should invest more research effort in validating assessments as programme evaluation tools for comparative studies of subject-specific or cross-cultural TPACK surveys to provide more useful and specific information.

Third, multiple sources of data and larger-scale studies are needed to investigate curriculum leaders in various educational contexts and verify the potential of curriculum leadership to apply ICT to educational curriculum development.

7.4 Limitations of the study

This study was designed and implemented carefully based on its purpose and the research questions. Nevertheless, it was subject to four major limitations beyond the control of the researcher that might have affected its findings. These limitations are acknowledged and addressed as follows.



The first limitation lies in the reviewed literature related to curriculum leadership, which is more likely to be contextualised in primary or secondary schools in Western countries. However, the intention of a literature review is to transfer these contexts to the higher education level by examining curriculum leadership in Chinese schools, curriculum processes, strategic dimensions for ICT capacity building in TEIs and the improvement of students' learning outcomes. Future studies could provide operational guidelines for curriculum leadership in higher education institutions.

The second limitation relates to the generalisability of the study. This study identified three teacher education programmes at one Chinese provincial normal university as three case studies. Schmidt et al. (2009), Sahin (2011) and Chai et al. (2011a) noted that conducting the TPACK survey in one country produced culturally biased results. However, the generalisability of case studies can be increased by the strategic selection of cases (Willis, 2014). The three teacher education programmes considered in this study were sampled purposively to improve their representativeness. Furthermore, the small sample of interviewed curriculum leaders and surveyed pre-service teachers might have limited the generalisability of the study. For example, due to current enrolment or employment issues, the sample size of the History teacher education programme was rather small, and that of the Science programme offered

more responses from pre-service teachers. However, the findings could be adjusted using statistical analysis and therefore may be usefully applied to a range of educational contexts either similar to or different from that of China.

The third limitation is the use of coding as a tool to analyse the qualitative data. The claims of this study could be weakened if the coding scheme was flawed or the researcher made misjudgements when coding the qualitative data. However, the researcher developed the coding scheme cautiously and generated categories of curriculum leaders' complex behaviour following the four dimensions in Hallinger's (2011) model. The researcher also attempted to minimise subjectivity and enhance reliability while coding the qualitative data during analysis.

The fourth limitation relates to the use of the survey. The survey adopted in this study was developed by Chai et al. (2013). The TPACK factor items in the survey were originally adopted from a study by Schmidt et al. (2009). The survey was used to assess the self-efficacy or confidence of teachers' TPACK rather than their ICT in education competencies. Furthermore, the survey was mainly examined using factorial models, and little observable evidence was obtained from the teachers' practices to support its validity. However, validated surveys for assessing pre-service

teachers' TPACK remain lacking (Graham, 2011; Koh et al., 2010; Voogt et al., 2012). The survey used in the current study was identified as a satisfactory and applicable self-assessment instrument for describing teachers' application of ICT to their teaching practices based on their knowledge perspectives (Lin et al., 2012). This instrument, which also measured the teachers' self-efficacy, is more likely to be useful in predicting teachers' actual behaviour or practices (Tschannen-Moran & Hoy, 2001; Voogt et al., 2012; Zelkowski et al., 2013). Therefore, to some extent, the teachers' TPACK self-efficacy taken from the survey results may provide preliminary value for evaluating their ICT in education competencies.

7.5 Conclusions

The purpose of this study was to explore how curriculum leadership supported or hindered teacher education programmes in developing pre-service teachers' ICT in education competencies. As pre-service teachers' TPACK perceptions can be good predictors of their ICT in education competencies, a mixed-method research design was adopted not only to survey the pre-service teachers' TPACK perceptions, but also to explore how curriculum leadership influenced and was influenced by teacher education programmes and investigate the roles of curriculum leaders in developing



pre-service teachers' ICT in education competencies. Using a combination of quantitative and qualitative data, this study bridged the gap between curriculum leaders' roles and the development of pre-service teachers' ICT in education competencies.

First, this study drew rich descriptions for each sampled subordinate school. It presented three school profiles in a similar contextual sequence with the intent to compare how curriculum leadership in each subordinate school influenced and was influenced by teacher education programmes and how these programmes developed their pre-service teachers' TPACK perceptions.

Second, this study illustrated the relationships between curriculum leaders at the university, subordinate school and classroom levels. It identified several issues and challenges in the current curriculum leadership system, including top-down management, a lack of communication and collaboration and a lack of reflection and feedback. The findings may provide a basis for exploring the interrelationship between the components in the curriculum leadership system.



Finally, in addition to the preceding findings, this study also revealed that curriculum leaders were pressured to acquire and use effective programme management strategies involving ICT in education. In particular, the study highlighted the importance of university senior management in supporting coordination and communication between curriculum leaders. This study also explained the importance of pre-service teachers' reflections on or evaluations of teaching to the improvement of courses or programmes (see Figure 6.3). These findings may be interpreted in a way that allows curriculum leaders to design a more robust pre-service teacher education programme that applies ICT.

Although this study was limited to one normal university in China, its outcomes may contribute to an important future direction for examining TPACK at the programme and course levels with a focus on curriculum leadership. This is an area that requires more research. This study is still valuable in that it enhances the curriculum leadership literature and expands the theoretical knowledge of curriculum leadership effects while supporting the application of ICT to teacher education. Its findings can be used to inform education policymakers and indicate the potential for further curriculum leadership development.



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APPENDIX 1: CONSENT FORM AND INFORMATION SHEET

THE HONG KONG INSTITUTE OF EDUCATION

Department of Curriculum and Instruction

CONSENT TO PARTICIPATE IN RESEARCH (English Version)

Educational Leadership and the Development of ICT in Education Competencies of Pre-service Teachers in Teacher Education Institutions

I _____ hereby consent to participate in the captioned research supervised by Professor Lim Cher Ping and conducted by PhD student Xiong Xi Bei.

I understand that information obtained from this research may be used in future research and may be published. However, my right to privacy will be retained, i.e., my personal details will not be revealed.

The procedure as set out in the **attached** information sheet has been fully explained. I understand the benefits and risks involved. My participation in the project is voluntary.

I acknowledge that I have the right to question any part of the procedure and can withdraw at any time without penalty of any kind.



Name of participant

Signature of participant

Name of Parent or Guardian (if
applicable)

Signature of Parent or Guardian (if
applicable)

Name of Researcher

Signature of Researcher

Date



香港教育學院
課程與教學學系
參與研究同意書
(Chinese Version)

師範院校中領導力與師範生教育資訊技術能力的發展

本人_____同意參加由林質彬教授負責監督，熊西蓓
博士研究生執行的研究項目。

我理解此研究所獲得的資料可用於未來的研究和學術發表。然而
我有權保護自己的隱私，我的個人資料將不能洩漏。

我對所附資料的有關步驟已經得到充分的解釋。我理解可能會出
現的風險。我是自願參與這項研究。

我理解我有權在研究過程中提出問題，並在任何時候決定退出研
究而不會受到任何不正常的待遇或被追究責任。

參加者姓名:

參加者簽名:

父母姓名或監護人姓名: (如
適用)

父母或監護人簽名: (如適用)

研究員姓名:

研究員簽名:

日期:



APPENDIX 2: QUESTIONNAIRE

国际科技、教学法、学科知识问卷调查 2012 版

International Technology, Pedagogy and Subject Knowledge On-line Questionnaire Survey (2010, Mainland China)

各位职前老师:

Dear Pre-service teachers:

本问卷是为了调查教师的学科知识、科技知识并教学知识而设，您的参与将协助我们理解教师如何整合这三方面的知识，以便在课堂上进行电脑辅助教学。您所提供的回答将用于统计分析，个人姓名将不会出现在研究报告中。问卷应当可以在 20 分钟内完成，如果您同意参加，请开始作答，感谢您的支持。

This questionnaire is designed for doing the research of pre-service teachers' subject knowledge, technological knowledge and pedagogical knowledge. Your participation will assist us to understand the integration of these three parts of knowledge, in order to improve the application of the technological classroom teaching. Your replies will be used for statistical data analysis; your personal name will not be presented into the research reports. The questionnaire should be completed within twenty minutes. If you agree to participate, please start to answer the following questions. Your kindly support is greatly appreciated by us.

个人资料 Personal Information

Q1	姓名 Name: <input type="text"/>
Q2	性别 Gender: <input type="radio"/> Male (男) <input type="radio"/> Female (女)
Q3	年龄 Age: <input type="text" value="Please select"/>
Q4	教学科目 Subject: <input type="text"/>
Q5	我有六個月以上的正式教学经验 I have above 6-months' teaching experience <input type="radio"/> 否 No <input type="radio"/> 是 Yes
Q6	我修過的教育技术相关課程包括（请填写课程名称无）： The relevant educational courses I have taken or none <input type="text"/>

请仔细阅读一下的题目，并按最能代表您的水平的选项。完成请检查是否有遗漏，并按呈交。Please read the following questions carefully, and click the option, which is most likely to represent your level. When you complete the questionnaire, please check whether there are omissions, and click submit.



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Institute of Education Library

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1 - 非常不同意 Strongly Disagree , 2 - 不同意 Disagree , 3 - 稍微不同意 Slightly Disagree , 4 - 不置可否 Neutral , 5 - 稍微同意 Slightly Agree , 6 - 同意 Agree , 7 - 非常同意 Strongly Agree

	(一) 學科知識 Part 1 - Content knowledge	1	2	3	4	5	6	7
P1_1	我對於我所教的科目擁有足夠的知識。 I have sufficient knowledge about my teaching subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P1_2	我能夠向專家一樣針對所教科目內容進行思考。 I can think about the content of my teaching subject like a subject matter expert.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P1_3	我能夠靠自己更深入的去理解所教的科目內容。 I am able to gain deeper understanding about the content of my teaching subject on my own.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P1_4	我對於自己所掌握的學科知識有充足的信心。 I am confident to teach the subject matter.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



1 - 非常不同意, 2 - 不同意, 3 - 稍微不同意, 4 - 不置可否, 5 - 稍微同意, 6 - 同意, 7 - 非常同意

	(二) 一般教学法知识 Part 2 - Knowledge about teaching methods	1	2	3	4	5	6	7
P2_1	我能够设计具有挑战性的任务来延伸学生的思考。 I am able to stretch my students' thinking by creating challenging tasks for them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P2_2	我能够指导学生採用合适的学习策略。 I am able to guide my students to adopt appropriate learning strategies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P2_3	我能够帮助学生们去监控他们自己的学习。 I am able to help my students to monitor their own learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P2_4	我能够帮助学生反思他们的学习策略。 I am able to help my students to reflect on their learning strategies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P2_5	我能够为学生策划一些小组学习活动。 I am able to plan group activities for my students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P2_6	我能够指导学生在小组活动中有效去讨论课题。 I am able to guide my students to discuss effectively during group work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



1 - 非常不同意, 2 - 不同意, 3 - 稍微不同意, 4 - 不置可否, 5 - 稍微同意, 6 - 同意, 7 - 非常同意

	(三) 针对我的教学科目的教学知识 Part 3 - Knowledge about teaching my teaching subjects	1	2	3	4	5	6	7
P3_1	即使不使用科技, 我也能够处理学生在我教的科目中普遍会出现的问题。 Without using technology, I can address the common misconceptions my students have for my teaching subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P3_2	即使不使用科技, 我也知道如何选择有效的教学方法去引导学生去思考和学习。 Without using technology, I know how to select effective teaching approaches to guide student thinking and learning the subject matter.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P3_3	即使不使用科技, 我也能够帮助学生利用各种方法了解我所教的科目知识。 Without using technology, I can help my students to understand the content knowledge of my teaching subject through various ways.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P3_4	即使不使用科技, 我也能够处理学生在我所教的科目中常出现的学习困难。 Without using technology, I can address the common learning difficulties my students have for my teaching subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P3_5	即使不使用科技, 我也能够促进学生在所学习的科目内容中进行有意义的讨论。 Without using technology, I can facilitate meaningful discussion about the content	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	students are learning in my teaching subject.							
P3_6	即使不使用科技，我也能够促使学生解决与我所教科目相关的真实情境问题。 Without using technology, I can engage students in solving real world problem related to my teaching subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P3_7	即使不使用科技，我也能够让学生全身心投入实践活动中学习我所教的科目内容。 Without using technology, I can engage students with hands-on activities to learn the content of my teaching subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P3_8	即使不使用科技，我也能够协助学生自行管理学习我所教的科目内容。 Without using technology, I can support students to manage their learning of content for my teaching subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

1 - 非常不同意, 2 - 不同意, 3 - 稍微不同意, 4 - 不置可否, 5 - 稍微同意, 6 - 同意, 7 - 非常同意

	(四) 科技知识 Part 4 - Knowledge about technology	1	2	3	4	5	6	7
P4_01	我具有有效地使用电脑科技的能力。 I have the technical skills to use computers effectively.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P4_02	我能够轻松地学习科技。	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



	I can learn technology easily.							
P4_03	当使用科技时，我知道如何解决我自己所面临的科技问题。 I know how to solve my own technical problems when using technology.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P4_04	我能跟上重要的新科技发展。 I keep up with important new technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P4_05	我能够製作网页。 I am able to create web pages.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P4_06	我能够使用网路的社群媒体，例如：Blog、Wiki 、Facebook 等。 I am able to use social media (e.g. Blog, Wiki, Facebook).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P4_07	我能够使用网路上的一些沟通工具，例如：Yahoo Messenger（即时通）、QQ、MSN、ICQ、Skype 等。 I am able to use communication tools (Yahoo, IM, MSN Mesenger, ICQ, Skype etc).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P4_08	我能够使用网路上的一些协作工具，例如：谷歌网页、谷歌文件等。 I am able to use collaboration tools (e.g. Google Sites, Google Doc).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P4_09	我能够使用网路上许多工具，例如：在线墙贴、在线思维导图、播客等。 I am able to use a range of online tools (e.g. Wallwisher, web-based mind mapping tools, Podcast etc).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

1 - 非常不同意, 2 - 不同意, 3 - 稍微不同意, 4 - 不置可否, 5 - 稍微同意, 6 - 同意, 7 - 非常同意

	(五) 关于使用科技的教学知识 Part 5 - Knowledge about using technology to teach	1	2	3	4	5	6	7
P5_1	我能够使用科技向学生介绍真实世界的现况。 I am able to use technology to introduce my students to real world scenarios.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P5_2	我能够帮助学生自己使用科技来搜寻更多的资料。 I am able to facilitate my students to use technology to find more information on their own.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P5_3	我能够促使学生使用科技来规划与管理他们自己的学习活动。 I am able to facilitate my students to use technology to plan and monitor their own learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P5_4	我能够帮助学生使用科技来建构不同的知识表述方式。 I am able to facilitate my students to use technology to construct different forms of knowledge representation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P5_5	我能够促使学生利用科技与同学们一起完成一些作业。 I am able to facilitate my students to collaborate with each other using technology.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

1 - 非常不同意, 2 - 不同意, 3 - 稍微不同意, 4 - 不置可否, 5 - 稍微同意, 6 - 同意, 7 - 非常同意

	Part 6 - Knowledge about technology used in my teaching subject	1	2	3	4	5	6	7
P6_1	我能够使用专门为我的教学科目所设计的专业软体(例如电子词典、语料库、几何画板、数理模拟软件。) I can use the software that are created specifically for my teaching subject. (E.g. e-dictionary/corpus for language; Geometric sketchpad for Maths; Data loggers for Science)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P6_2	我知道哪些科技是我的学科知识在进行研究时需要用到的。 I know about the technologies that I have to use for the research of content of my teaching subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P6_3	我能够使用合适的科技来展现我所教的科目内容, 例如: 多媒体资源、模拟软件等。 I can use appropriate technologies (e.g. multimedia resources, simulation) to represent the content of my teaching subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P6_4	我能够使用专为我的学科知识设计的专业软体来进行相关的探究。 I can use specialized software to perform inquiry about my teaching subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

1 - 非常不同意, 2 - 不同意, 3 - 稍微不同意, 4 - 不置可否, 5 - 稍微同意, 6 - 同意, 7 - 非常同意

	(七) 科技、教学法、学科知识的整合 Part 7 - ICT Integration Knowledge	1	2	3	4	5	6	7
P7_1	我能够设置关乎教学科目的课题, 并通过切当的在线工具促进学生之间的协作学习。 I can formulate in-depth discussion topics about the content knowledge and facilitate students' online collaboration with appropriate tools. (e.g. Google Sites, Discussion Forum)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P7_2	我能够製作与教学科目内容知识有关的真实问题情境, 并利用电脑呈现以吸引学生学习。 I can craft real world problems about the content knowledge and represent them through computers to engage my students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P7_3	我可以按学科内容规划活动, 帮助学生使用恰当的科技来建构不同的内容知识表述方式。(例如使用在线思路图, 维基网等)。 I can structure activities to help students to construct different representations of the content knowledge using appropriate ICT tools (e.g. Webspiration, Mindmaps, Wiki).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P7_4	我能够针对学科内容设计电脑辅助自主学习活动(如利用博客, 网络探究 Webquest 等)。 I can create self-directed learning activities of the content knowledge with appropriate ICT tools (e.g. Blog, Webquest)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P7_5	我能够设计探究活动, 并以适当的科技(例如模拟软件, 网络资源)引导学生理解学科知识内容。 I can design inquiry activities to guide students to make sense of the content knowledge with appropriate ICT tools (e.g. simulations, web-based materials).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

P7_6	我能够针对学生为中心的学习，设计一些适当地整合教学内容、教学科技和教学方法的课程。 I can design lessons that appropriately integrate content, technology and pedagogy for student-centered learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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1 - 非常不同意, 2 - 不同意, 3 - 稍微不同意, 4 - 不置可否, 5 - 稍微同意, 6 - 同意, 7 - 非常同意

	知识观 Epistemic Beliefs	1	2	3	4	5	6	7
P8_1	我不喜欢解决没有明确答案的问题。 I dislike working on problems that have no clear-cut answers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P8_2	我对于处理模糊不清的情境感到不安。 I feel uncomfortable in dealing with ambiguous situations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P8_3	我喜欢在上课时被清楚告知我们应该要学习的事物及必须要做的事情。 I prefer classes in which students are told exactly what they are supposed to learn and what they have to do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P8_4	我相信教科书上作者陈述的事实。 I believe the facts in textbook written by authorities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
P8_5	我不会怀疑专家说的话。	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



APPENDIX 3: INTERVIEW GUIDES

A: Interview guide with Vice-President (Academic), Vice-Director of Teaching

Affairs Office, Vice-Dean (Academic)

1. The overall situation of the university's efforts in developing pre-service teachers' ICT in education competencies?

- The university's goals or plans regarding developing pre-service teachers' such competencies in the university
- Comment on the survey result of pre-service teachers' TPACK perceptions
- Comment on the level of ICT in education competencies pre-service teachers possess
- Summarise your major roles

2. The types of teacher education programs

- Teacher education programs
- Curriculum structure
- ICT core courses

3. The interviewee's role in developing pre-service teachers' ICT in education competencies?



- Comment on the values, foci and contextual factors of your curriculum leadership
- The interviewee's roles in executing these ICT policies and plans
- The support received in executing these policies and plans
- The challenges existing in the process

4. Supports for teacher educators

- What sort of training does the university provide to teacher educators?
- Are there any other policies to encourage teacher educators using of ICT in teaching?

B: Interview guide with course coordinator

1. The interviewee's responsibilities

- Comment on the survey result of pre-service teachers' TPACK perceptions
- Comment on the level of ICT in education competencies pre-service teachers possess
- Summarise your major roles

2. About the ICT core courses

- What are the general contents and objectives of the ICT core courses to enhance the ICT in education competencies of pre-service teachers?



- What is the rationale of the design of the courses? How are the courses organised?
- Which department or unit is in charge of designing and delivering these courses?
- How are pre-service teachers' ICT in education competencies evaluated in these courses?

3. The interviewee's role in developing pre-service teachers' ICT in education competencies?

- Comment on the values, foci and contextual factors of your curriculum leadership
- How do you see the importance of developing pre-service teachers' ICT in education competencies?
- What are the ideas that guide you in promoting ICT integration in teaching and learning?

4. Support mechanism

- What kind of support the interviewee receives from the university to carry out these ICT core courses?
- What kind of support that you see as most valuable?
- What trainings does the university provide to teacher educators in their capacity



of using ICT in teaching?

5. Challenges

- What challenges did you face in carrying out the courses and plans?
- What support do you need to overcome these challenges?

C: Focus group interview guide with lecturers

1. The lecturer's vision of ICT in education

- Comment on the survey result of pre-service teachers' TPACK perceptions
- Comment on the level of ICT in education competencies pre-service teachers possess
- Comment on the values, foci and contextual factors of your curriculum leadership
- Summarise your major roles

2. General information of the ICT core courses

- The background of the pre-service teachers
- The main contents and objectives the ICT core courses
- The rational of the design of the ICT core courses
- The assignments and exams

3. Pre-service teachers



- What knowledge and skills do they need to already have prior to taking the course?
- Are the pre-service teachers following the course well?
- What do they seem to like most about the course and what do they find difficult?

4. Support

- What kind of support do you get for the course? Anything you find particularly helpful?
- What sort of training do you receive from the university to develop your capacity of teaching with ICT?

5. Challenge

- What challenge have you encountered?
- How do you plan to tackle them?
- What kind of support do you need to do that?

D: Interview guide with pre-service teachers

1. Self-reported ICT in education competencies

- Comment on the survey result of pre-service teachers' TPACK perceptions
- Comment on the level of ICT in education competencies pre-service teachers



possess

2. Course experience

- How do you see the objectives of the ICT core courses?
- What do you find helpful and what not?
- Did you learn from the course certain ways of using ICT that you want to apply
in your future teaching?

3. Experience with modeling use of technology of the university

- How does the lecturer of the course apply ICT in the course?
- What are other ways of applying ICT that you observed in the university, in
what situations?

4. Effectiveness of the course

- What do you think are the competencies you need to make good use of ICT in
teaching? Is the course providing you with the competencies?
- Are there any changes or improvements you desire of the course?



APPENDIX 4: A SAMPLE OF INTERVIEW TRANSCRIPTION

Interview with the Vice-Dean (Academic) in the School of Chemistry

The interview was conducted in the Vice-Dean's office in an afternoon at the School of Chemistry. The interview was actually a friendly chat, which lasted for about 40 minutes (R: researcher; VD: the Vice-Dean (Academic)).

R: Does the university have some goals or plans regarding developing pre-service teachers' ICT in education competencies?

VD: The current requirements for ICT in teacher education are rather ambiguous. To be honest, there are no standardised examinations or university policies to direct the development of ICT in education competencies of pre-service teachers. However, the requirements for pre-service teachers from the employment markets are much higher.

R: How do you see the importance of developing pre-service teachers' ICT in education competencies?



VD: As far as I am concerned, developing pre-service teachers' ICT in education competencies has always been my working priority. The development of ICT in teacher education has increasingly highlighted its importance over the past 2 or 3 years.

R: And how do you promote the development of such competencies for pre-service teachers?

VD: At present, the main channel to educate such competencies is classroom teaching, that is to say, on the curriculum. However, the credit management system will not provide more credits for ICT core courses. Therefore, we have to enhance the content of the current ICT core courses to maximise the learning outcomes within limited class hours.

R: Are you satisfied with the level of ICT in education competencies pre-service teachers possess? Would you please make comments on the survey result of your pre-service teachers?



VD: I am basically satisfied with the level of our pre-service teachers' ICT in education competencies, since we have exerted a great deal of effort in this field.

I think the survey results are acceptable. For instance, you see that our pre-service teachers are more confident about their pedagogical knowledge than content knowledge. It is natural that the professional knowledge on Chemistry is much more difficult than the pedagogical knowledge. Meanwhile, they expressed their confidence in teaching with ICT, because we provide them the enhance course 'Secondary-school chemistry multimedia courseware', which was very helpful to develop their ICT in education competencies.

R: What ICT core courses does your school provide to pre-service teachers to develop their ICT in education competencies?

VD: Besides the compulsory course 'Computer fundamentals', we offer the other two ICT core courses to our pre-service teachers. One is 'Comprehensive teaching skills of pre-service teachers', and the other is 'Secondary-school chemistry multimedia courseware'. The latter one is an optional course, but I required all our pre-service teachers to participate in this course, so it actually has been a compulsory course.



R: What have you done to improve the ICT in education curriculum structure? And what are the ideas that guide you in enhancing these ICT core course?

VD: In fact, the original course content was too old to keep up with the social development, and the teaching was focused too much on theory instead of practice. So we learned from the updated ICT core course for Chemistry pre-service teachers in South China Normal University. We talked with experienced lecturers and conducted investigations on behalf of our pre-service teachers' interests, beliefs and teaching practices to understand their ICT competencies. Then I worked collaboratively with Dr. Zeng to revise our course structures, contents, pedagogies and assessments to make them more suitable for our pre-service teachers. We collected pre-service teachers' feedback and reflections after each semester to ensure the teaching quality and fine-tune parts of the content if necessary.

R: Would you please talk about the contextual factors, which may have impacts on the development of such competencies of pre-service teachers?



VD: Because the current teacher evaluation system put too much emphasis on academic publication, the efforts and achievements made in developing pre-service teachers' ICT in education competencies were likely to be underestimated or overlooked. I think the MOE, the provincial educational department and the university need to invest more funds, human resources and even formulate more policies to support the development of pre-service teachers' ICT in education competencies.

R: What are your major roles in developing pre-service teachers' ICT in education competencies?

VD: I am responsible for teaching and learning in our school, including curriculum design, implementation, evaluation and students' learning outcomes. Regarding the ICT core courses, I put emphasis on the enhanced course 'Secondary-school chemistry multimedia courseware'. To be specific, I supervise the course coordinator and lecturer in the implementation of the ICT core course. I am concerned about the course quality and pre-service teachers' learning outcomes. Meanwhile, I also need to support our young teaching staffs in their professional learning of ICT.



R: What are the supports you received from the university?

VD: To be honest, the university has provided more supports in terms of ICT policies,

ICT infrastructure, resources and teacher professional development in recent years. However, it is far from enough to meet the requirements of pre-service teachers. Therefore, most work had to be conducted by each subordinate school.

I think the pre-service teachers' learning outcomes of ICT in education competencies are mostly dependent on the ICT core courses offered by each subordinate school.

R: What challenges do you face in the process of design or implementing ICT core courses?

VD: Due to the rapid development of technology, the ICT core course had to be updated continuously, presenting a potentially big challenge to us. As a result, the heavy workload, insufficient funds and lack of qualified lecturers collectively influenced the effectiveness of our ICT core courses.



R: Does your school have a plan to further develop such competencies of pre-service teachers?

VD: Yes. First, we realize that it is important to improve teachers' ICT competencies for pre-service teachers. So I will make more efforts on teacher professional learning and development activities. Regular evaluation of teaching and learning will be administered, for instance the teaching staff performance appraisal. Second, we will organize pre-service teachers' evaluation of teaching competitions to improve pre-service teachers' interests in ICT. Third, we need to continuously enhance our ICT core course to be up-to date, relevant and competitive.

(End of interview tape script)



Appendix 5: An example of code notes on interview data

Interview with the Vice-Dean (Academic) in the School of Chemistry

R: What have you done to improve the ICT in education curriculum structure? And what are the ideas that guide you in enhancing these ICT core course?

VD: In fact, the original course content was too old to keep up with the social development, and the teaching was focused too much on theory instead of practice. So we learned from the updated ICT core course for Chemistry pre-service teachers in South China Normal University. We talked with

experienced lecturers and conducted investigations on behalf of our pre-service

teachers' interests, beliefs and teaching practices to understand their ICT

competencies. Then I worked collaboratively with Dr. Zeng to revise our course

structures, contents, pedagogies and assessments to make them more suitable for

our pre-service teachers. We collected pre-service teachers' feedback and

reflections after each semester to ensure the teaching quality and fine-tune parts

of the content if necessary.

① values
② initiative
↓
new focus

Practices
3

③ active participation
work collaboratively
feedback & Reflections

