REIMAGING PRE-SERVICE TEACHERS' PRACTICAL KNOWLEDGE

DESIGNING LEARNING FOR FUTURE

Ge Weis

Routledge

Reimaging Pre-Service Teachers' Practical Knowledge

Drawing from the discourse of practice-oriented teacher education, this book investigates the state of pre-service teachers' practical knowledge in mainland China, providing insights into the reform of initial teacher education programmes for teacher educators.

Conducting empirical studies at a university in Beijing, involving 400 pre-service teachers, the author investigates factors influencing pre-service teachers' practical knowledge. Five innovative methodologies, namely concept mapping, visual metaphors, video analysis, epistemic network analysis, and formative interventions are employed to make pre-service teachers' practical knowledge visible, helping to increase our theoretical understanding of practical knowledge and proposing practical guidelines for the reorganisation of initial teacher education.

While the study is grounded in mainland China, the methodological thinking and theoretical discussions can inspire international scholars and teacher educators, and therefore contribute to the global reform of teacher education.

Ge Wei is Associate Professor and Director of Research Centre for Children and Teacher Education, Capital Normal University, China. His research interests centre on teacher education, teaching, and learning. He has published a monograph about teacher practical knowledge (Education Science Press, 2020).

China Perspectives

The *China Perspectives* series focuses on translating and publishing works by leading Chinese scholars, writing about both global topics and China-related themes. It covers Humanities & Social Sciences, Education, Media and Psychology, as well as many interdisciplinary themes.

This is the first time any of these books have been published in English for international readers. The series aims to put forward a Chinese perspective, give insights into cutting-edge academic thinking in China, and inspire researchers globally.

To submit proposals, please contact the Taylor & Francis Publisher for China Publishing Programme, Lian Sun (Lian.Sun@informa.com)

Titles in education currently include:

Deeper Learning
A Voice from Laboratory to Classroom
Hang Hu

Embracing the New Two-Child Policy Era
Challenge and Countermeasures of Early Care and Education in China
Xiumin Hong, Wenting Zhu, Qun Ma

Migration and Educational Policymaking in China
A Critical Engagement with Policy Sociology and Bourdieu
Hui Yu

Reimaging Pre-Service Teachers' Practical Knowledge
Designing Learning for Future
Ge Wei

For more information, please visit https://www.routledge.com/China-Perspectives/book-series/CPH

Reimaging Pre-Service Teachers' Practical Knowledge

Designing Learning for Future

Ge Wei

Contents

Figures

Tables

Foreword

The important role of a high-quality teaching profession in raising standards and transforming educational outcomes continues to be emphasised in research and policies globally. However, the question of how to cultivate pre-service teachers' practical competences and knowledge and integrate them effectively has been explored in many countries for several decades. Teachers' impact on students is strong and deep. To become excellent teachers demands that pre-service teacher education nurtures future teachers intellectually, emotionally, socially, and morally and connects these growth processes with practical competences for student's everyday well-being and learning as well as for longer-term educational purposes.

Reimaging Pre-Service Teachers' Practical Knowledge invites us to enter into a research journey in mainland China, walking along with Dr. Ge Wei alongside his series of rooted studies during the four-year longitudinal project. This book addresses a vital issue in teacher education in the theory-praxis nexus. Ge conceptualises practical knowledge as a bridge to connect pedagogical theories and teachers' practices, which is also a unique knowledge base for teaching as a profession. Along the way, Ge chooses Dewey, Connelly, and Fenstermacher among others, as thinking companions who spark his studies, naming some of what he discovers about practical knowledge, and his commitments and insights as a scholar.

From a practical view, this book is a bottom-up experimentation in initial teacher education, which records Ge as a teacher educator's personal experience about teaching and learning. Ge begins his book reflecting on his research interest and original aspiration of studying teacher practical knowledge. Then, he creatively employs five methodologies to explore how to diagnose and nurture pre-service teachers' practical knowledge, via video analysis, concept mapping, visual metaphors, epistemic network analysis, and formative interventions. Based on Ge's scholarship of teaching and learning in teacher education, his findings are not only academically breakthroughs but also pragmatically reform initiatives in initial teacher education.

The richness of the redesigning teacher learning is based on Ge's wide expertise on teacher education curriculum, blended teaching pedagogy, and

placement mentoring. During conducting this longitudinal project, Ge explores new ways for developing pre-service teachers' practical knowledge together with teacher educators, who make sense of any event by co-learning.

While illustrating a variety of innovative methodologies in initial teacher education, Ge paints a clear picture entitled "teachers matter". Indeed, there has been heightened recognition that teachers are key to educational quality and students' development. In Finland, for example, teachers have high social reputation and professional autonomy. My studies on the Finnish teacher education give evidence that a research-based teacher education model gives Finnish teachers sustainable development (Niemi, Toom, & Kallioniemi, 2016). What makes me excited is that Ge's book also implies a research-based approach in teacher education, the same approach that his Finnish counterparts have. In this sense, this book creates a resonance between two top education systems in the world. Moreover, Ge by this book gives us a great experience in teacher education that will be persuasive and practicable in various contexts. By redesigning teacher learning and development, I believe that this book will inspire more countries and regions for their teacher education reforms.

Hannele Niemi
Professor of Faculty of Educational Sciences, University of Helsinki
UNESCO Chair on Educational Ecosystems for Equity
and Quality of Learning

Reference

Niemi, H., Toom, A., & Kallioniemi, A. (Eds.). (2016). *Miracle of education: The principles and practices of teaching and learning in Finnish schools* (2nd revised ed.). Rotterdam: Sense Publishers.

Acknowledgements

Prologue

Walt Whiteman in his poetry said, 'When you possess a book, you would know the writer'. *Reimaging Pre-Service Teachers' Practical Knowledge: Designing Learning for Future*, as my first monograph written in English, integrates my scholarly and passionate teaching experience at a Chinese normal university for five years, my thinking and reflection of teaching and teacher education for 13 years, and my personal and relational life in the world for 32 years. Fermenting this book is indeed a long journey during which I have devoted all my consciousness, thinking, emotions, and spirituality into it. It is, as what it is, a complex and wandering trajectory. Hereinafter, I intend to figure out the background of writing the present book and then put my designing of pre-service teacher learning forward.

Dystocia of the book

Revisiting the memory of authoring the book, it is a 'hardened story' (Conle, 1996) with self-struggling. In the summer of 2019, when I received an email from Mr. Feichi Gao, a previous editor from Routledge Publishing House who asked me to submit a book proposal, I was delighted and honoured by the invitation. Just in the same year, I got the research funding from the Beijing Municipal Education Commission to study the mechanisms of pre-service teachers' professional learning and development in mainland China. I sincerely would like to share my on-then project with international colleagues, but due to the very starting point of the project, I didn't have the courage to draft a book proposal with little empirical data. Until September 2020, after completing the first round of data collection and analyses, I wrote a responding email to Feichi to query whether he still kept his invitation. Fortunately, Feichi's warm and prompt reply gave me a lot of confidence. I immediately drafted a book proposal in a week to Feichi and then received very positive feedback from two anonymous reviewers.

I naively supposed that my writing of this book is going to start. Unfortunately, at the end of November 2020, my right humerus was seriously fractured in an accident. After a six-hour surgery, I stayed in the hospital for 30 days. When my doctor removed the plaster bandage from my arm,

my right hand and fingers had no feeling and could not move at all. I was shocked and scared that I would likely lose the ability of writing.

During the COVID-19 pandemic, I had to go back home for recuperation because of the tight medical resources in hospitals. I decided to leave my workplace in Beijing to my hometown, recovering with my parents in a western small county in Shaanxi. Since January 2021, my parents had been massaging my broken arm and hand every day and night. I cried, was angry, and disappointed, not only for the possible-abandoned writing of my first monograph to international readership but also for my future life in academia.

Two months later in March 2021, a miracle happened! My right hand and fingers could move gradually. Thanks to the parenthood love and their persistence, I regained the confidence to continue my living and writing as well. I began to reimage the feeling of writing and the passion for research I lost in the darkest winter of 2020.

When I went back to work in April 2021, I contacted Feichi again. Sadly, he had left Routledge to another publishing company. I had to communicate with another editor and promote my publication processing because I didn't want to give up. From then on, I knew Ms. Lian Sun, the successive editor who continued to support me for the book writing. Until now, I have to work more effectively to remedy my four-month sick leave. Lian kindly supplied me an additional half a year before submission; otherwise, I would not have completed the book.

The reason why I storied my life experience during the past two years is that writing is not a frivolous thing. It does not only matter with intellects but also physical and emotional labours, even our destiny (Richardson, 1994). My research focus on pre-service teachers' learning and development in the past decade shows the initial teachers' development with struggling. My writing experience for the present book is cohesive to the meaning I want to express from the growth of the pre-service teachers. Just because of the contingency, I didn't want to miss the chance to share my research and experience together within this book, which is worth retelling and reliving (Clandinin & Connelly, 2000). Experiencing the writing of this book, I began to know that uncertainties in our research and studies evoke volitional actions, which constructs our best-loved self (Schwab, 1954/1978) by imaging and reimaging the reality and dream of education. The brief story tells the-how of writing this book; then, I share the-why of my writing about and for pre-service teachers.

Encountering pre-service teachers

I dreamt of being a teacher when I was seven years old. Before graduating from Zhejiang University, the top-three university in mainland China located in south east, I served as a private tutor to teaching mathematics for one year. Series practical issues (e.g. effective interaction with students,

differentiated instruction, and situated teaching and learning strategies) during my tutoring at that time render my awareness that the bottom-up problems in teachers' work settings need to be researched.

I went back to continuing my postgraduate study and completed my doctoral degree in 2017 at Peking University. As a teacher educator and a teacher education researcher now, I often recall my puzzles a decade ago and then try to get a response from my research on pre-service teachers. However, the practice-oriented initial teacher education does not listen to pre-service teacher selves' voices and expressions. As Craig (2020) said,

> […] despite widespread agreement about the importance of teachers, research largely focuses on stakeholders, and what they think pre-service and practicing teachers should know and do. What pre-service and practicing teachers need to flourish in their teaching careers has received comparatively little attention. Also, most of what has been written has been of an abstract bent. A scarcity of research addresses what is fundamentally important to growing, nurturing, and sustaining quality teachers in their own terms.
>
> (p. 5)

Again, both as a teacher educator and a teacher education researcher, I have devoted myself to the inquiry: How to optimise our teacher education programmes by designing more effective teacher learning? How to construct pre-service teachers' transferable knowledge base in uncertain times? And how to better prepare pre-service teachers for their continuing professional development in future education?

Among various designs, developing pre-service teachers' practical knowledge is a possible path to bridging the gap between theory and practice in teacher education, and the current and future in teachers' career. Practical knowledge has been a classical conceptualisation in teacher education research since the 1980s (Elbaz, 1983) and has regained attention in academia alongside the discourse of 'practical turn' (e.g. Schön, 1983; Schwab, 1969) in teacher education during the past half a century. Due to the lacking of teaching experience, pre-service teachers have been regarded with little practical knowledge, while, since the 21st century, initial teacher education programmes worldwide have actively placed increased importance on practice and indeed found the practical knowledge of pre-service teachers (Darling-Hammond, 2000; Wei, 2020). In addition, the rising proportion of practicum and placement in initial teacher education aims to cultivate pre-service teachers' practical knowledge in advance and reduce their reality shock in future work (Veenman, 1984; Zeichner, 2010).

Under the discourse of practice-oriented teacher education, I begin to wonder what is the status quo of pre-service teachers' practical knowledge currently? What factors may contribute to the development of pre-service teachers' practical knowledge? How to nurture pre-service teachers'

practical knowledge by reforming initial teacher education programmes in a better way? This book intends to address these queries via a series of interconnected empirical studies in a Chinese normal university ranging from 2019 to 2021.

The present book is an assembling of outcomes of a longitudinal project supported by the Social Science Foundation, Beijing Municipal Education Commission (Grant No. SM201910028014) and the funding of remarkable academic achievement at Faculty of Education, Capital Normal University (Grant No. 21530420006). I, as the principal investigator of these projects, have conducted empirical investigations and interventions in the research field, a top-class normal university in China, where almost 400 pre-service teachers participated in my research. Although all the nearly 400 pre-service teachers do not get presented, their experiences are distilled by the participants in the book.

One of the major contributions of this book is a set of methodologies which could both examine and nurture pre-service teachers' practical knowledge. Five innovative methodologies, namely, concept mapping, visual metaphors, video analysis, epistemic network analysis, and formative interventions, have been employed to make pre-service teachers' practical knowledge visible and developable. Most of the methodologies above have been used for the first time in teacher education research in mainland China. My research assistants and I flexibly used five different methodologies in various contexts and curriculum modules in initial teacher education (e.g. seminar, school placement, and online learning during the COVID-19). Based on the five contextual cases, I compared the pros and cons of the five methodologies and then suggested that an integrated and prudent manner of using different methods could better help teacher educators to visualise pre-service teachers' practical knowledge and cultivate them in an accessible way.

Overall, the special interest of this book lies in increasing our theoretical understanding of pre-service teachers' practical knowledge by different methodologies and providing realistic insights into teacher educators about reimaging initial teacher education programmes. Although this book is grounded in mainland China, the methodological thinking and theoretical discussions might also inspire international scholars and contribute to the global reform of teacher education. The five methodologies could be generalised to other countries and areas for teacher training and education.

The book structure at a glance

The main body of this monograph is composed of seven chapters, excluding a prologue and an epilogue. At the beginning of my inquiry, the first chapter introduces the genealogy of studies on teacher practical knowledge. Both globally and locally, I analyse the practical knowledge of pre-service teachers nowadays. With the challenge from school workplaces, pre-service teachers need to have more competences to work the problems out under the support of their practical knowledge.

From the second to the sixth chapter, I invite readers to reimage pre-service teachers' practical knowledge alongside the five methodologies. In Chapter 2, concept maps are used as a reflective tool to not only diagnose pre-service teachers' practical knowledge but also foster their reflection upon their school placement. In Chapter 3, visual metaphor as an imaged and visualised grammar by pre-service teachers' paintings manifests their practical knowledge about their identity and being a teacher. In Chapter 4, during practicum, I have discussed how videotaping technology is widely used to record pre-service teachers' teaching. The manifestations of pre-service teachers' practical knowledge were analysed by employing a systematic coding strategy in a number of teaching videos. In Chapter 5, based on an online platform, the methodology of epistemic network analysis is used to recognise pre-service teachers' practical knowledge and their cognitive characteristics in the online learning community during the COVID-19 pandemic. In Chapter 6, a more progressive approach called formative interventions is used to redesign a teacher education module and record the processual outcomes of pre-service teachers' learning. Among the five methodologies, pre-service teachers' practical knowledge is not insufficient or waiting-to-be-developed anymore. Rather, pre-service teachers' practical knowledge exists and could be nurtured by teacher educators' designing. As a result, pre-service teachers' practical knowledge gets created as new images, impressed as new concepts, and replaced by new content in my research project.

Last but not the least, in Chapter 7, I try to summarise the findings and the above five methodologies by reimaging pre-service teachers' practical knowledge theoretically and practically. Due to the dual-identity both as a teacher educator and a teacher education researcher, my research methodologies could also work as instruments to nurture pre-service teachers' practical knowledge and reform the existed initial teacher education programmes. It is a very important issue to combine the theory and practice in teacher education through instrumentalities. Therefore, in the Epilogue, I conclude the issue with my personal reflection: I in fact performed the dual roles of insider (who engaged in the process of the design of the research with the pre-service teachers) and outsider (who tried to understand how the process facilitated the learning of the pre-service teachers), which makes it easier to achieve a combined partnership between research and practice (Coburn & Penuel, 2016).

It needs to be noted that all the participants in these projects have been ethically recruited, informed about what the studies entailed, and given the unconditional right to withdraw from participating. The recruitment was done via emails or face-to-face delivery. All participant names were replaced with pseudonyms to ensure anonymity. Informed consent was obtained from all research participants, and the study followed the ethical guidelines of the Beijing Municipal Commission of Education. If the data were drawn from part of pre-service teachers' course assignments, the assignments did not influence their course grades and were not subject to evaluation.

It is also necessary to mention that all the cases in this book are based in a normal university in mainland China. Readers should be cautious when my findings generalise to other countries alongside various socio-cultural contexts. Nevertheless, my perspective on pre-service teachers from different instrument-based research is of significance to international scholars and practitioners in teacher education. Aligned with international studies by Orland-Barak and Maskit (2017), I believe that the instrumentality is the bridge to combine theory-practice nexus, and I hope that the instrumentality-based methodologies could be adopted in more contexts.

After narrating my stories of how, why, and what I write in this book, I still warmly welcome any comments, suggestions, and possible collaborations on comparative studies on this issue. Readers could contact me by email: ge.wei@cnu.edu.cn

Concerning teaching and teacher education, we are always together on the way.

References

Clandinin, D. J., & Connelly, F. M. (2000). *Narrative inquiry: Experience and story in qualitative research*. New York: Jossey-Bass.

Coburn, C., & Penuel, W. (2016). Research-practice partnerships: Outcomes, dynamics, and open questions. *Educational Researcher, 45*(1), 48–54.

Conle, C. (1996). Resonance in pre-service teacher inquiry. *American Educational Research Journal, 33*(2), 297–325.

Craig, C. (2020). *Curriculum making, reciprocal learning, and the best-loved self.* New York: Palgrave Macmillan.

Darling Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. *Education Policy Analysis Archives, 8*(1), 1–44.

Elbaz, F. (1983).*Teacher thinking: A study of practical knowledge.* New York: Nichols Publishing Company.

Orland-Barak, L., & Maskit, D. (2017). *Methodologies of mediation in professional learning.* Cham: Springer.

Richardson, L. (1994). Writing: A method of inquiry. In N. Denzin & Y. Lincoln (Eds.), *Handbook of qualitative research* (pp. 516–529). Thousand Oaks, CA: Sage.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. Hampshire: Ashgate.

Schwab, J. (1954/1978). Eros and education: A discussion of one aspect of discussion. In I. Westbury and N. Wilkof (Eds.), *Science, curriculum and liberal education: Selected essays* (pp. 105–132). Chicago, IL: University of Chicago Press.

Schwab, J. (1969). The practical: A language for curriculum. *School Review, 78*, 1–23.

Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research, 54*, 143–178.

Wei, G. (2020). *Generation of teacher practical knowledge*. Beijing: Education Science Press.

Zeichner, K. M. (2010). Rethinking the connections between campus courses and field experiences in college- and university-based teacher education. *Journal of Teacher Education, 61*(1–2), 89–99.

1   Understanding pre-service teachers' practical knowledge

1 Introduction

This monograph emerged from my profound belief that teachers contribute significantly to the quality of education and human well-being. More than a decade and a half ago, the Organisation for Economic Co-operation and Development (OECD, 2005) issued the same proposal based on the report of a study of the teacher workforce in 25 countries. However, the primer critically failed to address prospective teachers.

An experienced teacher with sufficient practical knowledge acts effectively in a constantly changing classroom environment. The epistemology of practice is a teacher's private, integrated, but ever-changing system of knowledge, experience, and values that are relevant to teaching practice at any particular time. The development of pre-service teachers' practical knowledge involves them learning how to become professionals in a real educational context that consists of social relations, cultural understanding, and institutional norms. By participating in field experiences, pre-service teachers not only build a bridge between theory and practice in the learning of teaching but also develop practical knowledge in the schooling context.

In this first chapter, I will visit the backdrop of initial teacher education and its challenges in the 21st century. This will illustrate that the increasing demand for higher teacher quality facilitates the development of pre-service teachers' practical capability (Darling-Hammond & Bransford, 2005). Practical knowledge – a substantive epistemic ability for teacher learning and development – has evolved from a term into an academic field. Scrutinising the academic discourse regarding teachers' practical knowledge will elucidate the essential role played by practical knowledge in the reform of initial teacher education.

2 Conundrum of initial teacher education

2.1 Global challenges of initial teacher education

Since the late 1980s, initial teacher education has faced serious challenges related to adequately preparing pre-service teachers to work in schools as

future teachers. In addition, educational systems worldwide are struggling with a shortage of teachers. This shortage may be because an increasing number of qualified teachers have been leaving the profession within their first few years of teaching, which has resulted in an ageing teacher population (OECD, 2018). This trend may result from the discrepancy between the curricula of teacher education institutes and everyday teaching practices, which could induce a sense of unpreparedness among teachers regarding their professional activity (Grossman et al., 2009; Meijer, 2010). As Feiman-Nemser (2001) argued, after decades of school reform, there is a growing consensus that the quality of schools depends on the quality of its teachers:

> What students learn is directly related to what and how teachers teach, and what and how teachers teach depends on the knowledge, skills, and commitments they bring to their teaching and the opportunities they have to continue learning in and from their practice.
>
> (p. 1013)

The relative contributions of initial teacher education programmes and schools to pre-service teachers' professional learning have been an issue of concern in the field of teacher education (Athanases, Sanchez, & Martin, 2020; Brooks, 2021). The issue primarily pertains to the roles of the practical and theoretical aspects of initial teacher education in pre-service teachers' professional learning. Faced with the global reform of teacher education, the most confounding and debated topic is the integration of 'theoretically based knowledge that has traditionally been taught in university classrooms with the experience-based knowledge that has traditionally been located in the practice of teachers and the realities of classrooms and schools' (Darling-Hammond, 2006, p. 307). Also as Craig (2020) stated,

> Teachers' practices, reflecting their personal practical knowledge, will always be fluid and shape-shifting. Necessarily contoured by their own changing selves, teachers' practices are contingent on the learners they teach, knowledge advances in the disciplines, innovations in the teaching field, unfurling social issues and crises (i.e. global pandemic), and the educational policies influencing the context in which their practices unfold.
>
> (p. 14)

The theory–practice dichotomy has been identified as a perennial concern in initial teacher education (Korthagen, 2010). Great emphasis has been placed on bridging the gap between theory and practice when preparing pre-service teachers for their future work (Grossman et al., 2009). Researchers are constantly seeking the most relevant practices for facilitating the cultivation of well-balanced professional knowledge, reflective skills, and

practical capabilities among teachers, which would enable them to manage the challenges of their profession (e.g. Athanases et al., 2020; Mulryan-Kyne, 2020). Therefore, more attention is being paid to the composition of and links between different types of knowledge, especially the practical knowledge that guides teachers' professional practice and reveals how they re-conceptualise teaching (Wei, 2020).

Grossman et al.'s (2009) work informed the key features of the practical and conceptual aspects of initial teacher education. The practical aspects encompass multiple opportunities for practice in fieldwork and higher education settings, in addition to the practical tools introduced in teacher education coursework. The conceptual aspects – mainly delivered in higher education – include the conceptual tools that facilitate teachers' framing and interpretations of practice, but they do not offer specific solutions for practice in classrooms and schools. Furlong (2013) framed one of the key issues as 'how much time should be devoted to examining professional issues theoretically by drawing on theory and research and how much [should be] devoted through direct practical experience' (p. 69). Initial teacher education in some places has transformed into more practice-oriented training in schools, and the role of the university role has been recast as one primarily concerned with the analytical dimensions of teacher education (Hodson, Smith, & Brown, 2012). However, a more balanced approach in conceptual and practical aspects characterises initial teacher education in other places.

Having enough competent teachers to impart values, knowledge, and skills to students has always been a central concern for policymakers worldwide. Consequently, teacher education has focused significantly on curricular and pedagogical matters, including the search for effective teaching for positive student learning outcomes (Darling-Hammond, 2017). Over time, teacher education has broadened its scope of interest to accommodate increasingly diverse structural, social, and professional issues. When it comes to teacher education, what happens in schools and classrooms is nested within each country's educational policy environments, which are governed by their distinct political system. Nations attempt to provide quality teaching and learning to students via teachers who are mostly employed by government agencies. Since teachers are professionals and social beings with distinct worldviews, they are frequently unable to implement policies that flow down the conduit to them in replicable ways. They necessarily must bring themselves, their emotions and personalities, and their relationships with students into the mix. Teachers also recognise that learners are thinking and feeling beings, not automatons. Like themselves, students require the creative licence to contribute to curriculum-making in ways that fulfil their needs and desires as learners.

Developing practical knowledge when learning to become a teacher is a highly complex and multi-faceted process that places unique demands on the cognitive, affective, and performance nature of the novice (Sancar, Atal, & Deryakulu, 2021). Prospective teachers need to learn how to act and

effectively make on-the-spot judgments (Darling-Hammond, Hammerness, Grossman, Rust, & Shulman, 2005). They need to use the appropriate skills to do the right thing in a timely manner (Doyle & Carter, 1987) through careful observation and interpretation of the situation at hand (Biesta, 2015).

2.2 Initial teacher education in China

Orland-Barak and Lavrenteva (2019) summarised the six global trends of teacher education reform. They proposed that the global move towards advanced strategic, constructivist, and socio-cultural orientations to pre-service teachers' learning is strongly reflected in the stated vision, mission, and curricula of local teacher education contexts worldwide. The following six major themes that reflect this vision appear to have become integral to initial teacher education programmes worldwide:

1 the establishment of school–community–university partnerships;
2 incorporating more school practice focused on pupil learning in the preparation of future teachers;
3 a shift from a focus on teaching and curriculum to a focus on learning and learners;
4 the inclusion of activities that promote reflective practice and the development of the teacher-as-researcher;
5 academic and school spaces for fostering teacher learning that attends to social justice and inclusion; and
6 preparation of teacher educators and provision of mentoring frameworks to support student teacher learning.

These six initial teacher education trends imply that pre-service teachers' practical knowledge is integral to their professionalism and future sustainable development. Moreover, pre-service teachers' practical knowledge inherently contains their understanding of the subject matter, context, students, and themselves.

The global trends in teacher education have also been observed in China. Over the past two decades, teacher education in China has undergone unprecedented changes, including the rapid expansion of enrolment, innovation and structural system reorganisation, mergers between institutions of higher learning, and teaching quality improvement (Xue & Li, 2021). As an important element of the system of higher education, teacher education cannot escape the formidable challenges presented by change. Initial teacher education has been shown to develop significantly within this environment.

However, teacher education in China has struggled to keep pace with changes in the country's education system for nearly four decades. Numerous state policies, which include government and the Chinese Communist Party policies, have shared the common goal of improving the teacher education system to support educational reform. The implemented reform measures

were attempts to address issues such as system building, teacher preparation and training, the examination and certification of teachers, and recruitment and deployment of teachers for educational equality in the country.

In response to the state's calls for continued reform and the innovative improvement of the existing approach of teacher education, China's Ministry of Education (e.g. MOE, 2010, 2011a, 2012) instructed teacher education institutions to adopt new modes of teacher preparation, higher-degree programmes for teachers, partnerships with schools and governmental agencies, and internal measures to overhaul the management of teacher education.

In addition, the need for changing the teacher education curriculum and its practice-deprived orientation has been repeatedly stated in important policy documents. For example, the Ministry of Education decreed that teacher education institutions 'should formulate modes of teacher preparation and curricula that can [enable teachers] to implement quality education in secondary and primary schools, strengthen teaching practicum, and the ability of teacher education graduates to educate and teach and pursue life-long development' (MOE, 2012, p. 1). Operating under governmental pressure, course providers typically responded by introducing new modes of course delivery. This mainly involved the rearrangement of course sequences in a manner that expressed the connections between major components of teacher education such as subject knowledge, educational knowledge, school curriculum and pedagogy, practicum, and general education (political education, language education, and physical education).

Since 2017, an emphasis on practice has been listed as a standard for initial teacher education programmes to acquire national accreditation in China (MOE, 2017). As an essential component of the teacher education curriculum, school placement requires the participation of knowledgeable and experienced practitioners to prepare and guide pre-service teachers through the process of teaching and nurture their practical knowledge. The teacher preparation curricula at most normal universities in China distinguished the teaching of school subjects from educational studies. Independent academic departments were tasked with the responsibility of offering courses in subject teaching, which included the supervision of practicum. The academic departments, which were mostly involved in basic research, often considered teacher education to be their secondary pursuit. The lack of experience in teacher education, meagre expertise in teaching, and weak connection to schools made the implementation of teaching practicum even more difficult at comprehensive universities. Thus, the teaching practicum was ironically a neglected area in teacher preparation. Initial teacher education remained dominated by heavy academic coursework and divorced from the reality of the school and classroom.

To address the above shortcomings, the state introduced uniform standard guidelines for teacher preparation and in-service training at the system level. Promulgated in 2011, the *Teacher Education Curriculum Standards* listed specific requirements for teacher preparation programmes that

produced teachers for kindergartens, primary schools, and secondary schools. The document, which was supposed to be used as a standard-setting implementation guideline, portrayed teachers as 'reflective practitioners' and advised that teacher education programmes 'should strengthen their practical awareness, pay attention to real problems, and reflect the new requirements that educational reform and development have imposed on the teachers' (MOE, 2011b, p. 1).

School placement subsequently became an integral part of the teacher education curriculum. The new teaching practicum required pre-service teachers to undergo no less than 18 weeks (equivalent to one semester of study) of teaching practice 'under the supervision of teachers who selected for their strong sense of duty and rich experience' (MOE, 2011b). The state also encouraged higher institutions to forge partnerships with schools and local education agencies as a means to consolidate the practice of teaching in their teacher education curricula (MOE, 2011b). As the university-government-school collaboration scheme gained acceptance, it was viewed as a possible avenue for tapping the professional wisdom of frontline teachers for teacher preparation.

In certain cities, new 'experimental districts for teacher education reform and innovations' were established in response to official calls for a sustainable base for such three-way collaboration (MOE, 2011b, p. 1). A positive institutional response notwithstanding, the state apparently expected more from course providers. Published in 2014, the state's *Opinions on the Implementation of the Plan to Nurture Outstanding Teachers* indicated that it found the aims and relevance of teacher preparation to still be lacking. Additionally, it found the contents and methods of teacher education institutes' curriculum and pedagogy to be relatively obsolete and the quality of their practices and teacher educators to be poor (MOE, 2014). Given its observations, the state needed to adopt other strategies that would enable it to play a larger role in the selection of teachers. These strategies involved reviving teacher certification and entrance examinations for teachers.

China's reformation of its initial teacher education was a response to the global challenge of teacher training. Indeed, given the agency of teachers and the importance of their knowledge, beliefs, attitudes, qualifications, motivation, and skills, they are integral to the successful implementation of change and consolidation of the quality of educational systems. Cultivating pre-service teachers' practical knowledge is regarded as a solution to the issues related to teacher education. After providing the Chinese context for this study, a general theoretical overview of how different researchers have studied teacher practical knowledge will be presented, followed by a more precise framework to analyse pre-service teachers' practical knowledge.

2.3 Revisiting the theory-practice continuum

The programme structures of most initial teacher education programmes consist of various curricular components. These include general education,

subject matter studies (whether taught concurrently or consecutively with other studies), foundation of education studies, methods studies, and field experience (Zeichner & Conklin, 2008). In most programmes, the first four components are delivered as coursework and the fifth is housed as fieldwork. In many parts of the world, higher education has the formal responsibility of providing initial teacher education, whereas schools have varying degrees of involvement in different initial teacher education programmes.

Studies have shown that pre-service teachers' professional learning is influenced by their peers, mentors, and teaching supervisors during fieldwork (Grossman et al., 2009). Furlong (2013) acknowledged the importance of student teachers learning through practical work in schools. He emphasised the importance of asking questions in professional practice and suggested that higher education is the place for introducing 'the best that is known' (Furlong, 2013, p. 2) about practice and critiquing current practice.

Apart from the aforementioned curriculum organisation and institutional perspectives, our understanding of different aspects of initial teacher education is informed through the lens of the theory–practice continuum. Furlong, Barton, Miles, Whiting, and Whitty's (2000) classification of levels of professional training provides a useful lens to examine the differentiation of professional learning activities along the theory–practice continuum. Training in the form of disciplinary theory refers to the critical study of practice and its principles in light of theory and research. Training in the form of practical principles refers to the acquisition of knowledge regarding the principles behind professional practices and reflection on their use and justification. Indirect practice involves the development of practical understanding, judgment, and skills in detached contexts, whereas direct practice refers to the competence acquired through direct practical experience in authentic classroom and school contexts.

Other researchers have asserted that theory can take on different roles in initial teacher education. For example, Eraut (2003) distinguished between theory as a direct guide to action and theory as an intellectual resource that aids one's understanding of a context or an issue. Korthagen (2010) echoed this with a distinction between using knowledge for action and using it to understand a category of situations. The work of these researchers informs the examination of the practical and conceptual aspects of initial teacher education.

Professional learning in the practical aspects of initial teacher education encompasses learning through multiple practical experiences in fieldwork and higher education settings, in addition to the practical tools introduced in initial teacher education coursework. For instance, lesson observation and analysis is a useful professional learning technique. To develop fluidity and competence in practice, student teachers need multiple opportunities to enact practice 'across a variety of settings, from more controlled settings in the university through the more authentic settings of classrooms' (Grossman et al., 2009, p. 284). During fieldwork, it is important for pre-service teachers to have opportunities to experience and engage in decision-making

in various aspects of their work (Gallant & Mayer, 2012). In initial teacher education coursework, practical tools are usually introduced in methods courses and include the principles, frameworks, or guidelines that guide decisions about teaching and learning and can be enacted in practice (Grossman et al., 2009).

The Chinese Ministry of Education has comprehensively reformed teacher education over the past several decades. The reform has resulted in the establishment of a relatively stable teacher education system, regulation of teacher education programmes and curricula, and provision of opportunities for in-service teachers to train and upgrade their educational credentials (Xue & Li, 2021). However, except for the introduction of some innovative approaches, the teacher education process did not change significantly at the micro level. Therefore, certain problems have persisted. As Zhou (2014) suggested,

> […] Improving the quality of teacher education will depend on revolutionary changes at the micro level, such as changing teacher education content from context-free knowledge and knowledge of disciplines to discipline knowledge in practice, improving the quality of teacher educators and changing their indoctrinated instructional approach, joint help from the university faculty, and cooperative teachers for student teachers to develop practical knowledge, using research-based evidence to evaluate and improve programmes, and empowering teachers to pursue self-directed professional development. In addition, teachers' beliefs and professional identities are recognised as two essential qualities of a good teacher.
>
> (p. 521)

In this vein, I agree that initial teacher education should innovate its models and practice. Thus, based on practice-oriented teacher education and the contextualised stance of bottom-up reform, the present monograph proposes practical knowledge as the critical knowledge base for filling the gap between theory and practice in teacher education.

3 Practical knowledge as the antidote

It is interesting to note that teachers' voices are not reflected in the ever-growing volume of literature on professional development and learning (Cooper et al., 2020). The reality is that teaching is a complicated and sophisticated business that relies on the complex interplay between personal and social processes, where pedagogy and context are enacted through astute teacher decision-making (Smith, 2017). Therefore, the manner in which practical knowledge in teaching is developed and nurtured is important because meaningful approaches to supporting such development serve as

a cornerstone of educational change, enhanced teaching quality, and improvements to student learning outcomes (Fullan, 2014). In this sub-section, I will elucidate the landscape of research on teacher practical knowledge over the past half-century. A theoretical framework of teachers' practical knowledge structure emerges through the scrutiny of the scholarship about teaching and teachers' practices. Overall, practical knowledge is regarded as an antidote for resolving the challenges related to initial teacher training and education worldwide.

3.1 Backdrop of practical knowledge research

For many years, schools have primarily been structured in a manner that supports a version of traditional knowledge claims in which teachers are viewed as passive spectators of knowledge embedded in the existing formal curriculum. The classroom has thus been viewed as a sphere in which teachers' most significant task is to transmit the relevant subject matter to students, who passively receive it. The basic assumption underlying this epistemology is to insist on the correspondence theory of objective truth and impose it onto life in the classroom. According to this epistemology, true knowledge about the process of teaching-studying-learning is produced by others (e.g. the university researchers and experts), and teachers should utilise this knowledge to solve concrete problems embedded in their professional lives. This foundationalist version of curriculum and schooling and the passive rule of teachers in this tradition has been challenged from the perspective of the epistemology of practice (e.g. Boyles, 2006; Carr, D., 2003; Carr, W., 2004, 2005; Schön, 1983; Whitehead, 2000). The logic of the following epistemology enables practitioners to understand the rationality behind their actions. Whitehead (2000) contended that 'when I [as a practitioner] make a claim to believe or to know something [as a result of my reflection], or to explain why something happened, I want to understand the logic of the belief, knowledge or explanation' (p. 94).

Until the 1980s, teachers' practice and practice-based thinking and actions received more attention. As has been recognised for a considerable time period, a better understanding of what it means to develop as a pedagogy is inextricably linked to the development of a teacher's workplace knowledge of learning and teaching. This knowledge in action is often recognised as practical knowledge (Toom et al., 2019). Thus, teaching practice is not the application of an educational theory that is independent of time and place. Teachers are not passive spectators of the technical and abstract knowledge produced by others. The opposition here is to espouse technical rationality and rational planning, guided by disembodied abstract theories.

Practice-based teacher knowledge claims regarding what happens in classroom settings, specifically regarding what teachers already know, have been reflected in a variety of research programmes under the umbrella of

teachers' practical knowledge (e.g. Connelly & Clandinin, 1985; Elbaz, 1981, 1983; Meijer, 1999; Zanting, 2001). My colleagues and I also stated the following:

> Teacher knowledge has been conceptualised and discussed in two distinguished forms: propositional or 'formal' knowledge, which is developed by conventional, scientific research methods; and practical knowledge or 'wisdom of practice', generally believed to have been acquired primarily as a result of teachers' professional experiences and their reflections on those experiences. Teachers' practical knowledge is based on the epistemological assumption that generating knowledge about good teaching is not the exclusive property of university researchers, and teachers also have theories that can contribute to a codified knowledge base for teaching.
>
> (Chen, Wei, & Jiang, 2017, p. 520)

Practical knowledge is based on an epistemological assumption that 'generating knowledge about good teaching is not the exclusive property of university researchers, and it recognizes that teachers also have theories that can contribute to a codified knowledge base for teaching' (Zeichner, 1994, p. 10). In this book, teachers' practical knowledge is defined as:

1   The knowledge that stems from various sources in practice (e.g. professional experience in the classroom, teacher training programmes, and personal life history),
2   including all teachers' cognitive (e.g. knowledge, beliefs, and motives) and non-cognitive (e.g. emotion, identity, and values) aspects, and
3   its most significant function is to guide teachers' situated and relational practices.

This attempted definition of teachers' practical knowledge pertains to its resources, components, and functions. In short, teachers' practical knowledge is a kind of professional knowledge from, of, and for teachers' practice (Lampert, 2010). Teachers' practical knowledge can refer to the knowledge that teachers themselves generate as a result of their reflection on their experiences and verification through actions (Fenstermacher, 1994).

3.2 Meanings of teacher practical knowledge

It is difficult to define practical knowledge because it changes its meaning as per the socio-cultural context and teachers' practical actions on-site. Chaharbashloo, Gholami, Aliasgari, Talebzadeh, and Mousapour (2020) summarised teachers' practical knowledge as personal (each teacher's practical knowledge is to some extent unique), contextual (bounded in and adapted to the classroom situation), reflective (it originates in and develops

through experiences in teaching), and tacit (i.e. not often articulated by teachers). Additionally, they indicated that it guides teaching practice and is content-related (Chaharbashloo et al., 2020). Teachers' practical knowledge is a multi-faceted concept that needs to be studied from different points of view and with various assumptions.

Elbaz (1981, 1983) was among the first scholars to specifically identify categories through a case study of a high school English teacher called Sara. Elbaz described these categories as an imagery reflection of Sara's cognitive style and classified them into five broad domains: curriculum, subject matter, instructional, teaching milieu, and self. Following Elbaz, other researchers (e.g. Meijer, 1999; Toom, 2006) conducted empirical studies to address the content of teachers' practical knowledge. In her study, Meijer (1999) found that teachers' practical knowledge includes knowledge about subject matter, general characteristics of students, student learning and understanding, purposes, curriculum, and instructional techniques (see also Kennedy, 2004; Toom, 2006). Therefore, empirical studies and theoretical contemplation have indicated that teachers' practical knowledge is inclusive and encompasses various phenomena and educational elements in the context of teaching.

In this monograph, practical knowledge is taken to be an amalgam of all teachers' cognitions, such as declarative and procedural knowledge, beliefs, and values that influence their pre-active, interactive, and post-active teaching activities (Zanting, Verloop, Vermunt, & Van Driel, 1998). As Meijer (1999) argued,

> given the range of different terms that are used in these studies and the equal number of definitions that can be found, it can be concluded that there is no agreement about the characteristics or the content of this kind of knowledge.
>
> (p. 60)

Synthesising these previous studies, the characteristics of teachers' practical knowledge can be described as follows:

(1) Although it is primarily considered experiential, teachers' practical knowledge has other important sources. Formal knowledge, existing theories of teaching and learning, and meta-knowledge sources such as social and cultural contexts (e.g. community of practice and the general sphere of society) are among other important sources of teachers' practical knowledge.

(2) Knowledge must be processed to be used. All information from the various sources mentioned undergoes a process (e.g. intuitive or meta-cognitive reflection while teaching, and remote reflection after or before teaching) of personalisation (i.e. adaptation and transformation) to be tailored to practical teaching situations.

(3) The content of practical knowledge is related to a variety of educational phenomena in the classroom. Knowledge is generally concerned with

general pedagogical issues, content pedagogical knowledge, subject matter, the self, student characteristics, curriculum, and educational purposes.

More specifically, the content of teachers' knowledge has been classified into several categories (e.g. Borko & Putnam, 1996; Calderhead, 1993; Grossman, 1995; Shulman, 1987). Borko and Putnam (1996) organised these categories into three broad themes:

(1) General pedagogical knowledge and beliefs, which 'encompass a teacher's knowledge and beliefs about teaching, learning, and learners that transcend particular subject matter domains' (p. 675). A teacher's knowledge of classroom management, instructional strategies, learning, learning, and teaching is considered to be related to general pedagogical knowledge.

(2) Subject matter knowledge and beliefs, which are related to teachers' knowledge of the facts, concepts, and procedures of a specific discipline.

(3) Pedagogical content knowledge and beliefs, which is described as 'the ways of representing and formulating the subject that makes it comprehensible to others' (p. 676).

Such categorisations of teachers' knowledge are not primarily related to practical knowledge. Rather, they are primarily concerned with the general view of teachers' knowledge and beliefs. To accurately define the meaning of teacher practical knowledge, we need to scrutinise the genealogy of research and studies on teacher practical knowledge.

4 Genealogy of research on teacher practical knowledge

Originating from Aristotelian philosophy, the concept of practical knowledge refers to a practice-based epistemology that regards the validity of action as a criterion to judge the truth of knowledge (Stout, 2018), which is also called *phronesis.* Since the 1980s, the original International Study Association of Teachers Thinking has developed this field by conducting studies on practical knowledge in teacher education. A robust body of research on teachers' practical knowledge has formed over the past century. Fenstermacher (1994) drew the academic trajectories of teacher knowledge (especially practical knowledge) research into three main lines:

1   Elbaz (1983), Connelly and Clandinin (1990), and Clandinin and Connelly (2000), who pioneered this work;
2   the studies of Schön (1983) and his followers, Russell and Munby (1991), under the Deweyan tradition; and
3   works called 'teacher research' by Cochran-Smith and Lytle (1990).

Affected by these three strands, many studies involve specific dimensions of teacher practical knowledge such as situational (e.g. Clandinin & Connelly, 1996, 2000), theoretical (e.g. Beijaard & Verloop, 1996; Dunne, 2005), personal (e.g. Connelly & Clandinin, 1985), social (e.g. Husu, 2005; Tirri, Husu, & Kansanen, 1999; Toom, 2006), and experiential knowledge (e.g. Meijer, 1999; Zanting, 2001). In the following sections, I reframe

Fenstermacher's categorisation and subsequently use the ideas of the afore-mentioned three approaches to depict the genealogy of teacher practical knowledge research (c.f., Chen & Wei, 2018; Wei, 2019, 2020).

4.1 Technical-rational approach

Research on teacher knowledge has resulted from the failure of what is generally called the behaviourist approach, in which the mutability, indeterminacy, and particularity (Pendlebury, 1990) of teaching as a practice-based profession were neglected (e.g. Clark & Peterson, 1986; Shulman, 1986). 'Many curricular and educational reforms failed because they did not seem to account for the changing character of the situations met in practice, and did not correspond to the teachers' ideas about what works in practice' (Meijer, 1999, pp. 10–11).

Kennedy (2004) compared reform ideals with practical intentions of teachers and concluded that there is 'substantial merit in the hypothesis that teachers' interpretations of classroom situations, and the beliefs and values that contribute to those interpretations could account for their long-recognized failure to adopt reform ideals. Whereas a reformer may interpret a classroom situation as presenting an opportunity for intellectual engagement, a teacher may interpret the same situation as threatening to disrupt lesson momentum' (p. 27). Craig (2020b) criticised the technical-rational approach, indicating that it characterised teachers as passive implementers of the national curriculum. In this widespread view, shifts in teachers' practices occur because policymakers or academics at various levels of educational organisations mandate changes that teachers must dutifully follow due to legal requirements, their subordinated positions, and/or their lack of power. Situated near the bottom of education's food chain, the teacher is a 'technician…receiver, transmitter, and implementer of other people's knowledge' (Cochran-Smith & Lytle, 1999, p. 276) and 'instructions' (Goodson, 2017, p. 5).

The technical-rational approach to teacher practical knowledge makes this knowledge look like a 'manual' (Westbury, 2000, p. 17) or a 'cookbook' (Oyoo, 2013, p. 458). Teachers in situ are more 'business manager[s]' than 'paradigm[s] of moral life' (Alexander, 2015, p. 27), and the 'ethical dimension of practical knowledge' (Chen et al., 2017, p. 518) is neglected.

In this vein, the dispersed initial teacher education courses do not prepare graduates well for the realities of teaching, and teachers find it difficult to apply the knowledge acquired through formal study to the complexities of teaching (Black & Halliwell, 2000). This failure in teacher education and curricular reforms was partially considered a result of the dominance of process-product rationality in research on teaching and teacher education. This argument, in turn, was based on the theoretical assumption that in addition to teachers' behaviours being associated with their pedagogical decisions, teachers' cognitions are fundamentally and mutually related to their actions.

4.2 Individual-experiential approach

Practical knowledge fits the narrative mode of knowing (Bruner, 1986). The shift in research on teaching was stimulated by the appearance of qualitative or interpretative studies of classroom teaching (e.g. Jackson, 1968). The individual-experiential approach to studying teacher practice and practical knowledge regards teachers as agentive actors, who make decisions on specific situations rather than 'following any particular set method or scheme' (Dewey, 1904, pp. 27–28). As Carter (1990) indicated,

> by generating richly detailed portraits of the demands of classroom environments and the ways in which teachers struggled to cope with these demands, this tradition had a powerful influence on the development of research on teachers' knowledge and its acquisition.
>
> (p. 295)

The interest in research on teacher thinking has increased as a practical result of the theoretical assumption underlying research on teacher cognition and the growing application of interpretative methodology in research on teaching. Relying on different tasks, research in this tradition was conducted to understand the multiple ways in which teachers make sense of the educational environment in their schools and classrooms (e.g. Craig, 2012).

The individual-experiential approach acknowledges the teacher as a holder, user, and producer of knowledge who, as a moral agent and personal self, adeptly negotiates a government-authorised curriculum in an active relationship with the students in their care. Thus, as Schwab (1971) stated, teachers deliberate on their knowledge about themselves as a teacher, the course content, the reach of the milieu, in addition to their knowledge of students, their relationships with one another, and their individual uniqueness. According to DeBoer (2014), teachers inspire students through accounts of personal experiences or enable students to share their own insights and opinions.

Inspired by Dewey, Schwab, Connelle, and Clandinin, researchers in this tradition carried out different inquiries to understand how knowledge may be structured in the minds of teachers, acknowledge teachers' experiential knowledge, advocate and provide services for teachers' practice, hear the otherwise silent voices of ordinary teachers (Wei, 2021), and identify issues about pedagogies that should be reformed (Craig, 2020a).

4.3 Practice-reflective approach

Practical knowledge is known and produced by teachers as a result of their professional experiences and reflections on these experiences. The focus on reflection stems from the belief that reflection facilitates critical thinking and the linkage between theory and practice. Reflection is considered a key element in the exercise of a teacher's practical knowledge, as it makes them review their practice within the context of their knowledge.

Although the experiential aspect of practical knowledge is highly emphasised, it has other aspects as well. Practical knowledge guides teachers' actions in practice, whereas scientific or formal knowledge is abstract and propositional. Practical knowledge is experiential, procedural, situational, particularistic, and implicit. It refers to teachers' knowledge of classroom situations and the practical dilemmas they face in carrying out purposeful action in these settings.

Donald Schön (1983) criticised professional education in higher education. His investigation presented reflection-in-action as a special form of thinking by professionals. Max van Manen (1995) proposed that teachers perform a three-level reflection: technical reflection, practical reflection, and critical reflection. His phenomenology pedagogy focused on the tactic and wisdom of teaching. The practical-reflective approach regards reflective practice as the transformative mechanism of teacher practical knowledge. Reflection and reflective practice are increasingly being discussed and promoted as an essential part of initial teacher education programmes. Many scholars have recently designed reflective frameworks and tools to raise pre-service teachers' reflection frequency and quality (e.g. Mulryan-Kyne, 2020; Vesterinen, Toom, & Krokfors, 2014). Overall, reflective practice celebrates the art of teaching, as it allows for continual interpretation, investigation, and reflective conversation with oneself about the problem while employing the information gained from past experiences to inform and guide new actions (Sellars, 2014).

Although findings in these areas continue to strengthen the design of initial teacher education programmes, their contributions are limited. Growing the collective understanding of the broad features of effective initial teacher education programmes is insufficient for organising initial teacher education (Sztajn, Borko, & Smith, 2017). Additionally, identifying effective tools requires information on how to design learning experiences to engage teachers with tools. However, the above three approaches to understanding and researching teachers' practical knowledge lack the ambition to change or develop teachers' practical knowledge. Relevant studies should also be practice-oriented and enable the diagnosis and development of teachers' practical knowledge.

5 A theoretical framework

To study teachers' practical knowledge in a more targeted manner, I examine teachers' practical knowledge in four domains in this book (see also Figure 1.1):

1 knowledge about the self, which orients teachers' professional identity construction (e.g. Clandinin & Connelly, 1996);
2 knowledge about disciplines, which enables teachers to have mastery of their subject area and draw from a variety of teaching methods and strategies (e.g. Meijer, Verloop, & Beijaard, 2001);
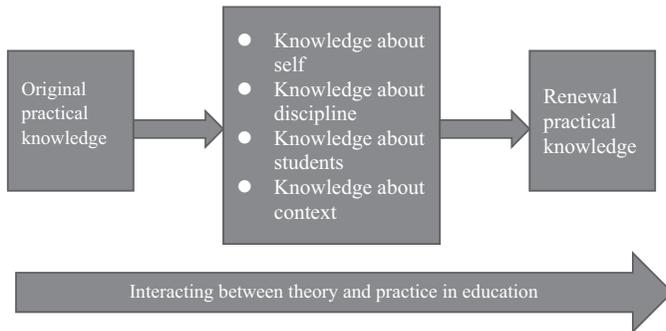
Figure 1.1 A framework for analysis

3   knowledge about students, which helps teachers develop positive rela-
tionships with students (e.g. van Driel, Beijaard, & Verloop, 2001); and

4   knowledge about context, which refers to teachers' understanding of
macro social and educational circumstances and their sensitivity to mi-
cro problematic situations in the workplace (e.g. Buchanan, 2015).

The above components serve as a framework to examine the development of
pre-service teachers' practical knowledge during the various stages of initial
teacher education. Figure 1.1 is an initial framework that combines the dif-
ferent components of pre-service teachers' practical knowledge.

The major concern of this book is recognising and nurturing pre-service
teachers' practical knowledge by optimising initial teacher education pro-
grammes. I employed the social-cultural perspective (Vygotsky, 1978) on
teacher learning and development, which posits the development of pre-
service teachers' practical knowledge through artefacts and human-created
instrumentality (Gutierrez & Vossoughi, 2010). The five innovative method-
ologies to develop pre-service teachers' practical knowledge are outlined in
the next section to contextualise the following series of chapters.

6   Five innovative methodologies

The five proposed methodological instruments or toolkits are concept maps,
visual metaphors, video analysis, epistemic network analysis, and formative
interventions. All the methods have the same characteristics and aim, which
is to make pre-service teachers' practical knowledge visible.

6.1   Concept mapping

A concept map is a visualised representation of human knowledge. It is com-
prised of concepts and relationships between them (Novak & Gowin, 1984).

One way to use concept maps is to have people represent the knowledge they activate during the performance of different tasks. Concept mapping has been recently used as an instrument to explicate in-service teachers' practical knowledge by European researchers (van den Bogaart, Mazereeuw, Hummel, & Kirschner, 2017). Comparisons between maps of the same teacher at different moments provide valuable insights into the changes in pre-service teachers' practical knowledge. According to van den Bogaart et al. (2017), concept maps will retain high validity when supplemented with annotations and semi-structured interviews to allow participants to clarify the relationships between concepts and investigate the focus of their thoughts on changing their knowledge development. This methodology was used for a cohort of pre-service teachers before and after their school placement. A comparison between the pre- and post-maps illuminated their practical knowledge.

6.2 Visual metaphors

Metaphors are representations of human thinking (Lakoff & Johnson, 1980). The use of visual metaphors as a methodology is rooted in the scholarship of visual images. It is defined as the ability to interpret, negotiate, and make meaning from information presented in the form of an image. A visual metaphor extends the meaning of words, which typically only entails the interpretation of the written or printed text. Visual metaphors are based on the idea that pictures can be 'read' and that meaning can be discerned through a process of reading. The use of visual texts as a methodology illustrates professionals' implicit understandings and stances towards their practice and has proliferated in teacher education curricula. In this book, I collected and analysed pre-service teachers' visual metaphors to examine their professional identity before enrolling them into the teacher cohort. This visualised tool also helps pre-service teachers rethink their professional vision of becoming a teacher.

6.3 Video analysis

Since the early 1990s, the use of videos as a methodology has gained importance in teacher education pedagogy as a medium for the in-depth observation of experience. It has been recognised as a powerful reflective tool, an integral component of reflective action-research models in teacher education, and central to stimulated recall techniques of analysis and interpretation. Videos are a powerful method for mediating learning on action. They encourage self and group examination and a focus on teaching-learning live events from the perspective of both the teacher and the learner. In this book, I analysed videos of the teaching conducted by 66 pre-service teachers in primary schools. Their enactments in the videos served as a record of their practised knowledge of professional work.

6.4 *Epistemic network analysis*

Epistemic network analysis is a novel method that involves analysing elements in coded data and then representing the connections as dynamic network models (Shaffer, Collier, & Ruis, 2016). Essentially, epistemic network analysis measures the relationships between coded elements by quantifying the co-occurrences of those elements in discourse (Shaffer et al., 2016). It utilises sphere normalisation to ensure that those who talk a lot do not obscure individuals who may not talk as much but still make meaningful connections. This sphere normalisation process allows the epistemic network analysis to model the pattern of connections an individual makes as opposed to the total number of connections made due to varying amounts of interaction (Shaffer et al., 2016). Owing to the COVID-19 pandemic, our initial teacher education courses in 2020 had to be conducted online. The online teaching platform stored data on more than 200 pre-service teachers' learning trajectories. An epistemic network analysis was utilised to examine pre-service teachers' practical knowledge in an online environment, which inspired us to consolidate the effectiveness of blended learning in the post-pandemic era.

6.5 *Formative interventions*

The Finnish activity theorist Yrjö Engeström (1987, 2015) developed a progressive methodology of formative interventions based on the Vygotskian principles of dual stimulation (Vygotsky, 1997) and ascending from the abstract to the concrete (Davydov, 2008). From the cultural-historical activity-theoretical perspective, an intervention is intended to be disruptive but developmental in relation to the practice in which the intervention takes place. An intervention is meant to be deliberate, systematic, and to some extent halt or slow down business-as-usual for the practice to be examined closely by the practitioners and for a new critical consciousness to be stimulated among them. The primary assertion of formative intervention as a methodology is that it enables pre-service teachers to do more than simply work on improving their own performance either through action research methods or through participation in a researcher-led design experiment. This critical consciousness is stimulated by the power of the conceptual tools of activity theory in helping pre-service teachers analyse how the object of their collective activity is constructed, how rules and a division of labour have emerged historically within a community of practitioners, how cultural tools are appropriated by members of that community, and how these might be changed for the better. I employed this methodology to organise a 13-month experiment in a Chinese initial teacher education programme. These interventions and their abstract trajectories enacted a utopic teacher education environment.

References

Alexander, H. (2015). *Reimaging liberal education: Affiliation and inquiry in democratic schooling.* New York: Bloomsbury Press.

Athanases, S. Z., Sanchez, S. L., & Martin, L. M. (2020). Saturate, situate, synthesize: Fostering preservice teachers' conceptual and practical knowledge for learning to lead class discussion. *Teaching and Teacher Education*, https://doi.org/10.1016/j.tate.2019.102970

Beijaard, D., & Verloop, N. (1996). Assessing teacher's practical knowledge. *Studies in Educational Evaluation, 22*(3), 275–286.

Biesta, G. J. (2015). *Beyond learning: Democratic education for a human future*. London: Routledge.

Black, A. L., & Halliwell, G. (2000). Accessing practical knowledge: How? why? *Teaching and Teacher Education, 16*(1), 103–115.

Borko, H., & Putnam, R. T. (1996). Learning to teach. In D. C. Berliner, & R. C. Calfe (Eds.), *Handbook of educational psychology* (pp. 673–707). New York: Macmillan.

Boyles, D. R. (2006). Dewey's epistemology: An argument for warranted assertions, knowing, and meaningful classroom practice. *Educational Theory, 56*(1), 57–68.

Brooks, C. (2021). The quality conundrum in initial teacher education. *Teachers and Teaching*, https://doi.org/10.1080/13540602.2021.1933414

Bruner, J. (1986). *Actual minds, possible worlds.* Cambridge, MA: Harvard University Press.

Buchanan, R. (2015). Teacher identity and agency in an era of accountability. *Teachers and Teaching: Theory and Practice, 21*(6), 700–719.

Calderhead, J. (1993). The contribution of research on teacher's thinking to the professional development of teachers. In C. Day, J. Calderhead & P. Denicolo (Eds.), *Research on teacher thinking: Understanding professional development* (pp. 11–18). London and Washington, DC: The Flamer Press.

Carr, D. (2003). Rival conceptions of practice in education and teaching. *Journal of Philosophy of Education, 37*(2), 253–266.

Carr, W. (2005). The role of theory in the professional development of an educational theorist. *Pedagogy, Culture and Society,* 13(3), 333–346.

Carter, K. (1990). Teachers' knowledge and learning to teach. In W. R. Houston (Ed.), *Handbook of research on teacher education* (pp. 291–310). New York: Macmillan.

Chaharbashloo, H., Gholami, K., Aliasgari, M., Talebzadeh, H., & Mousapour, N. (2020). Analytical reflection on teachers' practical knowledge: A case study of exemplary teachers in an educational reform context. *Teaching and Teacher Education, 87*, 102–131.

Chen, X., Wei, G., & Jiang, S. (2017). The ethical dimension of teacher practical knowledge: A narrative inquiry into Chinese teachers' thinking and action in dilemmatic spaces. *Journal of Curriculum Studies, 49*(4), 518–541.

Clandinin, D. J., & Connelly, F. M. (1996). Teachers' professional knowledge landscapes: Teacher stories—stories of teachers—school stories—stories of schools. *Educational Researcher, 25*(3), 24–30.

Clandinin, D. J., & Connelly, F. M. (2000). *Narrative inquiry: Experience and story in qualitative research*. San Francisco, CA: Jossey-Bass.

Clark, C. M., & Peterson, P. L. (1986). Teachers' thought processes. In C. M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 255–296). New York: Macmillan.

Cochran-Smith, M., & Lytle, S. (1990). The teacher research movement: A decade later. *Educational Researcher, 28*(7), 15–25.

Cochran-Smith, M., & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. *Review of Research in Education, 24*(1), 249–305.

Connelly, F. M., & Clandinin, D. J. (1985). Personal practical knowledge and the modes of knowing. In E. Eisner (Ed.), *Learning and teaching the ways of knowing* (pp. 174–198). Chicago, IL: University of Chicago Press.

Connelly, F. M., & Clandinin, D. J. (1990). Stories of experience and narrative inquiry. *Educational Researcher, 19*(5), 2–14.

Cooper, R., Fitzgerald, A., Loughran, J., Phillips, M., & Smith, K. (2020). Understanding teachers' professional learning needs: What does it mean to teachers and how can it be supported? *Teachers and Teaching, 26*(7–8), 558–576.

Craig, C. (2012). Butterfly under a pin: An emergent teacher image amid mandated curriculum reform. *Journal of Educational Research, 105*(2), 90–101.

Craig, C. (2020a). "Data is [G]od": The influence of cumulative policy reforms on teachers' knowledge in an urban middle school in the United States. *Teaching and Teacher Education*, https://doi.org/10.1016/j.tate.2020.103027

Craig, C. (2020b). *Curriculum making, reciprocal learning, and the best-loved self.* New York: Palgrave Macmillan.

Darling-Hammond, L (2006). *Powerful teacher education.* San Francisco, CA: Jossey-Bass.

Darling-Hammond, L. (2017). Teacher education around the world: What can we learn from international practice? *European Journal of Teacher Education, 40*(3), 291–309.

Darling-Hammond, L., & Bransford, J. (Eds.). (2005). *Preparing teachers for a changing world.* San Francisco, CA: Jossey-Bass.

Darling-Hammond, L., Hammerness, K., Grossman, P., Rust, F., & Shulman, L. (2005). The design of teacher education programs. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 390–441). Hoboken, NJ: Wiley.

Davydov, V. V. (2008). *Problems of developmental instruction: A theoretical and experimental psychological study.* New York: Nova Science Publishers.

DeBoer, G. (2014). Joseph J. Schwab: His work and his legacy. In M. Mathew (Ed.), *International handbook of research in history, philosophy and science teaching* (pp. 2433–2468). Dordrecht: Springer.

Dewey, J. (1904). The relation of theory to practice in education. In C. A. McMurray (Ed.), *The third NSSE yearbook*. Chicago, IL: University of Chicago Press.

Doyle, W., & Carter, K. (1987). How order is achieved in the classroom. In N. Hastings & J. Schwieso (Eds.), *New directions in educational psychology* (p. 2). London: Falmer Press.

Dunne, J. (2005). An intricate fabric: Understanding the rationality of practice. *Pedagogy, Culture and Society, 13*(3), 367–390.

Elbaz, F. (1981). The teacher's "practical knowledge": Report of a case study. *Curriculum Inquiry, 11*(1), 43–71.

Elbaz, F. (1983).*Teacher thinking: A study of practical knowledge*. New York: Nichols Publishing Company.

Engeström, Y. (1987/2015). *Learning by expanding: An activity-theoretical approach to developmental research* (2nd ed.)*.* Cambridge: Cambridge University Press.

Eraut, M. (2003). The many meanings of theory and practice. *Learning in Health & Social Care, 2*(2), 61–65.

Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. *Teachers College Record, 103*(6), 1013–1055.

Fenstermacher, G. D. (1994). The knower and the known: The nature of knowledge in research on teaching. In L. Darling-Hammond (Ed.), *Review of research in education* (pp. 3–56). Washington, DC: American Educational Research Association.

Fullan, M. (2014). *Teacher development and educational change*. New York: Routledge.

Furlong, J. (2013). *Education: An anatomy of the discipline.* Abingdon: Routledge.

Furlong, J., Barton, L., Miles, S., Whiting, C., & Whitty, G. (2000). *Teacher education in transition: Re-forming professionalism?* Buckingham: Open University Press.

Gallant, A., & Mayer, D. (2012). Teacher performance assessment in teacher education: An example in Malaysia. *Journal of Education for Teaching, 38*, 295–307.

Goodson, I. (2017). Life histories and narratives. In I. Goodson (Ed.), *The Routledge international handbook on narrative and life history* (pp. 3–10). New York: Routledge.

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, reimagining teacher education. *Teachers and Teaching, 15*(2), 273–289.

Grossman, P. L. (1995). Teachers knowledge. In L. W. Anderson (Ed.), *International encyclopedia of teaching and teacher education* (2nd ed., pp. 20–24). Oxford: Kidlington.

Gutierrez, K., & Vossoughi, S. (2010). Lifting off the ground to return anew: Mediated praxis, transformative learning, and social design experiments. *Journal of Teacher Education, 61*(1 & 2), 100–117.

Hodson, E., Smith, K., & Brown, T. (2012). Reasserting theory in professionally based initial teacher education. *Teachers and Teaching, 18*, 181–195.

Husu, J. (2005). Analyzing teacher knowledge in its interactional positioning. In D. Beijaard, P. Meijer, G. Morine-Dershimer & H. Tillema (Eds.), *Teacher professional development in changing conditions* (pp. 117–131). The Netherlands: Springer.

Jackson, P. (1968). *Life in classroom.* New York: Holt, Rinehart & Winston.

Kennedy, M. M. (2004). Reform ideals and teachers' practical intentions. *Educational Policy Analysis Archives, 12*(13), 1–34.

Korthagen, F. (2010). Situated learning theory and the pedagogy of teacher education: Towards an integrative view of teacher behavior and teacher learning. *Teaching and Teacher Education, 26*, 98–106.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by.* Chicago, IL: University of Chicago Press.

Lampert, M. (2010). Learning teaching in, from, and for practice: What do we mean? *Journal of Teacher Education, 61* (1–2), 21–34.

Meijer, P. C. (1999). *Teacher's practical knowledge: Teaching reading comprehension in secondary education*. Doctoral dissertation. The Netherlands: Leiden University.

Meijer, P. C. (2010). The teacher education knowledge base: Experienced teachers' craft knowledge. In E. Baker, P. Peterson, & B. McGaw (Eds.), *International encyclopedia of education* (pp. 642–649). Amsterdam: Elsevier.

Meijer, P. C., Verloop, N., & Beijaard, D. (2001). Similarities and differences in teachers' practical knowledge about teaching reading comprehension. *The Journal of Educational Research, 94*(3), 171–184.

MOE. (2010). Outline of national medium- and long-term plan for educational reform and development (years 2010–2020). Retrieved from: http://old.moe.gov.cn/public files/business/htmlfiles/moe/info_list/201407/xxgk_171904.html on 24 March 2021.

MOE. (2011a). Opinions of the ministry of education on vigorously promoting teacher education curriculum reform. Retrieved from http://old.moe.gov.cn//publicfiles/business/htmlfiles/moe/s3702/201110/xxgk_125722.html on 24 March 2018.

MOE. (2011b). Teacher education curriculum standards (for trial implementation). Retrieved from: https://wenku.baidu.com/view/c25a1726482fb4daa58d4b00.html on 24 March 2021.

MOE. (2012). Opinions on deepening teacher education reform. Retrieved from: http://www.moe.gov.cn/srcsite/A10/s7011/201211/t20121108_145544.htmlon 24 March 2021.

MOE. (2014). Opinions of the ministry of education on the implementation of the plan to nurture outstanding teachers. Retrieved from: http://old. moe.gov.cn//publicfiles/business/htmlfiles/moe/s7011/201408/174307.html on 24 March 2018.

MOE. (2017). Implementation strategy for accreditation in teacher education in higher education institutions (for trial implementation). Retrieved from: http://www.gztrc.edu.cn/attachment/sites/item/2019_03/13_09/957d3d7828e40b38.pdf on 24 March 2021.

Mulryan-Kyne, C. (2020). Supporting reflection and reflective practice in an initial teacher education programme: An exploratory study. *European Journal of Teacher Education*, doi: 10.1080/02619768.2020.1793946

Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn.* New York: Cambridge University Press.

OECD. (2005). *Teachers matter: Attracting, developing and retaining effective teachers.* Paris: OECD.

OECD. (2018). *Education at a glance 2018: OECD indicators.* Paris: OECD.

Orland-Barak, L., & Lavranteva, E. (2019). Global orientations, local challenges, and promises in initial teacher education. *Oxford research encyclopedias, education.* https://doi.org/10.1093/acrefore/9780190264093.013.771

Oyoo, S. (2013). Enhancing and sustaining teacher effectiveness as the 'Trojan horse' in successful science education in Kenya. In C. Craig, P. Meijer, & J. Broeckmans (Eds.), *From teacher thinking to teachers and teaching: The evolution of a research community* (pp. 457–477). Bingley: Emerald Group Publishing Limited.

Pendlebury, S. (1990). Practical arguments and situational appreciation in teaching. *Educational Theory, 40*(2), 171–179.

Russell, T., & Munby, H. (1991). Reframing: The role of experience in developing teachers' professional knowledge. In D. Schön (Ed.), *The reflective turn: Case studies in and on reflective practice* (pp. 164–187). New York: Teachers College Press.

Sancar, R., Atal, D., & Deryakulu, D. (2021). A new framework for teachers' professional development. *Teaching and Teacher Education, 101*(2), 103305.

Schön, D. (1983). *The reflective practitioner: How professionals think in action*. London: Basic Books.

Schwab, J. (1971). The practical: Arts of the eclectic. *The School Review, 79*, 493–542.

Sellars, M. (2014). *Reflective practice for teachers.* London: Sage.

Shaffer, D. W., Collier, W., & Ruis, A. R. (2016). A tutorial on epistemic network analysis: Analyzing the structure of connections in cognitive, social, and interaction data. *Journal of Learning Analytics, 3*(3), 9–45.

Shulman, L. S. (1986). Paradigms and research programs in the study of teaching: A contemporary perspective. In C. M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 3–36). New York: Macmillan.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Education Review, 57*(1), 1–21.

Smith, K. (2017). *Teachers as self-directed learners: Active positioning through professional learning.* Singapore: Springer.

Stout, R. (2018). Practical reasoning and practical knowledge. *Canadian Journal of Philosophy, 49*(4), 1–16.

Sztajn, P., Borko, H., & Smith, T. (2017). Research on mathematics professional development. In J. Cai (Ed.), *Compendium for research in mathematics education* (pp. 793–823). Reston, VA: National Council of Teachers of Mathematics.

Tirri, K., Husu, J., & Kansanen, P. (1999). The epistemological stance between the knower and the known. *Teaching and Teacher Education, 15*(8), 911–922.

Toom, A. (2006). *Tacit pedagogical knowing: At the core of teachers' professionality.* Helsinki: University of Helsinki.

Toom, A., Tiilikainen, M., Heikonen, L., Leijen, A., Mena, J., & Husu, J. (2019). Teacher candidate learning of action-oriented knowledge from triggering incidents in teaching practice. *Teachers and Teaching, 25*(5), 536–552.

van den Bogaart, A., Mazereeuw, M., Hummel, H., & Kirschner, P. (2017). Comparing collective and personal professional theories of experienced practitioners. *Scandinavian Journal of Educational Research, 63*(3), 363–377.

van Driel, J. H., Beijaard, D., & Verloop, N. (2001). Professional development and reform in science education: The role of teachers' practical knowledge. *Journal of Research in Science Teaching, 38*(2), 137–158.

Van Manen, M. (1995). On the epistemology of reflective practice. *Teachers and Teaching, 1*(1), 33–50.

Vesterinen, O., Toom, A., & Krokfors, L. (2014). From action to understanding – Student teachers' learning and practical reasoning during teaching practice. *Reflective Practice, 15*(5), 618–633.

Vygotsky, L. (1978). *Mind in society.* Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1997). The history of development of higher mental functions. In R. W. Rieber (Ed.), *The collected works of L. S. Vygotsky* (Vol. 4, pp. 207–219). New York: Plenum.

Wei, G. (2019). Transitional interests of research on teacher practical knowledge in the west. *Journal of Comparative Education, 10*, 45–51.

Wei, G. (2020). *Generation of teacher practical knowledge.* Beijing: Education Science Press.

Wei, G. (2021). Imagined professional identity: A narrative inquiry into a Chinese teacher's perezhivaniya in life. *Teaching and Teacher Education*, https://doi.org/doi.org/10.1016/j.tate.2021.103337

Wei, G., & Chen, X. (2018). Emergence and development of research on teacher practical knowledge. *Journal of East China Normal University, 6*, 107–117.

Westbury, I. (2000). Teaching as a reflective practice: What might Didaktik teach curriculum? In I. Westbury, S. Hopmann, & K. Riquarts (Eds.), *Teaching as a*

reflective practice: The German Didaktik tradition (pp. 15–39). Mahwah, NJ: Lawrence Erlbaum Associates.

Whitehead, J. (2000). How do I improve my practice? Creating and legitimating an epistemology of practice. *Reflective Practice, 1*(1), 91–104.

Xue, E., & Li, J. (2021). *Teacher education policy in China: Background, ideas and implications.* Singapore: Springer.

Zanting, A. (2001). *Mining the mentor's mind: The elicitation of mentor teacher's practical knowledge by prospective teachers.* Leiden: ICLON Graduate School of Education.

Zanting, A., Verloop, N., Vermunt, J. D., & Van Driel, J. H. (1998). Explicating practical knowledge: An extension of mentor teachers' roles. *European Journal of Teacher Education, 21*(1), 11–28.

Zeichner, K., &Conklin, H. (2008).Teacher education programs as sites for teacher preparation. In M. Cochran-Smith, S. Nemser, &J. McIntyreL(Eds.), *Handbook of re-search on teacher education* (3rd ed., pp. 269–289.). Mahwah, NJ: Lawrence Erlbaum/Routledge.

Zhou, J. (2014). Teacher education changes in China: 1974–2014. *Journal of Education for Teaching, 40*(5), 507–523.

2 Concept mapping

Sketching pre-service teachers' practical knowledge

1 Introduction

Global competition for human capital and the subsequent educational reform in the 21st century call for high-quality teachers with the appropriate professional knowledge, competences, attitudes, and beliefs (OECD, 2019). Effectively preparing prospective teachers to be more adaptive to practice in the workplace is a response to this necessity (Moon, 2016). In this line, initial teacher education programmes worldwide have actively placed increased importance on practice (Darling-Hammond et al., 2017).

Within initial teacher education programmes, school placement is crucial in preparing qualified teachers. During school placement, pre-service teachers have opportunities not only to design and implement teaching but also to engage in other daily work in schools (Clarke, Triggs, & Nielsen, 2013). The situated nature of placement allows pre-service teachers to examine educational theories they learned in teacher colleges and develop their practical knowledge through solving authentic challenges in the workplace.

Previous studies in teacher education research have regarded 'practical knowledge' as a kind of professional knowledge that teachers obtain from, of, and for their practice (Lampert, 2010). In addition, the development of practical knowledge is considered a process by which teachers reflect on their experience and form personal beliefs about their own educational practice (van Driel et al., 2001). Due to its experiential nature, practical knowledge has been viewed as learning outcomes by matured teachers, rather than inexperienced pre-service teachers. Under the discourse of 'practical turn' in teacher education (Janssen, Westbroek, & Doyle, 2014), however, few studies have investigated the validity of on-site practice assignment in initial teacher education programmes, like school placement, for developing pre-service teachers' practical knowledge.

This chapter aims to reveal the status quo of pre-service teachers' practical knowledge in school placement by means of concept mapping and supplementary semi-structured interviews. I use the term 'knowledge orientation' (Elbaz, 1983) as a theoretical conceptualisation to analyse the characteristics of pre-service teachers' practical knowledge and the latent factors attributed to the formation of different orientations. Overall, my

special interest lies in increasing our theoretical understanding of pre-service teachers' practical knowledge from the lens of 'knowledge orientation' and providing realistic insight into school placement in initial teacher education programmes by addressing the following two research questions:

1 What pre-service teacher practical knowledge orientations can be identified through the method of concept mapping?
2 What are the factors influencing the formation of different pre-service teacher practical knowledge orientations?

The research findings hopefully contribute to critical reflection on school placement in initial teacher education programmes and have implications for teacher educators to recognise pre-service teachers' knowledge orientations and potential development in advance.

2 Practical knowledge in school placement

It is widely acknowledged that school placement provides opportunities for pre-service teachers to find ways to apply theoretical and research-based knowledge to address challenges and also allows pre-service teachers to comprehend the breadth of a teacher's identity (Zeichner, 2010). Meanwhile, there is a clear expectation that during placement in initial teacher education programmes, pre-service teachers learn practices that will enable their construction of practical knowledge (Meijer, de Graaf, & Meirink, 2011; Toom et al., 2019). Pre-service teachers' professional development through practice and its relation to the accumulation of their practical knowledge in its various forms have been identified as central elements in initial teacher education programmes (Meijer et al., 2011).

A number of empirical studies have revealed that various factors influence pre-service teacher development in school placement. A representative study via Clarke and Hollingsworth (2002) shows that teacher professional development is characterised by the following interconnected domains: teacher personal factors; external resource, such as mentoring; factors related to practice in teaching and experimentation; and the factors related to consequences, such as students' salient outcomes. This holistic view of teacher development suggests that the development of pre-service teachers during placement is also multifaceted (see Figure 2.1). In this vein, Leeferink, Koopman, Beijaard, and Ketelaar (2015) concluded that pre-service teachers' learning from experiences is a process involving many interrelated personal and social aspects, including past and present experiences gained in various situations and contexts over time. More specifically, pre-service teachers' personal experiences and reflection (Orland-Barak, 2014), received mentoring (Mena, Hennissen, & Loughran, 2017), and critical events (Toom et al., 2019) are the most mentioned reasons that can be adopted as a set of factors to interpret the differences of pre-service teachers' practical knowledge.

The Change
Environment

*External
Domain*

External Source
of Information
or Stimulus

Domain of
Practice

Personal Domain

Knowledge
Beliefs
And
Attitude

Professional
Experimentation

Salient
Outcomes

Domain of
Consequence

Enactment

Reflection
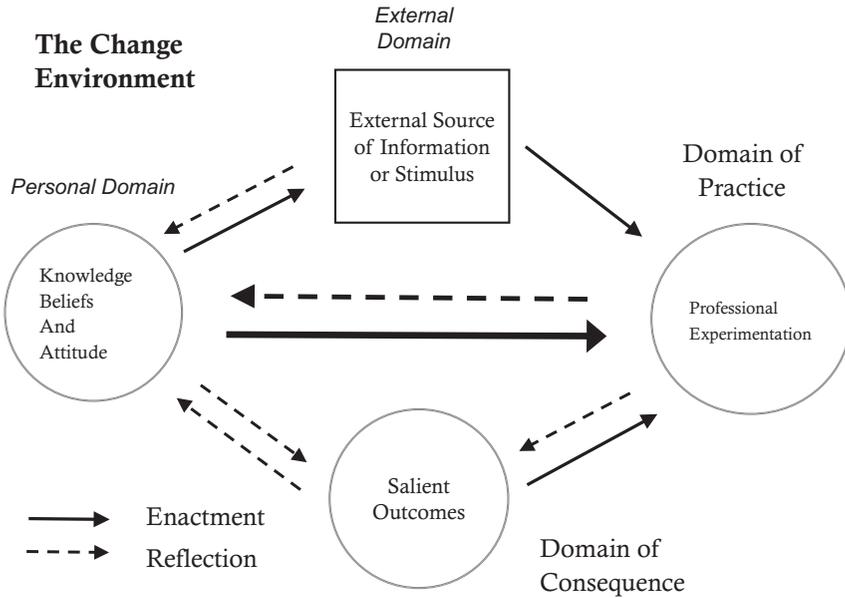
Figure 2.1 The interconnected model of professional growth (adapted from:
Clark & Hollingsworth, 2002)

Originating from Aristotelian philosophy, the concept of practical knowl-
edge refers to a practice-based epistemology that regards the validity of
action as a criterion to judge the truth of knowledge (Stout, 2018). Teacher
practical knowledge refers to the knowledge that teachers themselves
generate as a result of their reflection on their experiences and verification
through actions (Fenstermacher, 1994). Previous studies agree that teacher
practical knowledge includes four components:

1 knowledge about the self, which orients teachers' professional identity
   construction (Clandinin & Connelly, 1996);
2 knowledge about disciplines, which enables teachers to have mastery
   of their subject area and draw from a variety of teaching methods and
   strategies (Meijer, Verloop, & Beijaard, 2001);
3 knowledge about students, which helps teachers develop positive rela-
   tionships with students (van Driel et al., 2001); and
4 knowledge about context, which refers to teachers' understanding of
   macro social and educational circumstances and their sensitivity to mi-
   cro problematic situations in the workplace (Buchanan, 2015).

The above components serve as a framework with which to examine changes
in pre-service teachers' practical knowledge during school placement.

The starting point of this study is that the composition of pre-service teachers' practical knowledge based on the above four components results in different knowledge orientations. According to Elbaz (1983), an 'orientation' is defined as the way teachers hold their practical knowledge; this concept offers an integrative manner to describe teachers' practical knowledge structures and inner beliefs. A teacher's orientation guides his or her interpretation of problems and actions for professional development. Based on a study of an experienced English teacher, Elbaz (1983) proposed five orientations of practical knowledge: situational, theoretical, personal, social, and experiential. In addition, using Meijer, Verloop, and Beijaard's (1999) classification, Witterholt, Goedhart, and Suhre (2016) categorised teacher practical knowledge as teacher-oriented, pupil-oriented, subject-matter-oriented, or goal-oriented knowledge. A more recent study identified teacher practical knowledge as content-oriented or learning-oriented (Chaharbashloo, Gholami, Aliasgari, Talebzadeh, & Mousapour, 2020). However, most of the existed studies have described the in-service teachers' practical knowledge instead of pre-service teachers' practical knowledge. Research about whether and how initial teacher education programmes develop pre-service teachers' practical knowledge is scant. In this study, thus, I explore the orientations of pre-service teachers' expressed practical knowledge by a knowledge visualisation tool, i.e. concept mapping.

3 Concept mapping as a reflective tool

In both qualitative and quantitative approaches, interviews (Meijer et al., 2011), questionnaires (van Driel et al., 2001), reflective reports (Leeferink et al., 2015), and videos (Toom et al., 2019) have been used as instruments to assess pre-service teachers' professional knowledge. Besides, concept mapping has recently been used by European researchers as a tool to describe in-service teachers' practical knowledge (van den Bogaart, Mazereeuw, Hummel, & Kirschner, 2017; Witterholt et al., 2016). However, concept mapping has been little used for analysing pre-service teachers' practical knowledge and for research in Asian countries.

In this chapter, concept maps were adopted to represent the nature of the knowledge that pre-service teachers considered relevant at the beginning of their placement and six weeks after the start of their placement. Comparisons between maps of the same pre-service teachers at different moments provide valuable insights into the changes in their practical knowledge.

I have conducted this study in the College of Elementary Education at a Chinese normal university, during a placement period among fourth-year undergraduate students, which lasted for six weeks from the beginning of October to mid-November 2019. Nine pre-service teachers voluntarily participated in this study (see Table 2.1).

According to van den Bogaart, Schaap, Hummel, and Kirschner (2017), concept maps retain high validity when they are supplemented with annotations to allow participants to clarify the relationships between concepts and

Table 2.1 General information about the participants (*N* = 9)

Names	Gender	Disciplines	Grade taught	Prior teaching experience
Zhao	Male	ICT	6	Two years as a teacher assistant
Peng	Female	Chinese	1	One year as a teacher assistant
Chang	Female	Chinese	2	Little teaching experience
Lu	Female	Chinese	1	Little teaching experience
Liu	Female	Chinese	6	Little teaching experience
Feng	Female	Math	1	Little teaching experience
Guo	Female	English	4	Little teaching experience
Wang	Female	Chinese	2	Little teaching experience
Tian	Female	Science	5	Three years as a part-time teacher

share their thoughts concerning the changes in their knowledge development. Thus, I also examined the development of pre-service teachers' practical knowledge alongside pre-service teachers' annotations in subsequent interviews.

Overall, the first dataset comprises the concept maps that the nine pre-service teachers drew at two time points: before and after their placement. The participants received oral instructions on how to create a concept map (e.g. listing key words instead of long sentences and drawing the relationship among concepts with lines and arrows) and were given examples of different key concepts (e.g. knowledge about the self, and knowledge about the discipline). In the preplacement concept mapping assignment, the following instruction was provided to ask pre-service teachers to generate concepts related to the central theme: '*As a pre-service teacher, I have professional knowledge and judgment on…*'. In the postplacement concept mapping task, pre-service teachers were asked to organise the concepts around a new theme: '*After placement, I formed professional knowledge and judgment on…*'. Both the concept mapping tasks were completed by pre-service teachers independently in Chinese (see Appendix 2.1).

After collecting the concept maps, I promptly reviewed all maps and planned follow-up interviews with focal questions to ask. Individual interviews were conducted one day after the concept mapping tasks. My research team and I designed the interview schedule which contains questions about pre-service teachers' interpretations of their concepts and the reasons why changes had occurred between the pre- and post-maps (see Appendix 2.2). In the interviews, we especially focused on pre-service teachers' understanding of themselves, students, the subject matter they taught, and the contexts in which they worked. In addition, pre-service teachers were encouraged to talk about what they experienced in their placements and what they expected after the placements. The average duration of the interviews was approximately 40–60 minutes per pre-service teacher, and all interviews were recorded and transcribed verbatim in Chinese.

Then, the concept maps were analysed by comparing the pre- and post-concept maps of each pre-service teacher to explore the changes in his or her practical knowledge. The '3-R' strategy (i.e., Richness, Rigor, and Relevance) was used to analyse the maps (Witterholt et al., 2016). In terms of the *richness* of concept maps, we counted the total number of concepts in the pre- and postplacement concept maps for each pre-service teacher. In addition, my research team and I paid attention to the newly emerged concepts in the postplacement concept maps, which evidenced pre-service teachers' practical knowledge changes. Regarding *rigor*, we examined whether the concept map became more logically clear and content specific after placement. Finally, the structural relationships among the different concepts, including lines and directions, were analysed through the lens of *relevance*. The variation in the structure and sequence of the pre- and postplacement concept maps showed the development of pre-service teachers' practical knowledge. For each pre-service teacher, my research assistants and I used these three strategies to examine which concepts were the same or different between the pre- and postplacement concept maps. Based on the 3-R analysis, pre-service teachers' practical knowledge orientations were investigated as integrated manifestations.

Through a number of close reading and rereading of 18 interview transcripts thoroughly, we coded the qualitative data, drawing upon the approach to multi-tiered coding methods (Corbin & Strauss, 2007). First, by thematic coding, raw data were organised into condensed codes and themes. Second, axial coding and selective coding were conducted to further conceptualise the previously identified themes and to map them into theoretical typologies. Moreover, member checking and data source triangulation were used to enhance the credibility of the analysis (Flick, 2014). The interview transcripts and initial interpretation of the data were shared with the participants to check the accuracy and appropriateness of the interpretation. In addition, the above two data sources were compared with each other to corroborate our findings.

4 Three orientations of pre-service teachers' practical knowledge

All nine pre-service teachers' practical knowledge during school placement and the influential factors associated with their knowledge orientations were discerned from the transcripts of the concept maps and the annotated interviews, which showed the characteristics, focuses, and nature of their knowledge and actions; their practical knowledge was organised into the following three typologies.

4.1 Interpersonal-interaction-oriented practical knowledge

During school placement, Zhao, Peng, and Chang exhibited an interpersonal interaction orientation, as revealed by their concept maps. This orientation

is contingent on the relational nature of practical knowledge, and pre-service teachers with this orientation paid more attention to the relation with their students, colleagues, mentors, and their students' parents than other aspects of teaching.

In Zhao's maps (see Figures 2.2 and 2.3), the number of concepts increased from 23 to 31 after placement, clearly indicating that his knowledge about students (+1) and context (+5) changed. Zhao's preplacement map illustrated his belief that students have diverse characteristics. His concept of the 'diversity of students' was diminished and replaced by 'guiding and rectifying students' errors' in his postplacement map. In addition, in terms of the relation with students, Zhao also added a new concept in his postplacement map, namely, 'changing face'. Zhao interpreted this concept as follows:

> I chat with my students, even play with them for fun. But if students break some principle, I change my face and adopt a stern expression. After solving this problem, I recover to be very kind. It is a balance between stern and kind.
>
> (postplacement interview, 20-11-2019)

In the school setting, Zhao was rigorously conscious that learning to navigate interpersonal relations was of critical importance, which led to the addition of a new concept, 'interaction with colleagues and collegiality', in his postplacement map. Zhao described collective lesson preparation among three teachers as a critical event during his placement. This experience made him believe that teachers collaboratively solve problems to obtain good results.

In contrast to Zhao's maps, on Peng's maps, the number of concepts decreased from 24 to 21 after placement. Her concepts about the self and
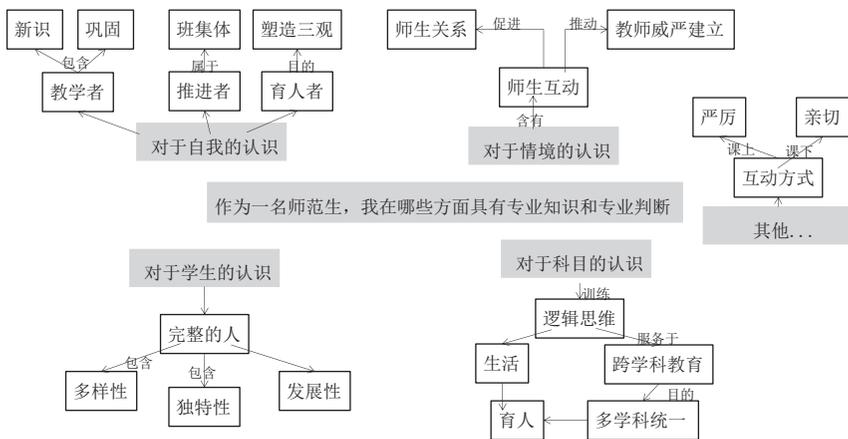
Figure 2.2 Zhao's preplacement map (in Chinese originally)

家校合作

成绩呈现 | 提高教学水平

新授 | 巩固 | 复习 | 塑造三观 | 家校关系 | 师生关系 | 促进 | 推动 | 教师威严建立 | 师徒关系

目的

包含

教学者 | 育人者 | 沟通者 | 师生互动 | 师师互动 | 包含 | 师生关系

对于自我的认识 | 对于情境的认识 | 严厉 | 亲切 | 变脸

互动方式

经历了实习之后，我对哪些方面具有专业知识和专业判断

对于学生的认识 | 对于科目的认识 | 其他...

发展性 | 包含 | 完整的人 | 需要 | 纠正 | 逻辑思维 | 训练

包含 | 需要

独特性 | 引导 | 生活 | 跨学科教育

育人 | 多学科统一
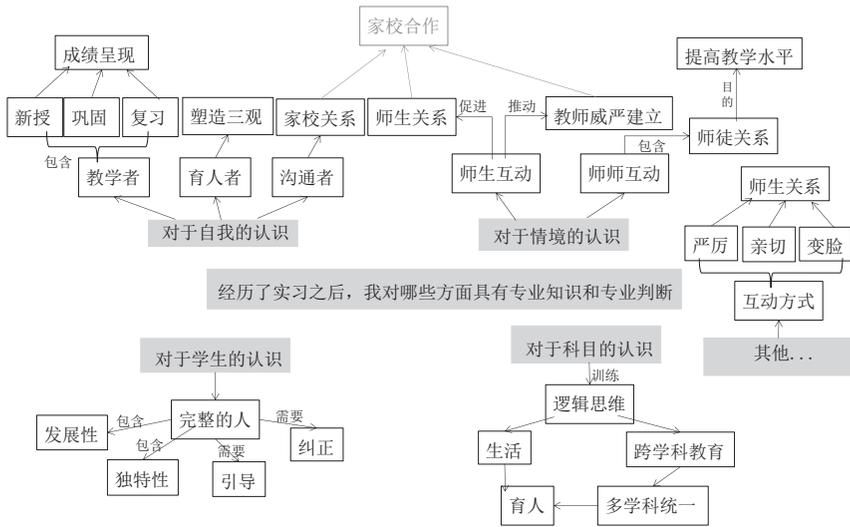
Figure 2.3 Zhao's postplacement map (in Chinese originally)

discipline declined, but her knowledge about students (+5) and contexts (+1) increased. Peng expanded her understanding of students to include the 'family-school partnership', 'collegial relationship', 'team work', and 'relation between parents' as newly emerged concepts. Paying more attention to interpersonal interaction in schools, Peng was inspired by two critical incidents in placement.

> I once participated in a parents' meeting, and the parents regarded me as a real teacher and asked me about their children, which gave me much self-esteem and made me aware of the family-school partnership.
> (postplacement interview, 23-11-2019)

In addition, in terms of teacher-student relations, Peng was moved by her mentor's sense of responsibility. Once a time, Peng's mentor spent an afternoon with her organising an activity so they could show their caring for a student who was sick. This event reminded Peng that a teacher needs to know what caring is and teach her students to learn to care about others, which is more important than learning disciplines. These experiences made the interpersonal dimension more relevant for Zhao's practical knowledge.

In addition, in Chang's maps, the number of concepts increased from 23 to 30 after placement. The number of items of knowledge about discipline did not change. However, her knowledge about students (+2) and context (+4) increased. The rigour of Chang's concepts became clearer. For example, Chang used 'psychological characteristics' and 'physical characteristics'

to describe her knowledge about students in her preplacement map. These ambiguous words were replaced by students' 'gender difference', 'cognitive styles', and 'family education' after placement. When asked about the changes, Chang noted that her professional quality was constantly improved through communication with students. In addition, in her postplacement map, Chang mentioned three kinds of relations associated with knowledge about context, i.e., the family-school partnership, teacher-student relations, and collegial relations. Chang believed that the three kinds of relations not only affect teachers but also direct students' development, which shows the high relevance among the concepts. Interpersonal orientation emerged as a core property of Chang's practical knowledge during placement.

4.2 Problem-solving-oriented practical knowledge

Lu, Liu, and Feng used their practical knowledge to solve problems during placement, and they thought that 'sensitivity to problems' and teachers' 'key competences' of applying both theoretical concepts and practical interpretations as tools to solve problems were indispensable. This orientation is contingent on the pragmatist epistemology that holds that knowledge is a result of problem solving.

The number of concepts in Lu's map decreased from 18 to 15 after placement, but the number of concepts specifically about understanding context increased by 3. Reading many academic books about education made Lu use more abstract concepts related to teacher competences, for instance, 'subject-matter knowledge' and 'teaching methods', before placement. However, these theoretical terms became more rigorous descriptions such as 'systematic knowledge', 'specific knowledge', and 'logics of curriculum' in her postplacement map.

Lu's changed practical knowledge stemmed from her failed public lesson. Lu's passion about Chinese and the history of language was challenged by a failed lesson, in which half of the students did not understand her point. Lu's mentor helped her to reflect on her teaching video, and she understood that 'what I [the teacher] believe may not be right [to the students]'. Due to the lack of prior teaching experience, Lu thought that teaching was a very hard job. She hoped that practical knowledge could help her solve more problems in teaching. She said,

> I need to not only learn theoretical knowledge but also reflect and try to make mistakes in practice so that I can gain something and then become a teacher.
>
> (preplacement interview, 27–09–2019)

The relevance among Lu's concepts shows the connection between placement and university-based study. She regarded theory and practice as having the same importance, but only if they could solve real problems in schools.

In Liu's maps (see Figures 2.4 and 2.5), the number of concepts decreased from 18 to 12 after placement; her knowledge about discipline (+3), students (−6), the self (−2), and context (−1) changed. As Liu described, her placement school was very responsible regarding pre-service teacher training. She had many opportunities to observe and teach lessons during her placement. Although the number of concepts about the self decreased, Liu proposed 'educational sensitivity' as a new concept in her postplacement map. Educational sensitivity is viewed as a critical quality of the teaching profession and vital property of teachers' practical knowledge (van Manen, 1991). Liu's idea of educational sensitivity originated from an embarrassing experience:

> One day, a naughty boy ridiculed me, calling me a little dog. I tolerated his abuse because he is still a kid. But another day, my mentor heard about this event. She told me seriously that we need to let the boy know that this action is wrong. Then, the boy and his parents apologised to me.
>
> (postplacement interview, 20-11-2019)

Feng clearly increased her knowledge about discipline (+3). After her teaching placement, Feng's knowledge about discipline, which had been reflected in only one concept, i.e., 'disciplinary knowledge', before placement, became more detailed and rigorous and was reflected in five concepts, i.e., 'pedagogical strategies', 'connectivity', 'teamwork', 'perceptions of discipline', and 'self-reflection'. In terms of the usage of educational theories, Feng also used the term 'sensitivity', similar to Liu. However, Feng interpreted 'sensitivity' as a competence to combine educational theories and practices to solve problems.
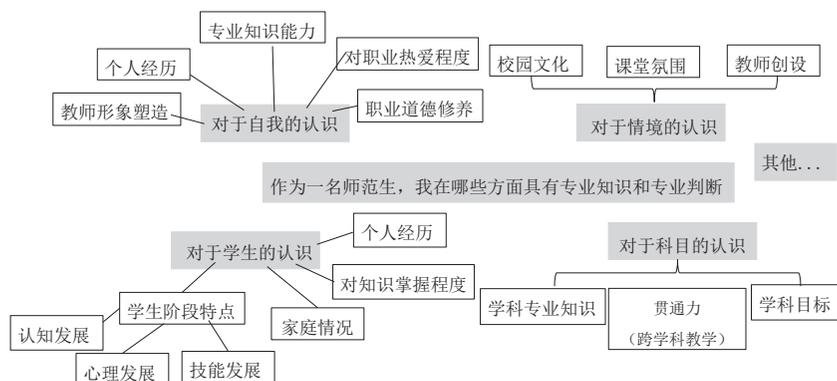
Figure 2.4 Liu's preplacement map (in Chinese originally)
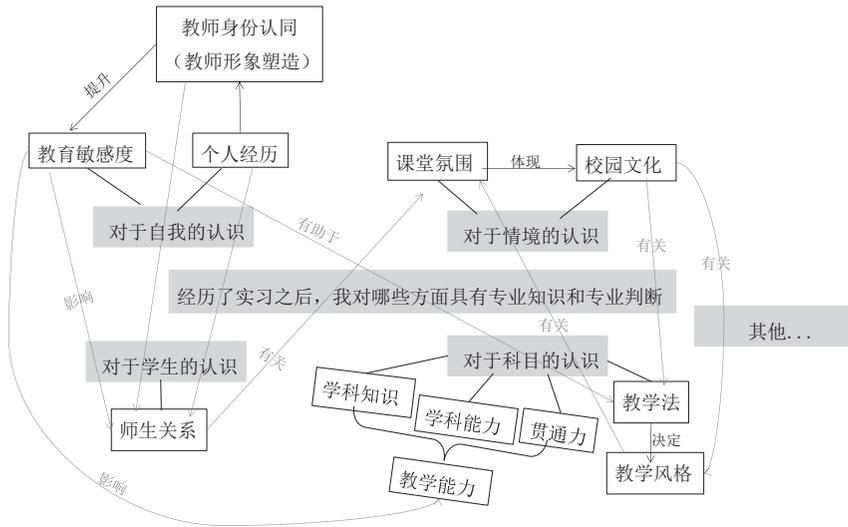
Figure 2.5 Liu's postplacement map (in Chinese originally)

> It is a challenge to use theoretical principles in practice. When encountering a certain incident, teachers need to invoke certain knowledge or skills. It is about sensitivity.
>
> (postplacement interview, 23-11-2019)

In Feng's annotation, due to her little prior teaching experience, she emphasised the effective solution to problems. Her knowledge about students and herself was also relevant to her knowledge about disciplinary teaching.

4.3 Professional-identity-oriented practical knowledge

In our analysis, the apparent development of knowledge about the self led to pre-service teachers' better understanding of their professional identity. During their placements, Guo, Wang, and Tian exhibited professional-identity-oriented practical knowledge, which is contingent on the professionalism epistemology of practical knowledge.

In Guo's maps (see Figures 2.6 and 2.7), the number of concepts increased from 22 in the preplacement map to 24 in the postplacement map; her knowledge about the self (+3) and discipline (+2) increased substantially. Meanwhile, she clearly recognised the relevance between knowledge about the self and context. Guo said that the school and her mentor did not give her much support. She did not even have much of a chance to teach classes. Compared to her preplacement map, Guo's postplacement map was more interpretive and detailed. In terms of knowledge about context, Guo
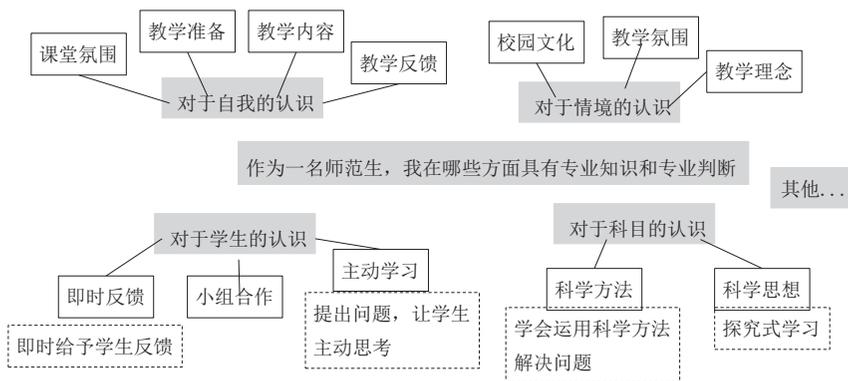
Figure 2.6 Guo's preplacement map (in Chinese originally)
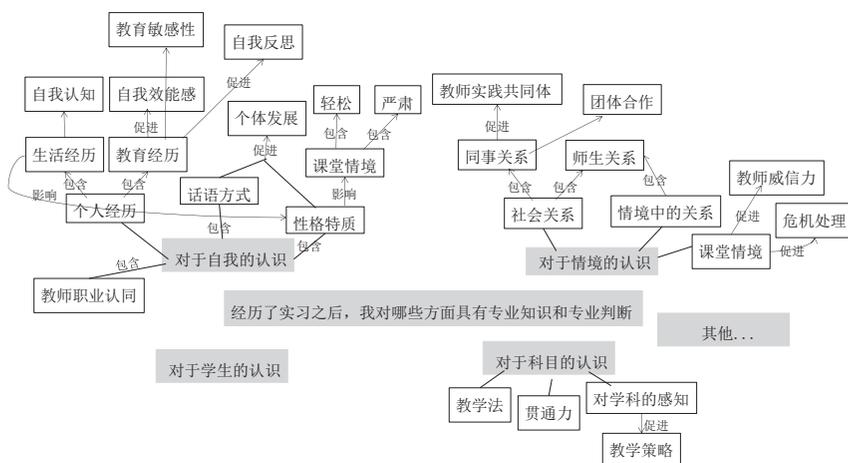
Figure 2.7 Guo's postplacement map (in Chinese originally)

included 'school culture' and 'judgment' in her preplacement map but instead included 'dealing with emergent events' in her postplacement map, which was more detailed. Guo tried to balance theory and practice, and her mentor told her that teaching is not simply the accumulation of ample experience. A certain amount of knowledge reserve and teaching experience is required to truly understand teaching. Meanwhile, Guo tried to use what she read in books to understand what she observed in the placement school:

> A theoretical basis will help you understand many educational phenomena in practice, so it is necessary to read more theoretical books.
>
> (postplacement interview, 20-11-2019)

Although Guo did not have much prior experience teaching, her belief in theory strengthened her teacher identity.

Compared to her preplacement map, Wang's postplacement map included seven additional concepts; her knowledge about the self (+8) and discipline (+3) developed substantially. Wang added new concepts, including 'self-efficacy', 'self-style', 'competence of dealing with emergencies', 'self-development', and 'self-reflection', related to her knowledge about the self. Moreover, she added 'critical events' as a connective concept among the above concepts. Wang's placement school was a high-quality school in Beijing. She expected to be able to see how the curriculum reform was carried out in this school. Thus, in her prior map, she wrote 'teacher ideas on educational reform' as a key concept. However, this concept was diminished in her postplacement map. She said,

> I found that the schoolteachers regard the textbooks as the Bible, and there are few teachers in the school who discuss the new student-centred approach to teaching, which is quite different from the atmosphere of education reform I imagined.
>
> (postplacement interview, 23-11-2019)

It seemed that the reality shock conversely made Wang aware of the important role of teachers in education reform. Her rigorous concepts about herself in the postplacement map evidenced her determination to become a qualified teacher.

In Tian's postplacement map, she added ten additional concepts related to knowledge about the self and six additional concepts about knowledge about context. Tian's major was science, which is an underappreciated course in his placement school. Her mentor spent additional time instructing students in the after-school community, which allowed more time for Tian to teach classes. One time, Tian administered some talented students a test, but the students could not answer the questions. This incident made Tian question herself:

> Am I lacking a lot of professional knowledge? Is it because the questions I asked are not specific enough? What kind of teacher I should be? These queries are always in my mind during the placement.
>
> (postplacement interview, 23-11-2019)

Tian's reflection on her knowledge structure made her notice the required competences of the teaching profession and connect knowledge and skills to herself and her identity as a novice primary schoolteacher.

5 Looking back the maps and knowledge

The main objective of this chapter is to study the orientations and influential factors attributed to the differences. Now, let's look back concept mapping

as a reflective tool and how it diagnoses pre-service teachers' practical knowledge.

Based on nine pre-service teachers' cases, we use the conceptualisation of 'knowledge orientation' to manifest pre-service teachers' practical knowledge. Although lacking of abundant professional experience, pre-service teachers have practical knowledge which emerges in their placements. The findings are in line with Toom et al. (2019) that pre-service teachers' practical knowledge is the result of their reflection and action on their educational beliefs in practice.

Furthermore, we find that different combinations of the various knowledge components led to the identification of three orientations of pre-service teachers' practical knowledge, which illuminates the inner structure of Elbaz's (1983) theoretical contribution of 'knowledge orientation'. Specifically, this exploration shows that interpersonal-interaction-oriented practical knowledge is mainly influenced by pre-service teachers' knowledge about students and contexts. In contrast, knowledge about the discipline does not play an important role in this orientation. Problem-solving-oriented practical knowledge is greatly affected by pre-service teachers' knowledge about the discipline and context. In contrast, knowledge about students and interpersonal elements are not as important for this role. In addition, professional-identity-oriented practical knowledge is formed based on pre-service teachers' knowledge about the self and the discipline.

In this vein, the findings suggest that initial teacher education programmes should pay more attention to recognising the three orientations, which can serve as focal points for the study of teaching and the organisation of teacher training. For example, the interpersonal interaction orientation suggests that initial teacher education programmes should emphasise that the teaching profession involves relational work. The problem-solving orientation implies that practical competence-based training could help pre-service teachers who have little experience in their transition. The professional-identity orientation proposes the need for attention to how to leverage pre-service teachers' commitment to the profession and sustain their achievement throughout placement and their lifelong careers.

Nevertheless, regarding teachers' authentic work, I agree with Chaharbashloo et al. (2020) that making clear-cut distinctions between the different orientations of pre-service teachers' practical knowledge would not accurately reflect placement realities. As the cases have suggested, these orientations lie on a continuum, which is an indication that practical knowledge is an organised whole that pre-service teachers use to function in a situation and act. It is more realistic, hence, to consider the three orientations as mobile points on a triangular continuum within an authentic workplace setting (see Figure 2.8). Thus, it inspires our teacher educators that initial teacher education programmes should have the ability to identify different orientations of pre-service teachers' practical knowledge by knowledge visualisation tools, like concept mapping, then find an individually and socially adapted equilibrium point among the three (Wei, 2020).
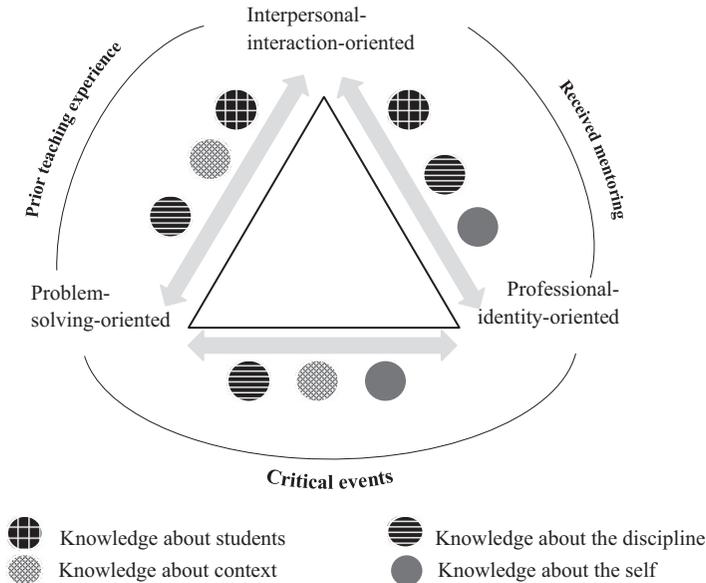
Figure 2.8 Orientations and influential factors of pre-service teachers' practical knowledge

In terms of the reasons why pre-service teachers formed different practical knowledge orientations, some factors emerged from the data. Rather than seeking a cause-and-effect relationship between the series factors and pre-service teachers' knowledge orientations, we employ the influential concepts in previous research to access an interpretive understanding on potential mechanism of pre-service teachers' development. Different from the study by Clark and Hollingsworth (2002), this study did not clearly reveal the factors of students' learning outcomes. This is likely because pre-service teachers are not accountable for students' learning outcomes after they leave the placement school. Nevertheless, pre-service teachers' prior teaching experience; external resources, such as mentoring; and practice through teaching and experimentation, such as critical events, play vital roles in the formation of pre-service teachers' practical knowledge.

First, prior teaching experience before placement is important. Zhao, Peng, and Tian had more than one year of teaching experience before placement, which led them to focus on interpersonal relations and self-identity. In contrast, Lu, Liu, and Feng were busy solving problems at schools. This finding is aligned with that of Meijer et al. (1999) that prior experience influences teachers' practical knowledge; thus, we agree that initial teacher education programmes should arrange placement as early as possible (Darling-Hammond et al., 2017).

Second, mentoring is important to guide pre-service teachers' knowledge development. Almost all of the nine pre-service teachers were affected by their mentors, not only regarding teaching (e.g. Lu and Tian) but also regarding their understanding of the wholeness of teacher profession (e.g. Peng and Liu). Although some mentors did not play positive roles (e.g. Wang, Guo), the study shows that mentoring stimulates pre-service teachers' reflection and contributes to the development of their practical knowledge (Orland-Barak, 2014).

Third, consistent with Toom et al. (2019), this study also illustrates that when combined with theoretical aspects, meaning-making and a variety of possible interpretations and reflections on critical incidents work as effective vehicles for pre-service teachers' learning. For example, the respect that Peng received from the parents' meeting, Lu's failed public lesson, and Wang's disappointment regarding school reform, which were both positive and negative, affected their beliefs and perceptions related to the teaching profession (Tripp, 1993).

In a word, the findings hold worthwhile implications for initial teacher education programmes that teacher educators should know about pre-service teachers' prior experience and then supply differentiated mentoring in placements. Meanwhile, creating positive events in placements is beneficial to cultivate pre-service teachers' practical knowledge in advance.

Overall, this chapter contributes to the literature through sketching the three ideal types of pre-service teachers' practical knowledge orientation. The three orientations locating on a continuum of teacher knowledge components indicate that practical knowledge is an organised and flexible whole that pre-service teachers use in authentic settings. Moreover, the three orientations may serve as focal points for the study of the re-organisation of initial teacher education programmes concerning pre-service teachers' potential development. Besides, the findings yield valuable insights for the analysis of teachers' practical knowledge and practical insights for initial teacher education programme reform. The earlier pre-service teachers' practical knowledge is concerned and cultivated in initial teacher education programmes, and the better pre-service teachers develop their adaptive expertise and release reality shock in their future work. Underlining a need for more coherent initial teacher education programmes, our findings regarding three kinds of orientations and the influencing factors may help pre-service teachers reflect on and better integrate knowledge learned in different learning arenas – both in teacher colleges and in placement.

Appendixes

2.1. Guides for pre- and postplacement concept-mapping

<div>

师范生实习前的实践性知识的概念图　　　　　　　序号：

姓名：　　　性别：　　　专业：　　　实习学校名称：　　　所教年级：

请您根据提示中的内容，并结合在校所学的专业知识，绘制出下面的概念图。
(提示：师生关系、教育敏感、教师身份认同、教学法、贯通力、学科知识、教学风格、学习能力、课堂氛围、
校园文化、个人经历、教师形象塑造、自我效能感、体察力、认知过程等等)

对于情景的认识

对于自我的认识

作为一名师范生，我对哪些方面具有专业知识和专业判断

对于学生的认识

其他......

对于科目的认识

</div>

Figure 2.9 Guides for preplacement concept mapping (in Chinese originally)

<div>

序号：　　　　　　师范生实习后的实践性知识的概念图

姓名：　　　性别：　　　专业：　　　实习学校名称：　　　所教年级：

请您根据提示中的内容，并结合在校所学的专业知识以及实习时的经历及反思，绘制出下面的概念图。
(提示：师生关系、教育敏感、教师身份认同、教学法、贯通力、学科知识、教学风格、学习能力、课堂氛围、校园文
化、个人经历、教师形象塑造、自我效能感、体察力、认知过程等等)
您可以在这些名词中选择您认为有联系的词，也可以自己补充延伸。

对于情景的认识

对于自我的认识

经历了实习之后，我对哪些方面具有专业知识和专业判断

其他......

对于学生的认识

对于科目的认识

日期：

</div>

Figure 2.10 Guides for postplacement concept mapping (in Chinese originally)

2.2. Contents of interview schedule

- Please introduce yourself and tell us about your educational background.
- Could you please interpret the concepts in your preplacement map? (e.g. about yourself, students, subject matters, and context)
- What factors probably influence your ideas of drawing this preplacement map?
- Could you please interpret the major changes of concept in your postplacement map? (e.g. about yourself, students, subject matters, and context)
- What factors probably influence the changing of your ideas of drawing the postplacement map?
- Could you please tell us one or two memorable event(s) in your placement?
- By the end of this semester, you will have graduated and then begin teaching. At this moment, what expectations of yourself as a teacher do you have?

References

Buchanan, R. (2015). Teacher identity and agency in an era of accountability. *Teachers and Teaching: Theory and Practice, 21*(6), 700–719.

Chaharbashloo, H., Gholami, K., Aliasgari, M., Talebzadeh, H., & Mousapour, N. (2020). Analytical reflection on teachers' practical knowledge: A case study of exemplary teachers in an educational reform context. *Teaching and Teacher Education, 87*, 102–131.

Clandinin, D. J., & Connelly, F. M. (1996). Teachers' professional knowledge landscapes: Teacher stories-stories of teachers-school stories-stories of schools. *Educational Researcher, 25*(3), 24–30.

Clarke, A., Triggs, V., & Nielsen, W. (2013). Cooperating teacher participation in teacher education: A review of the literature. *Review of Educational Research, 84*, 163–202.

Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth. *Teaching and Teacher Education, 18*, 947–967.

Corbin, J., & Strauss, A. (2007). *Basics of qualitative research* (3th ed.). Thousand Oaks, CA: Sage.

Darling-Hammond, L., Burns, D., Campbell, C., Goodwin, A. L., Hammerness, K., Low, E.-L., Zeichner, K. (2017). *Empowered educators: How high performing systems shape teaching quality around the world.* San Francisco, CA: Jossey-Bass.

Elbaz, F. (1983).*Teacher thinking: A study of practical knowledge*. New York: Nichols Publishing Company.

Fenstermacher, G. D. (1994). The knower and the known: The nature of knowledge in research on teaching. In L. Darling-Hammond (Ed.), *Review of research in education* (vol. 20, pp. 3–56). Washington, DC: AERA.

Flick, U. (2014). *An introduction to qualitative research* (5th ed.). Los Angeles, CA and London: Sage Publications.

Janssen, F., Westbroek, H., & Doyle, W. (2014). The practical turn in teacher education: Designing a preparation sequence for core practice frames. *Journal of Teacher Education, 65*, 195–206.

Lampert, M. (2010). Learning teaching in, from, and for practice: What do we mean? *Journal of Teacher Education, 61*(1–2), 21–34.

Leeferink, H., Koopman, M., Beijaard, D., & Ketelaar, E. (2015). Unraveling the complexity of student teachers learning in and from the workplace. *Journal of Teacher Education, 66*(4), 334–348.

Meijer, P. C., de Graaf, G., & Meirink, J. A. (2011). Key experiences in student teachers' development. *Teachers and Teaching: Theory and Practice, 17*, 115–129.

Meijer, P. C., Verloop, N., & Beijaard, D. (1999). Exploring language teachers' practical knowledge about teaching reading comprehension. *Teaching and Teacher Education, 15*(1), 59–84.

Meijer, P. C., Verloop, N., & Beijaard, D. (2001). Similarities and differences in teachers' practical knowledge about teaching reading comprehension. *The Journal of Educational Research, 94*(3), 171–184.

Mena, J., Hennissen, P., & Loughran, J. (2017). Developing pre-service teachers' professional knowledge of teaching: The influence of mentoring. *Teaching and Teacher Education, 66*, 1–13.

Moon, B. (Ed.). (2016). *Do universities have a role in the education and training of teachers? An international analysis of policy and practice.* Cambridge: Cambridge University Press.

OECD. (2019). *A flying start: Improving initial teacher preparation systems.* Paris: OECD Publishing.

Orland-Barak, L. (2014). Mediation in mentoring: A synthesis of studies in teaching and teacher education. *Teaching and Teacher Education, 44*, 180–188.

Stout, R. (2018). Practical reasoning and practical knowledge. *Canadian Journal of Philosophy, 49*(4), 1–16.

Toom, A., Tiilikainen, M., Heikonen, L., Leijen, Ä., Mena, J., & Husu, J. (2019) Teacher candidate learning of action-oriented knowledge from triggering incidents in teaching practice. *Teachers and Teaching: Theory and Practice, 25*(5), 536–552.

Tripp, D. (1993). *Critical incidents in teaching: Developing professional judgement.* London: Routledge Falmer.

van den Bogaart, A. C. M., Mazereeuw, M., Hummel, H. & Kirschner, P. (2017). Comparing collective and personal professional theories of experienced practitioners. *Scandinavian Journal of Educational Research, 63*(3), 363–377.

van den Bogaart, A. C. M., Schaap, H., Hummel, H. M. F., & Kirschner, P. A. (2017). Combining concept maps and interviews to produce representations of personal professional theories in higher vocational education: Effects of order and vocational domain. *Instructional Science, 45*(3), 359–376.

van Driel, J. H., Beijaard, D., & Verloop, N. (2001). Professional development and reform in science education: The role of teachers' practical knowledge. *Journal of Research in Science Teaching, 38*(2), 137–158.

van Manen, M. (1991). *The tact of teaching: The meaning of pedagogical thoughtfulness.* Albany, NY: SUNY Press.

Wei, G. (2020). *Generation of teacher practical knowledge.* Beijing: Education Science Press.

Witterholt, M., Goedhart, M., & Suhre, C. (2016). The impact of peer collaboration on teachers' practical knowledge. *European Journal of Teacher Education, 39*(1), 126–143.

Zeichner, K. (2010). Rethinking the connections between campus courses and field Experiences in college and university–Based teacher education. *Journal of Teacher Education, 61*, 89–99.

3　Visual metaphor

Drawing pre-service teachers' practical knowledge

1　Introduction

Teacher identity refers to their knowledge about themselves, which can potentially underpin their educational practices and is a critical part of teacher practical knowledge (Wei, 2020, 2021). As a reserve force for teaching professionals in primary and secondary schools, pre-service teachers should construct their identity in the teaching profession positively. Chinese researchers have primarily used quantitative questionnaires and qualitative interviews to investigate pre-service teachers' professional identities from sociological, psychological, and political perspectives (e.g. Wei & Chen, 2015; Ye, 2017). In contrast, a few researchers noticed the differences within individual teachers, especially with regard to the unconscious, silent, and emotional hidden aspects that potentially influence teachers' beliefs and actions (Chen, 2011).

Knowledge visualisation tools are graphical methods that can construct and convey complex insights, which enable researchers to easily present teacher identity. As a knowledge visualisation tool, visual metaphors have been widely used in the education field to conceptualise abstract and ambiguous identity and manage their knowledge. It has also been used in the business management field to promote the dissemination of individual experiences to the community (e.g. Clarke & Holt, 2017; Dodd, 2002; Smith, 2015). Some scholars introduced visual metaphors into the teacher education field as a heuristic method to overcome the limitations of verbal narratives and discover unconscious and hidden aspects during the process of constructing and conveying teachers' identity (e.g. Munday, Rowley, & Polly, 2017; Ruohotie-Lyhty, Aragao, & Pitkanen-Huhta, 2021; Tait-McCutcheon & Drake, 2016). Meanwhile, few researchers use visual metaphors as a reflective tool to promote teachers' critical thinking and facilitate the conceptualisation of the relationship between teachers and their professional development (Leitch, 2006).

This chapter investigates an alternative methodology to explore pre-service teachers' identities as a core component of their practical knowledge. My research team and I collected the visual metaphorical paintings of 16 pre-service teachers from different disciplines and subsequently

interviewed them. The visual grammar theory proposed by Kress and van Leeuwen (2001, 2006) was employed to generate an analytical framework to summarise and distil the core visual metaphors, and capture the teacher identity behind the metaphorical expressions.

2 Teacher identity within practical knowledge

Recent research on teacher education has featured numerous discussions of teacher professional identity and offers a framework for teachers to construct their own ideas of 'how to be', 'how to act', and 'how to understand' their work (Sachs, 2005, p. 15). As noted by previous scholars (e.g. Beauchamp & Thomas, 2009; Day, Kington, Stobart, & Sammons, 2006), teacher identity is multi-faceted, dynamic, and generated from teachers' engagement in their professional environment and socio-cultural contexts. As a result of the complex negotiation and heterogeneous interaction between teachers' personal experiences and various factors within and outside the school (Clandinin, Downey, & Huber, 2009; Flores & Day, 2006), teachers' professional identity is not only intellectual and rational (e.g. concerning critical reflection and knowledge construction) but also social and political (e.g. involving historicity and policy changes) in nature (Kelchtermans, 1996; Zembylas, 2004). While they have been studied separately, the consideration of the two facets of teacher professional identity as a holistic unity has largely escaped the attention of researchers. In their classical review, Beijaard, Meijer, and Verloop (2004) suggested that research perspectives on teachers' professional identity should go beyond cognitivist approaches such as developmental psychological identity theory (Erikson, 1968) and social identity theory (Gee, 2001).

   In this chapter, I regard teacher identity as a core component of pre-service teachers' practical knowledge (Chen, 2011). It relates to both static and dynamic aspects of pre-service teachers' thinking and acting in authentic education settings when they activate their practical knowledge. In other words, pre-service teachers' identity is a dialectical interaction between 'teacher self' and 'teacher role'. The term 'teacher self' refers to the understanding and confirmation of questions of 'who I am', and 'where I belong'. It is a kind of internal consciousness of being a teacher. 'Teacher role', is defined as the recognition of a pre-service teacher's social and professional responsibilities to external demands and expectations (Wei, 2021). It is in fact difficult for pre-service teachers to construct their teacher self and teacher role independently. Instead, pre-service teachers construct their identity by repeatedly verifying their teacher self and transforming their teacher roles in their learning and practicing process. The dynamic interactive process between teacher self and teacher role depicts a framework to analyse pre-service teachers' practical knowledge about themselves (see Figure 3.1).

Graphic
representation A
— project →
Graphic
representation B

↓ ↓

Source domain   Target domain

↓ ↓

The experience and
knowledge of
pre-service teachers
about their teacher's
identity.

The visual images or
visual symbols drawn
by pre-service
teachers.
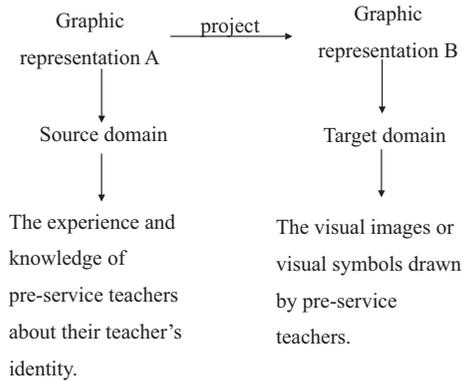
Figure 3.1 The analytical framework of visual metaphor

3 Visual metaphor as a knowledge visualisation tool

3.1 What is a visual metaphor

Proposed as a knowledge visualisation tool by Eppler and Burkhar (2004), a visual metaphor is a graphic depiction of seemingly unrelated shapes that convey an abstract idea by relating it to a concrete phenomenon. Methodologically, visual metaphors reflect the categories, functions, meanings, and mechanisms of the construction mode of thinking (Eppler & Burkhar, 2004). In addition, visual metaphors are also widely used as artistic expressions in advertising, film and television, painting, dance, opera, and other artistic fields.

Not a few researchers used visual metaphors to convey research in teacher education. For example, Leitch (2006) combined an art-based approach with narrative inquiry. Using the heuristic creative narrative method, Leitch explored the narratives of six female teachers to reveal how they processed and acted upon their lived experiences amidst conscious and non-conscious influences to construct their teacher professional identity (Leitch, 2006). The production of self-system pictures combines the unconscious in organisations and the theory of visual metaphorical images to explore the relationship between teachers, their schools, and the people around them.

Tait-McCutcheon and Drake (2016) conducted a study of pre-service teachers' professional learning and development from the perspective of cognitive linguistics. They asked pre-service teachers to conceptualise the relationship between them and their professional learning development through the metaphor of 'jacket'. The study found that the jacket metaphor effectively helps teachers enhance their self-reflection and critical awareness.

The manner in which teachers reflect on themselves, their schools, their students, and their professional learning opportunities can significantly influence their professional development because these factors affect their choices and beliefs. In addition, the jacket metaphor can help teachers conceptualise their positive and negative relationships with their professional learning and development.

Munday et al. (2017) explored the visualisation of teachers' professional selves through visual metaphors and symbolism used during the creation of images in E-portfolio. They held workshops individually in 2014 and 2015. In the 2014 workshop, pre-service teachers and scholars were asked to find an image on the Internet that served as a metaphor for their own teacher identity, following which they shared and discussed the selected images. It was found that participants were more likely to engage in discussions about their professional attributes as teachers through images. The 2015 workshop focused on teacher professional identity and development. During the workshop, participants used their mobile phones to photograph an object several times and discuss the image. An important finding of this study was that visual metaphor images influence the development of teachers' self-awareness. The visual metaphorical images were used as a complementary strategy to develop teachers' self-awareness and promote self-actualisation and reflection.

Ruohotie-Lyhty et al. (2021) used a visual-textual approach to investigate the expectations and fears of 121 student teachers in Finland and Brazil regarding their future status as teachers. The study compared Finnish and Brazilian pre-service teachers to investigate the impact of their different socio-cultural contexts on their teacher identity development. The researchers identified two distinct perspectives: the status-oriented perspective and the nature-oriented perspective. They then compared the similarities and differences between the two perspectives. It was found that Finnish and Brazilian pre-service teachers had different expectations regarding teachers' social status and their significance, which illustrated their expected identity and emphasised the importance of social-political factors in the construction of pre-service teachers' professional identity.

Overall, previous studies on visual metaphors in teacher education have provided a rich and innovative context that inspired us to conduct our research in China. In this chapter, my research team and I used the visual metaphor to elucidate and (re)construct the pre-service teachers' identity as a core element of their practical knowledge. Pre-service teachers' cognition of their identity, which is abstract and complex, can be expressed through visual images. The tacit nature of visual metaphors presents certain advantages. First, the projective mechanism of a visual metaphor is tacit since pre-service teachers construct the cognition of their professional identities (source domain) through graphic representations (target domain) instead of verbal narratives, which ensures that the interference from external factors will be greatly reduced in the process of their identity construction. Second,

Step 2   ***Export I：***
The self-introduction of per-service
teachers' paintings

Step 1
Based on the visual metaphor
analyser, we proposes an
interview outline from the visual
metaphor paintings.

**Verbal teacher's
identity**

Step 3   **Capture**

Non-verbal teacher's identity:
emotional; unconscious…

Step 4   **Extract**

Export II：
Pre-service teachers' reinterpretation
and reflection on visual metaphors,
and reconstruct and readjust to
teacher identity.

**The identity of
pre-service teachers**

Figure 3.2 Steps of using the visual metaphor method

visual metaphors allow researchers to observe and analyse pre-service teachers' identities tacitly since they can be seen as visual images (graphic representations) and what the researchers view is consistent with what was created. Therefore, pre-service teachers and researchers can discuss visual graphics to expose the hidden cognitive dimension and motivate pre-service teachers to (re)construct and reflect on their teacher identity.

Pre-service teachers' construction of and reflection on their professional identity is a dynamic process. In this process, they use visual graphics to construct and introspect their professional identity by recalling critical incidents related to their theoretical knowledge and practical experiences. Moreover, the creation of various visual metaphors can produce a holistic meaning that transcends the original meaning of single metaphors, thereby stimulating pre-service teachers to construct their professional identities. Based on existing studies and the properties of visual metaphors mentioned below, we put forward a framework for employing the visual metaphor method to research pre-service teachers' identities. This framework illustrates how the verbal and non-verbal aspects of pre-service teachers' identities are elicited and distinguished (see Figure 3.2).

3.2 Designing the study

Data were collected from 16 pre-service teachers from different disciplines in a Chinese normal university in December 2020. All of the participants are the fourth-year undergraduate students who majored in primary education. Almost six months later, they would graduate and become primary school teachers. Their bibliographical information is outlined in Table 3.1.

Data collection included several steps. First, we provided brief explanations and examples of the method of drawing visual metaphors. During

Table 3.1 Characteristics of the 16 pre-service teachers

Participants' names	Disciplines	Gender
Qian	Science	Male
Sun	Mathematics	Female
Li	Chinese	Female
Zhou	Chinese	Female
Zheng	Mathematics	Female
Hou	Chinese	Male
Wen	Chinese	Male
Song	Chinese	Male
Lin	Chinese	Female
An	ICT	Female
Kai	Mathematics	Female
Bo	Chinese	Male
Cai	English	Female
Deng	Chinese	Female
Fan	Mathematics	Female
Gong	Chinese	Female

this process, the participants were informed that the aesthetic meaning of the visual graphics would not be included in our analysis. Thus, it is not necessary to decorate the paintings too much. Subsequently, we researchers offered them a paper, on which they were asked use to graphic representations (e.g. nature, characters, symbols, concepts) to present a picture of their professional identity associated with their past experiences of learning and teaching. The participants were provided with various drawing materials (e.g. pencils, watercolours, crayons), sufficient time (about 20–30 min), and a comfortable environment.

To avoid verbal overshadowing from interfering with the participants' narrative of their visual metaphorical paintings (Munday et al., 2017), they were interviewed 1–2 weeks after their drawing. The interviews consisted of several questions (see Appendix). We researchers did not interrupt them which ensured that the initial cognition of the participants' professional identity could be recorded directly. The interviews were between 30 and 60 minutes long, and the recordings were transcribed and coded to integrate them with the graphic representations (Figure 3.3).

We examined the visual metaphors in accordance with the visual grammar theory proposed by Kress and Van Leeuwen (2001, 2006). Visual grammar consists of three dimensions: representational meaning, interactive meaning, and compositional meaning. The *representational meaning* is the literal representation in the drawing of an actor, action, objects, or location (i.e., what is depicted), which helps us examine how pre-service teachers depict their professional identities via graphic representations (Clarke & Holt, 2017). The *interactive meaning* relates to how the images attract the viewer's interest and the way the viewer is being asked to consider the participants or objects in the image (Hofinger & Ventola, 2004; O'Toole, 2010). The *compositional meaning* refers to how the representational meaning and interactive

序号：

　　请回顾你现有的理论学习和教育教学活动经历，利用图式（自然、人物、符号、概念……）画一画你对于"**教师**"的理解。

姓名：　　　　　　专业方向：　　　　　　绘制时间：　　月　　日

Figure 3.3 Guiding picture for drawing (originally in Chinese)

meaning of the visual metaphor integrate into a meaningful whole. In other words, it relates to how the visual metaphor is constructed in the image. This includes the manner in which the graphical representations are depicted, which involves the brush type (e.g. pencil, watercolour, and crayons) used, brush tracking (e.g. light or sharpness, blurred or clear), colour, etc.

Data analysis in the chapter involved three steps. First, we performed an initial analysis of the visual metaphor paintings according to a general viewing. Second, we coded the content of the interviews by thematic analysis method. Subsequently, we elicited the core metaphors and comprehensively analysed the meaning behind the visual metaphors. Finally, we summarised the analysis of the core metaphors in accordance with the sub-questions of our research, including 'What kind of understanding do pre-service teachers express about themselves through visual metaphors?', 'What kind of understanding do pre-service teachers express about the role of the teacher through visual metaphors?', and 'Which factors influence the pre-service teachers to construct their professional identities? What are the connections between these factors?'.

4 Four categories of pre-service teachers' identity

By analysing 16 paintings of pre-service teachers' visual metaphor, we collected 98 graphic representations and identified 28 core metaphors from them (see Table 3.2).

Using the data presented above, we proposed four states of pre-service teacher identities: missing, contradictory, transitional, and complete.

Table 3.2 Overall of the pre-service teachers' visual metaphors

Participants' names	Images of visual metaphor					Core metaphors	
	Category of nature	Category of education	Category of life	Others	Total	Content	Total
Qian	0	0	0	7	8	Programmer	1
Sun	1	1	1	0	3	Initiator of knowledge; Director for students' growth;	3
Li	3	0	3	0	6	Implementer of educational concepts	1
Zhou	1	1	0	1	3	Transmitter of knowledge; Mother	1
Zheng	1	3	0	0	4	Listener; Companion and Leader	1
Hou	1	1	7	2	11	Disseminator of ideals and beliefs; A life-long journey ;a secure job	3
Wen	3	1	1	2	7	Sunflower; Protective umbrella	2
Song	5	0	0	0	5	Warm sun; Fine rain with Soft wind	1
Lin	3	1	2	1	7	Large tree; significant component of education	2
An	3	1	1	0	5	Gardener	1
Kai	0	4	0	0	4	Leader; Coadjutant	2
Bo	2	1	3	1	7	Gardener; Ferrymen; Inheritors of knowledge and experience	3
Cai	0	4	6	3	13	Devotee	1
Deng	0	4	0	1	5	Those who proselytizes instructs dispels doubt also; Inspirator	2
Fan	0	2	0	1	3	Initiator of knowledge	1
Gong	0	6	0	1	7	Babysitter; Alchemist	2

序号：3

请回顾你现有的理论学习和教育教学活动经历，利用图式（自然、人物、符号、概念……）画一画你对于"教师"的理解。

姓名：xx 专业方向：中文 绘制时间：12月 ? 日
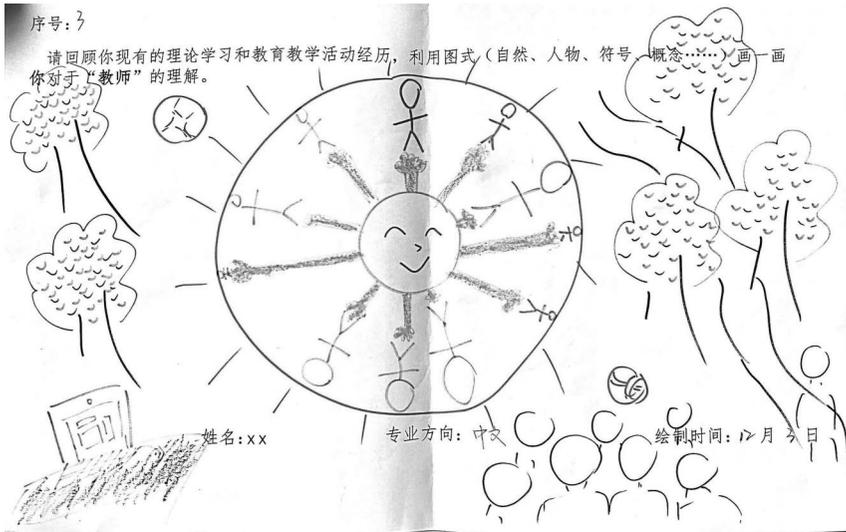
Figure 3.4 The visual metaphor painting of Li

4.1 Missing state

In total, 37.5% of the pre-service teachers were in this state. Pre-service teachers mainly focus on constructing a sophisticated understanding of their teaching roles. However, the construction of the teacher self is neglected or weakened, which means pre-service teachers fail to answer questions related to their current and future identity as teachers. For instance, Li introduced the idea of her visual metaphor painting as follows:

> My painting represents that a teacher should be an implementer of educational ideas about equity and life. There is a big sun at the centre and a small sun inside the big sun (which represents teachers). Inside the big sun, the small sun shines on different individuals (representing students) with various lengths of light. I am trying to show the equity of education, which implies that every student is different. Therefore, teachers should teach students based on their aptitude to ensure they remain at a relatively similar level. During this educational process, teachers and students together can form a fair and harmonious whole, exactly like the big sun in the centre of my painting. Many schemas surround the big sun, including trees, computers, balls, and people. These schemas represent things that are highly relevant to students' own lives. Games, nature, supervision are things that support children's growth. Through the teacher's teaching and guidance, the children will be able to find their way to them.
>
> (interview, 25-12-2020)

Based on her undergraduate study and academic exchange experience, Li created a core metaphor in which the teacher is the implementer of educational ideas about equity and life (Figure 3.4). In her painting, she focused on depicting the sophisticated meaning of her teacher role but ignored the internalisation of her educational ideas. This resulted in a deficiency in her teacher self. Reflecting on the reason for this deficiency, Li stated,

> At present, I am still struggling and confused about whether I should become a teacher or not. It is tough for me not to become a teacher because I have invested so much time and effort into training to be one. On the other hand, I tend to run away from answering questions about my professional identity, and it is difficult for me to recognise my position in my own painting.
>
> (interview, 25-12-2020)

4.2 Contradictory state

In total, 37.5% of the interviewed pre-service teachers were in this state. There are two types of contradictory states. One is the contradictory internal transformation of pre-service teachers who recognise themselves as teachers. Their idealised teacher self contradicts the teacher role that they construct. The other is the contradictory transformation between the identities of prospective teachers and teachers. The difference between the two types is that the former constructs their complete teacher identity. In contrast, the latter group only explains their teacher role and neglects the construction of the teacher self, which results in an incomplete teacher identity.

As for the former group, their contradiction is between their teacher role and teacher self. For example, Hou divided his painting into three parts: the teacher's life, career, and the cultivation of talent for the party and the state (from left to right). By drawing a blackboard, he expressed his ideas and beliefs about what a teacher's identity should be. He said,

> In the future, I believe my students will show concern about our nation and the public. When they grow up, they can contribute to our country and serve the people wholeheartedly.
>
> (interview, 27-12-2020)

However, Hou put himself under tremendous pressure to shape a teacher self that would match his lofty ideals and beliefs, thereby causing a chasm and contradiction between his teacher self and teacher role. For instance, Hou repeatedly tried to integrate his ideas and beliefs into his teaching during the exercise but never succeeded. He failed due to the gap between his ideals and reality, his lack of actual classroom teaching experience, and other such issues. He said,

> When I started an exercise in the primary school, I found that most schoolteachers mainly focus on disciplinary knowledge…their goals

and teaching methods heavily rely on the syllabus…the space for teachers to demonstrate their strengths is small. As for the current students, few of them have a sense of their home and nation, and they rarely perceive the beliefs of their teacher.

<div align="right">(interview, 27-12-2020)</div>

As for the latter group, the contradiction lies between their identity as a teacher and their identity as prospective teachers (Figure 3.5). Some preservice teachers refused to build their teacher self. They shared their dissatisfaction with the contemporary teacher role and held negative and critical opinions about their teacher identity. Fan is a good example. She introduced her painting and said,

> I do not think the teacher should encourage cramming. Instead, teachers should teach students heuristically and teach them to acquire a docile disposition and positive attitude towards life.…However, when I finished my painting, I realised that there is no absolutely right or wrong teaching method, but we use them in a rigid way… maybe the biggest demerit for current teachers is that they lack a sense of critical thinking and cannot get rid of the stereotypes from their past education.

<div align="right">(interview, 31-12-2020)</div>

Fan shared a critical view of current schoolteachers and education content, and this became a barrier for her to construct her teacher self in her professional identity. The cramming that she had to perform during her life as a student negatively affected her professional identity and made her critical of the role of contemporary teachers. Moreover, although she gained abundant knowledge from four years of undergraduate study, she failed to reorient her
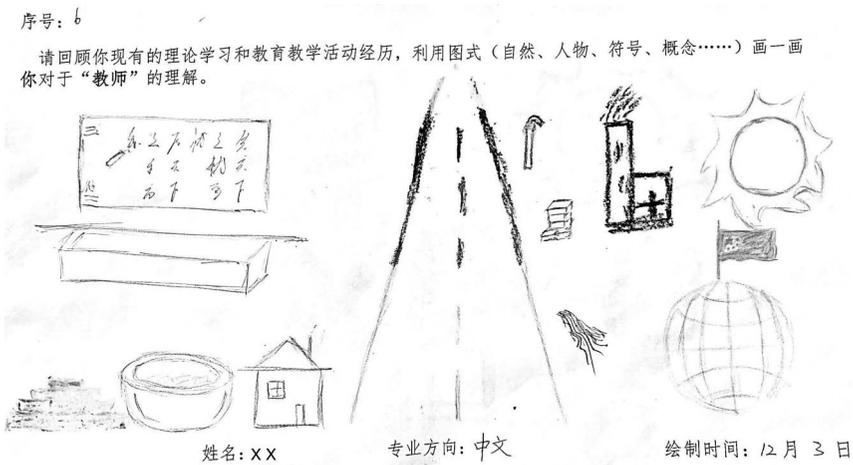

Figure 3.5 The visual metaphor painting of Hou

序号：15

请回顾你现有的理论学习和教育教学活动经历，利用图式（自然、人物、符号、概念……）画一画
你对于"教师"的理解。

姓名：XX   专业方向：小学教育(数学)   绘制时间：12月28
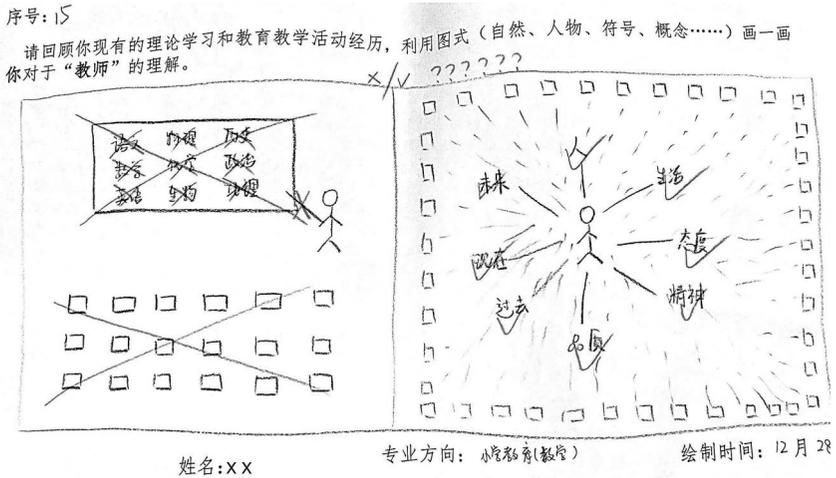
Figure 3.6 The visual metaphor painting of Fan

mind. Instead, the knowledge she gained intensified her criticism towards education and increased the divide between her identity as a teacher and her identity as a pre-service teacher (Figure 3.6).

4.3 Transitional state

In total, 18.75% of the pre-service teachers were in a transitional state. In this state, pre-service teachers hold a positive attitude towards their teacher identities. Referring to Zhou's painting, she explained,

> As for the tree trunk in the painting, I suppose that the relationship between the teacher and the student is similar to the connection between the trunk and the leaves. Teachers are like tree trunks, transporting water and minerals from the soil to the leaves. With the departure of spring and arrival of autumn, the leaves turn from green to yellow, fall into the ground, and finally fertilise the roots by sending nutrients to the soil. This is akin to the process in which teachers educate their students. The teacher imparts knowledge to their students, and the students ultimately repay the education and guidance provided by their teachers by contributing to society. I drew a self-portrait in the centre of my painting to describe my teacher identity. It was inspired by my tutor during my last exercise in my senior year, who described me as an agony aunt because I got along well with students and was a great listener. From my point of view, youthful teachers like us can bring a sense of enthusiasm to students. We should promote these good qualities to our daily teaching life. In [the] left part of the painting, I drew a scene

序号：4

请回顾你现有的理论学习和教育教学活动经历，利用图式（自然、人物、符号、概念⋯⋯）画一画你对于"**教师**"的理解。

姓名：ｘｘ   专业方向：报   绘制时间：１２月３日
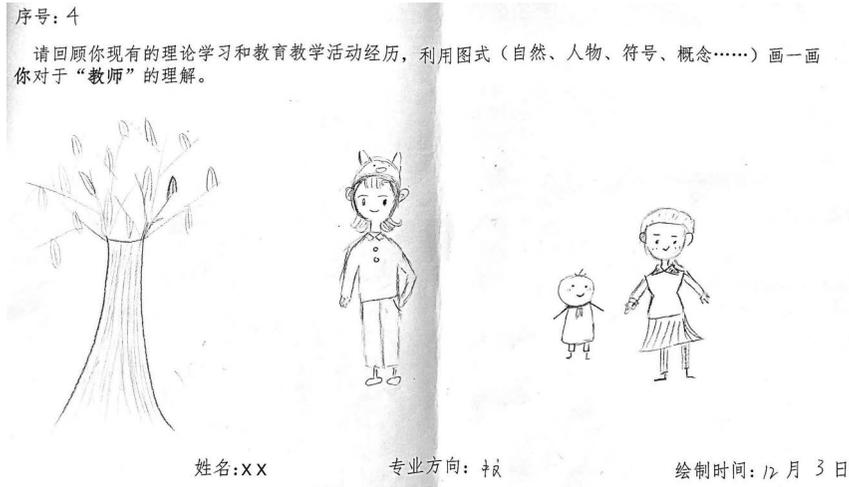
Figure 3.7 The visual metaphor painting of Zhou

depicting students as young pioneers, where a teacher tied a red scarf on her young student. Through it, I sought to convey the benign relationship between a teacher and their students…teachers are like a mother to their students, and children can feel content if they grow up in a caring teaching environment.

(interview, 30-12-2020)

Zhou constructed her teacher identity based on the evaluation she received from her mentor, which presented a clear and specific cognition about her identity as a teacher (Figure 3.7). Meanwhile, she created the core visual metaphor of 'teachers-as-mothers', presenting her conception of her teaching role. She intended to highlight the maternal concern and care she has for her students. She divided her painting into three parts, which depicted the transitional process from being a prospective teacher to an in-service teacher.

4.4 Completion state

In total, only 6.25% of the pre-service teachers were in this state. The teacher's belief plays a fundamental role in their construction of and reflection on their identities in this state. A firm teacher belief allows the pre-service teacher to accommodate and adjust to their new identity of being an in-service teacher. Moreover, they internalise the influence of external factors on their perception of their teacher identity. Pre-service teacher Wen constructed his core visual metaphor of 'teacher-as-a- sunflower' through the representation of a sunflower in his painting. Owing to the complex
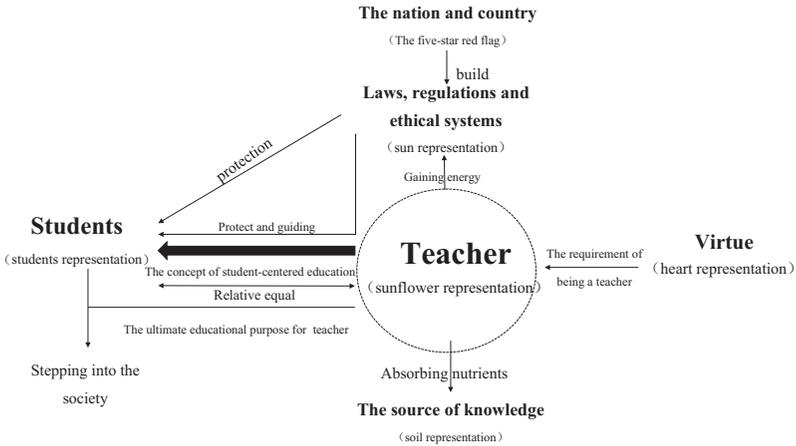
Figure 3.8 The conceptual association of the visual metaphor painting of Wen

conceptual association he created, we decided to use a concept map to illustrate the meaning behind his painting (see Figure 3.8).

Overall, Wen emphasised the high requirements for his teacher identity. He believed that the teacher should not only possess virtues and ideals but also constantly learn and self-examine. Moreover, Wen proposed his cognitive growth model as a teacher (see Figure 3.9). He explained the significance of the sunflower in his interview.

> The sunflower symbolises teachers, and the education from the teacher should regard students as a foundation, to respect students and care for their growth…If you look at the sunflower more carefully, you will notice that I drew three different petals. I did this because they represent different meanings. The first layer represents my past knowledge about education that I derived from past learning experiences. The second layer represents the continuous learning and introspection required to enrich my teaching experience when I am a real teacher. In addition, a crucial aspect of being an in-service teacher is possessing new and advanced knowledge about society, since the ability to adapt to society is an essential requirement for being a teacher. Furthermore, one thing that does not change during the growth of a teacher is the teacher's worldview. I want to be a teacher who can bring happiness and hope to students.
>
> (interview, 27-12-2020)

Wen mainly mentioned two aspects of a teacher's growth: the teacher's ideas and beliefs and their adaptation to external factors (society, culture, policies). As for the teacher's beliefs and ideals, he regarded them as the unchanging
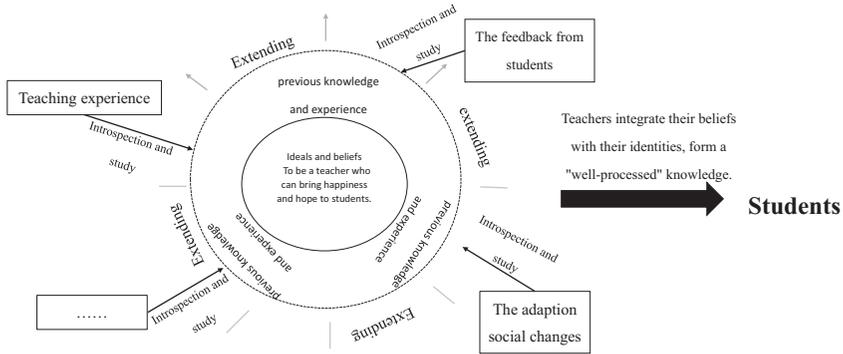
*Figure 3.9* The interior association of the sunflower representation
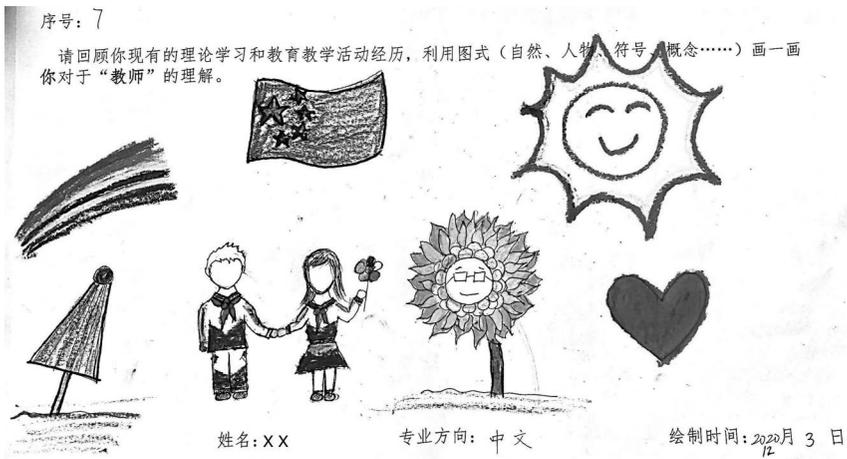
Figure 3.10 The visual metaphor painting of Wen

core of a teacher's growth. However, growth is a process of constant change and expansion. This process symbolises that teachers need to actively respond to and learn from external factors, such as learning advanced technology and acquiring knowledge corresponding to social changes. This requires teachers to have a positive attitude towards teaching and the ability to keep learning. We integrated the two aspects of teacher growth, which turned it into a dynamic process that jointly points to the student-centred concept. Teachers integrate their beliefs with their identities, form well-processed knowledge, and finally initiate them. This well-processed knowledge requires the teacher to have firm ideals and beliefs and the ability to adapt, integrate, reflect, and learn from external factors. As a result, teachers can realise their inner growth (Figure 3.10).

5 Discussion and implications

This chapter revealed that more than 50% of the pre-service teachers constructed their teacher self actively, whereas others failed to answer questions about their teacher self. The difference between the two groups lies in the gap between their idealised teacher identities and their real identities. Furthermore, the large gap between their ideal and reality causes numerous problems when pre-service teachers attempt to construct their teacher identities. Passive emotional experiences exaggerate the conflicts between pre-service teachers and their professional identity, which renders it difficult for them to construct their complete professional identity. It is believed that theoretical courses are the primary source of professional knowledge and guidance for pre-service teachers, and practical exercises enable them to perceive the teaching experience. Based on the results of this study, we propose the following implications for teacher education.

First, theoretical-based teacher education programmes should focus on solving real problems in educational practice. Some pre-service teachers reflected that the content of theoretical courses was rigid and insufficiently practical and that the boring teaching models made it difficult for them to be interested in theoretical courses. Therefore, they lacked a thorough understanding of the necessary theoretical knowledge, which made it challenging for them to quickly mobilise the acquired theoretical knowledge and apply it to specific situations. This would consequently lead to them having a poor ability to perform actual educational and teaching activities. In addition, such pre-service teachers would feel unprepared when dealing with actual teaching activities and would resultantly perpetuate this vicious cycle by mechanically emulating their instructors' behaviours and practices. Thus, it is not easy to form a unique teacher identity. Owing to pre-service teachers' poor ability to solve problems in real educational situations, instructors will be unable to assign vital teaching tasks to them. Overall, theoretical courses should be more focused on solving real and complex problems based on authentic cases. Simultaneously, certain details should be focused on. The authentic cases used should be typical and specific so that teachers can explain and relate diverse theoretical knowledge from these cases. Additionally, pre-service teachers should focus on the conceptual relevance of the theoretical knowledge and actively reflect on the problem-solving methods adopted by teachers. Finally, teachers should evaluate students by simulating specific educational practice situations.

Second, normal universities and teacher colleges should extend the duration of educational practice activities and pay attention to the assessment of these activities. Through the employment of visual metaphors, this study indicates that most pre-service teachers show an unstable understanding of their teacher identities. The reason for this cognitive phenomenon is likely pre-service teachers' neglect of their teacher self during the construction of their professional identity. In other words, pre-service teachers do not

view themselves a teachers-to-be. Instead, they neglect this aspect and only present their understanding of the meaning of their teacher role. This kind of cognition resembles viewing teacher identity from the perspective of a bystander and lacks experiential grounding. Pre-service teachers first need to view themselves as teachers-to-be, which would serve as their identity confirmation. Confirmation is a process of repeated and long-term selection and autonomous construction, which requires pre-service teachers to constantly recognise, reflect on, and reconstruct a professional identity over a long time period. Educational practice is the link through which pre-service teachers can most directly recognise their professional identity. The current educational practice module in the teacher education curriculum in China lasts from one month to one semester, and some schools' arrangements of educational practice activities are distributed across various semesters. This results in the fragmentation of knowledge and practice. The short duration of educational practice activities, their weak connection with theoretical knowledge, narrow scope, and insufficient assessment of pre-service teachers affect pre-service teachers' experience and reflection and the reconstruction of their professional identity. Therefore, normal schools should extend the continuous total duration of educational practice activities and attach importance to the assessment of activities.

In this chapter, we listed the reasons why pre-service teachers were in one of four different cognitive states. Pre-service teachers in the missing state did not consciously construct their teacher self in their visual metaphorical paintings. In other words, they did not display an understanding of their professional identity within the context of being a prospective teacher. It led them to present an unstable understanding of their teacher identity when asked to autonomously construct the same.

Pre-service teachers in the contradictory state displayed a conflict between their idealistic professional identity and reality. These pre-service teachers constructed idealised metaphors to represent their professional identities. However, such pre-service teachers find it difficult to construct their professional identity in real education and teaching situations, which results in them experiencing negative emotions. These seemingly invisible emotions reflect pre-service teachers' subjective consciousness of their teacher identity and hinder their transformation to the teacher self.

Pre-service teachers in the transitional state displayed positive emotions towards their teacher identity. Although there is a gap between the idealised teacher identity they construct and the teacher-to-be identity that they must inhabit, they do not contradict one another. The gap between their reality and ideal encourages them to realise that their identity is in the process of transformation.

Pre-service teachers' positive and negative emotions towards their professional identity directly affect their adoption of the teacher identity. These negative and positive emotions are mostly related to their personal educational and practical experience. Some pre-service teachers emphasised how

the influence of their nation and society instilled a sense of honour and duty in them during the process of their teacher identity construction. As can be seen, emotions are significant to pre-service teachers' construction of their professional identity, and these subtle emotions are generally are easily overlooked by researchers (Zembylas, 2004). However, the construction of visual metaphors facilitates the capture of the meaning of such emotions.

Pre-service teachers in the completion state presented a relatively stable understanding of their professional identities. Such a stable cognition arises from their firm beliefs, which enables them to explore and reflect on their self-constructed teacher's identity in a safe and grounded manner.

Appendix:

Interview outline

1 Could you please interpret your drawing to us?
2 What do you mean by certain symbols in your painting?
3 What might be the relationship between your drawing with your past experiences?
4 What is your visioning to become a school teacher?
5 How could you reflect on the initial teacher education programme you received?

References

Beauchamp, C., & Thomas, L. (2009). Understanding teacher identity: An overview of issues in the literature and implications for teacher education. *Cambridge Journal of Education, 39*, 175–189.

Beijaard, D., Meijer, P. C., & Verloop, N. (2004). Reconsidering research on teachers' professional identity. *Teaching and Teacher Education, 20*, 107–128.

Chen, X. (2011). *Bridging praxis and theory: A study of teachers and pre-service teachers' practical knowledge*. Beijing: Education Science Press.

Clandinin, D. J., Downey, C. A., & Huber, J. (2009). Attending to changing landscapes: Shaping the interwoven identities of teachers and teacher educators. *Asia Pacific Journal of Teacher Education, 37*(2), 141–154.

Clarke, C., & Holt, R. (2017). Imagery of ad-venture: Understanding entrepreneurial identity through metaphor and drawing. *Journal of Business Venturing, 32*, 476–497.

Day, C., Kington, A., Stobart, G., & Sammons, P. (2006). The personal and professional selves of teachers: Stable and unstable identities. *British Educational Research Journal, 32*, 601–616.

Dodd, S.D., 2002. Metaphors and meaning: A grounded cultural model of US entrepreneurship. *Journal of Business Venture, 17*(5), 519–535.

Eppler, M. J., & Burkard, R. A. (2004). *Knowledge visualization: Towards a new discipline and its fields of application*, ICA Working Paper#2/2004, University of Lugano.

Erikson, E. H. (1968). *Identity: Youth and crisis*. New York: Norton.

Flores, M. A., & Day, C. (2006). Contexts which shape and reshape new teachers' identities: A multiperspective study. *Teaching and Teacher Education, 22*, 219–232.

Gee, J. P. (2001). Identity as an analytic lens for research in education. In W. G. Secada (Ed.), *Review of research in education* (vol. 25, pp. 99–125). Washington, DC: American Educational Research Association.

Hofinger, A., & Ventola, E. (2004). Multimodality in operation: Language and picture in a museum. In E. Ventola, C. Charles, & M. Kaltenbacher (Eds.), *Perspectives on multimodality* (pp. 193–210). Amsterdam: John Benjamins Publishing.

Kelchtermans, G. (1996). Teacher vulnerability: Understanding its moral and political roots. *Cambridge Journal of Education, 26*, 307–323.

Kress, G., & van Leeuwen, T. (2001). *Multimodal discourse: The modes and media of contemporary communication*. London: Edward Arnold.

Kress, G., & van Leeuwen, T. (2006). *Reading images: The grammar of visual design*. London: Routledge.

Leitch, R. (2006). Limitations of language: Developing art-based creative narrative in stories of teachers' identities. *Teachers and Teaching: Theory and Practice, 12*(5), 549–569.

Munday, J., Rowley, J., & Polly, P. (2017). The use of visual images in building professional self-identities. *International Journal of ePortfolio, 7*(1), 53–65.

O'Toole, M. (2010). *The language of displayed art* (2nd ed.). London: Routledge.

Ruohotie-Lyhty, M., Aragao, R. C., & Pitkanen-Huhta, A. (2021). Language teacher identities as socio-politically situated construction: Finnish and Brazilian student teachers' visualisations of their professional futures, *Teaching and Teacher Education*. https://doi.org/10.1016/j.tate.2020.103270

Sachs, J. (2005). Teacher education and the development of professional identity: Learning to be a teacher. In P. Denicolo & M. Kompf (Eds.), *Connecting policy and practice: Challenges for teaching and learning in schools and universities* (pp. 5–21). London: Routledge.

Smith, R. (2015). Contextualising images of enterprise: An examination of visual metaphors used to represent entrepreneurship in text books. In H. Neergaard, & C. M. Leitch (Eds.), *Handbook of qualitative research techniques and analysis in entrepreneurship* (pp. 139–169). Cheltenham: Edward Elgar.

Tait-McCutcheon, S., & Drake, M. (2016). If the jacket fits: A metaphor for teacher professional learning and development. *Teaching and Teacher Education, 5*, 1–12.

Wei, G., & Chen, X. (2015). Social interaction and professional identity of student teachers: An empirical study in seven provinces in mainland China. *Journal of Educational Studies, 11*, 55–76.

Ye, J. (2017). *Historical-sociological investigation of teacher identity construction*. Beijing: Beijing Normal University Press.

Zembylas, M. (2004). The emotional characteristics of teaching: An ethnographic study of one teacher. *Teaching and Teacher Education, 20*, 185–201.

4 Video analysis

Manifesting pre-service teachers' practical knowledge

1 Introduction

In China, it is acknowledged that teachers' practical knowledge serves as a foundation for their professional development (Chen, 2003, 2011; Wei, 2020). Cultivating the practical knowledge of pre-service teachers in initial teacher education programmes at normal universities has been discussed extensively in recent international studies (e.g., Allas, Leijen, & Toom, 2020; Athanases, Sanchez, & Martin, 2020; Toom et al., 2019). The reason why practical knowledge gains much attention in academia is that practical knowledge is a melange of pedagogical theory and practice.

Global teacher education reform directly or indirectly revolves around the relationship between educational theory and practice (Darling-Harmmond & Lieberman, 2012). The adoption of 'practice-oriented, and life-long learning' as the core idea of teacher education was specifically proposed by *Teacher Education Curriculum Standards* issued by the Chinese Ministry of Education (2011). It is necessary to improve the practical competence of pre-service teachers and make them reflective practitioners by optimising the structure of the teacher education curriculum and strengthening its links to teaching practice (Schön, 1983).

Utilising pre-service teachers' representations of practical knowledge as a unit of analysis, my research team and I collected and analysed the teaching videos of 66 pre-service teachers from different disciplines during their placement. By manifesting pre-service teachers' practical knowledge across five categories (i.e. labelled, symbolic, visual, actionable, and linguistic), this chapter enables a reflection on the existing initial teacher education programmes in order to propose implications for nurturing pre-service teachers' practical knowledge through initial teacher education reform.

2 Representations of teacher practical knowledge

Representation is originally a cognitive psychological concept. Eysenck and Keane (2004) pointed out that representation is any sign or set of signs that refer to an object in its absence. Knowledge representation refers to the way information is recorded and presented in the brain (Pi, 1995).

A teacher's practical knowledge is tacitly embedded in their teaching environment and actions. Therefore, we need to use knowledge representations to make them visible. Through knowledge representations, pre-service teachers' practical knowledge can be externalised (Chen, 2011). There are few previous studies on the representations of teachers' practical knowledge. For instance, Allas, Leijen, and Toom (2017) explored the gains and losses of pre-service teachers after they attempted to teach with the help of various reflective tools such as video recordings, oral reports, and written notes, and formed dynamic representation results. The study in this chapter is mainly informed by Chen's (2011) categorisation of representations of teacher practical knowledge.

Labelled representations are the first such category. Labels are general keywords that represent human evaluation and opinions. Labelled representation is the presentation of practical knowledge with pre-service teachers' personal characteristics in classroom teaching, and it is often related to subjective factors such as pre-service teachers' educational beliefs and values. It mainly includes their educational beliefs, personal philosophy, and teaching styles.

Symbolic representations are the second category. A symbol is a sign that people form a representation of a certain object. Symbolic representations within specific context through language, text, sound, pictures, and other linguistic and non-verbal methods make each pre-service teacher's classroom teaching distinctive. It mainly includes habitually spoken language, body language, and situational symbols.

Visual representation is the third category. Piaget (1984) believed that a schema is an organised and repeatable behaviour pattern or mental structure and a dynamically variable cognitive structure. Visual representations reflect pre-service teachers' cognition of themselves, their teaching, students, and the educational situations in classroom teaching. It transforms these cognitions into their presentation of their practical knowledge about students and the classroom. Visual representations mainly consist of imagery.

The fourth category is actionable representation. Clandinin and Connelly (1987) indicated that an action is both an expression and a source of practical knowledge. The cognitions and experiences of subjects, courses, classrooms, and teaching that pre-service teachers discover through actions are subsequently presented in their classroom teaching in the form of behaviours. Actionable representation primarily consists of rules of action and principles of practice.

Linguistic representations comprise the fifth category. Language is our primary means of communication. Pre-service teachers communicate with students through verbal dialogue and articulate their own ideas and complete questions, summaries, reflections, and other teaching links. Linguistic representations mainly consist of expressions and logical principles. By analysing pre-service teachers' teaching videos, these five forms of practical knowledge representations could be revealed and examined.

3 Video analysis as a method

Derived from microteaching in the 1960s, video analysis has become a research method that improves teachers' professional development with the assistance of multimedia technology. In China, video analysis is mainly used in public classes, where teachers present them in public places in front of an audience. However, the lack of clear operational framework has resulted in the neglect of the value of teaching videos. It is thus difficult to help teachers and pre-service teachers receive quick and effective feedback when they produce a video.

Methodologically, Mannikko and Husu (2019) subverted the single perspective of traditional researchers and introduced new parties into the video by combining the observations of researchers. They analysed teachers' feedback on their own performance in videos from multiple perspectives. Li (2017) examined the teaching and research function of videos. He believed that the application of teaching videos could facilitate not only example observation and learning but also the analysis of and reflection on teachers' behaviour and language. Zuo (2016) chose to start with real teaching behaviours in the classroom context and conducted data quantification on the teaching behaviours observed in videos. Since video images record the real situation of pre-service teachers' growth, the diversified cognition of video images developed in the past half-century not only expands the scope of educational practice but also strengthens the depth of educational theory research.

Based on existing studies, it is found that video analysis as methodology focuses much more on teachers' authentic teaching processes. We put forward the framework of using a video analysis method to study the process of teaching public classes. This five-step framework presents the inductive process from the whole to the parts and back to the whole (see Figure 4.1).

This chapter utilised the pre-service teachers' teaching videos that were recorded during their school placement as raw data to capture authentic representations of their practical knowledge. To explore the representations of the practical knowledge of pre-service teachers from various disciplines, the present study used a video analysis method to analyse 66 pre-service teachers who majored in primary education. The advantages and deficiencies of pre-service teachers' practical knowledge have been statistically examined. The sample's characteristics are presented in Table 4.1. For a convenient comparison, the disciplines were divided into three categories.

According to Meijer, Verloop, and Beijaard (2001), a coding method can be used to tailor teacher practical knowledge, which would facilitate the acquisition of more accurate analysis results. Combined with classroom teaching, we further refined the form of knowledge representation in the coding table. With the help of operational definitions, the specific behaviours of pre-service teachers in each class were explained and listed together with the representational forms of practical knowledge. Finally, we constructed the *Coding list of pre-service teachers' practical knowledge representations* (see Table 4.2).
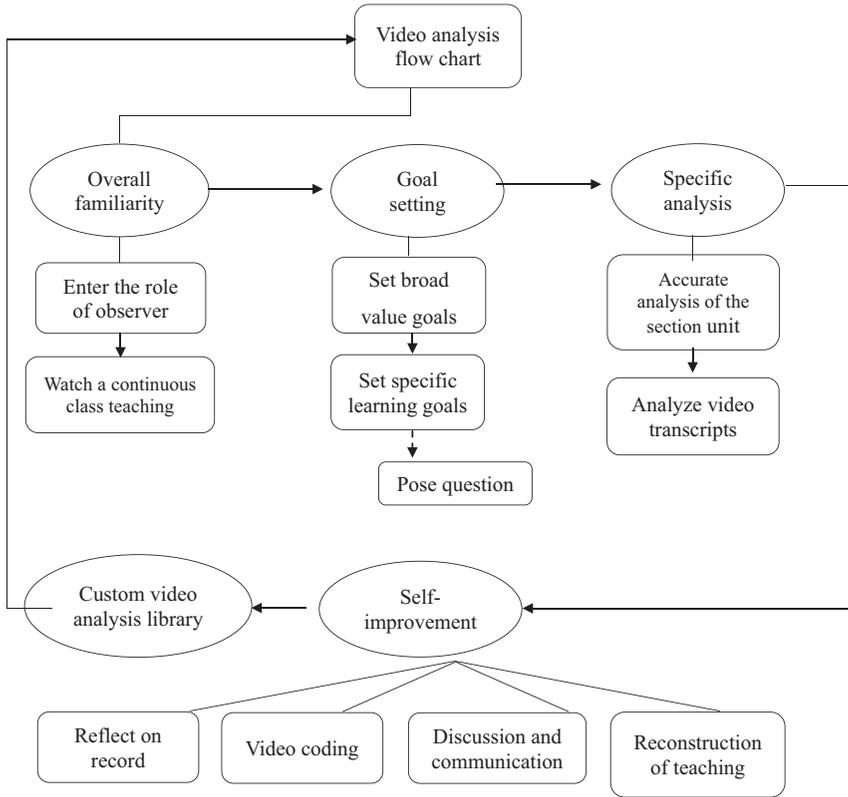
Figure 4.1 Flow chart for video analysis

Table 4.1 Sample selection

Disciplinary classification	Disciplines	Numbers	Ratio (%)
Language	Chinese	30	45.5
	English	13	19.7
Mathematical	Mathematics	12	18.2
	Science	1	1.5
	ICT	2	3.0
Art	Music	4	6.0
	Art	4	6.0
All disciplines		66	100.0

Table 4.2 Coding list of pre-service teachers' practical knowledge representations

Operational definitions / Representations	Categories	Specific characterisations	Operational definitions
Labelled	Education belief	Build a sense of self-efficacy	Demonstrate confidence in the classroom
		Identify students' learning needs and motivations	Adapt to and respect students' ideas and teach students according to their aptitude
		Fully attract and guide students	Be a facilitator, not a teacher
		Fully enlighten students	Ask questions and give the students a chance to express themselves
			Avoid the situation where teachers are monopolised by one person
		Enhance teacher-student interaction	Set up classroom activities, interaction with the table, and other links
		Strengthen interaction between parents and children	
	Personal philosophy	Focus on topics that students are interested in	Keep abreast of the times and students' thinking and present them in class materials
		Effectively use the way students receive them	It is flexible in classroom teaching and management and has humanisation
		Connect with lived realities	Listen carefully and think about the students' ideas, combine them with examples from real life, provoke the students to think
	Teaching style	Pursuing personalised classroom	Have one's own ideas on classroom presentation, which are reflected in teaching methods and classroom design
		Excellent design of blackboard writing	The writing is beautiful, logical, simple, and clear

Symbolic	Habitual speech, body language	Establish a self-concept	Use habitual expressions, movements, and gestures
	Situation symbol	Use effective auxiliary teaching resources	Use teaching resources that students like and are suited to their age group and the theme of the class
		Improve the situations used in the content that is taught	Design interesting situations to help students understand the problem
		Incorporate traditional, school, or class culture (humanities)	Try to ensure that the classroom has unique teaching characteristics
		Carefully design how knowledge is presented	Combine the classroom content to design the teaching situation, exercise situation, or role situation
		Carefully design the content	Combine the activity scheme to design the activity situation
Visual	Image	Pay attention to students' differences	Different approaches should be adopted for students of different genders and personalities
		Pay attention to the students as a whole	Ask questions to students who are not very involved in class
		Focus on student participation	Involve students in class by asking them questions and encouraging them to ask questions
		Understand the learning situation in place	Understand students' aptitude and existing knowledge and integrate what they have learned into the classroom
Actionable	Action rules	Use subject knowledge effectively	Teach subject knowledge to students in an efficient manner and conduct adequate practice
		Use the course knowledge effectively	Incorporate interdisciplinary knowledge and display an ability to integrate the curriculum
		Effective use of subject teaching knowledge	Display the ability to control the classroom and use one's knowledge of teaching methods skillfully
	Practice the principle of teaching	Reasonable control of the classroom links	Display the ability to control and guide the progress of the class
		Visit class and answer questions	Answer questions individually and collectively on general issues
		Consciously check whether students understand what is taught	Get feedback from students in time and use questions to solve problems in class

Operational definitions / *Representations*	*Categories*	*Specific characterisations*	*Operational definitions*
Linguistic	Express rules	Ask a variety of questions	Single question and series of questions are used alternately
		Ask questions in a variety of ways	Variable number of questions
		Variety of questions	Interrogative sentences, acting sentences, and incomplete leading sentences are used in combination
		Conclusion in place	Practice habit problem, knowledge problem, and open question are all involved
		Use encouraging language	Teachers summarise by themselves, students summarise, or teachers guide the students to summarise
		Make good use of inquiry	Give students positive hints, encouragement, and guidance
	Principles of logic	Strengthen the logic of teaching content	Foster students' logical thinking by asking questions
		Teaching is based on a knowledge system that progresses from simple to deep concepts	The ability to make a single piece of content into a series
		Summarise the students' answers according to the knowledge points	Cultivate students' independent thinking ability
		Sublimate students' viewpoints by combining knowledge points	Teaching content has a sense of hierarchy and design
		Combined with the lecture	Listen to and think about students' ideas carefully and summarise their answers with sentences or words from a professional perspective

Based on the coding list, we viewed the pre-service teachers' teaching videos and assigned values to their performances of such representations. We used a score of 1 as the full mark standard to quantitatively evaluate the knowledge representation performance of pre-service teachers. For example, when evaluating their performance with regard to designing student activities in the classroom, a score of 1 was allotted if they engaged in this activity, whereas a score of 0 was assigned if they did not or did so poorly.

We calculated the score related to each representation for the entire sample and the total score of each representation. To make the research results intuitive, we also calculated the variance of the representation score of all pre-service teachers to study the overall status quo and calculated the range to understand the situation across various representations, disciplines, and samples.

First, we randomly selected at least one sample of each discipline from the seven pre-service teachers for observation, until we roughly grasped the teaching situation of the pre-service teachers. Second, a preliminary coding table was set up, and the representational items of practical knowledge were designed and listed. The video was then viewed further, and the coding table was refined. The teaching videos of each sample were viewed at least twice. The first time, the teaching ideas and arrangements of pre-service teachers were viewed as a whole and the key points of their classroom links and the parts to be watched again were marked. Then, we focused on the marked links, assigned scores to the presentation of practical knowledge in the teaching videos based on the coding table, statistically analysed the characteristics and phenomena reflected by the numerical values, and drew research conclusions.

4 Unravelling practical knowledge in videos

Based on the coding list and the analysis method, this section unravels the 66 pre-service teachers' practical knowledge represented in their teaching videos. We first describe the overall status quo and then conduct cross-group comparisons.

4.1 Descriptive analyses

To comprehensively analyse the representations of pre-service teachers' practical knowledge, we adopted two perspectives (i.e. individual-based and representation-based analysis). The overall performance of pre-service teachers' practical knowledge was relatively stable, and their average score rate was approximately 0.74 (see Figure 4.2).

Horizontally, the ratio of the 66 pre-service teachers' scores to their total scores in the analysis process (i.e. the score rate) is plotted as a scatter plot. It can be seen that the score rate aggregated between medium and high levels with a variance of 0.015, indicating that the pre-service teachers'

representation of their practical knowledge was at a relatively stable level. However, the knowledge representation also obviously differed among pre-service teachers. This difference depends on many factors, including the pre-service teachers' grade, the discipline being taught, their prior experience, and the degree of guidance provided.

The level of practical knowledge representation of pre-service teachers was complementary, and well-developed representation forms accounted for the majority (see Figure 4.3). A longitudinal analysis of the sample data indicated that symbolic representation (0.78) was the most comprehensively
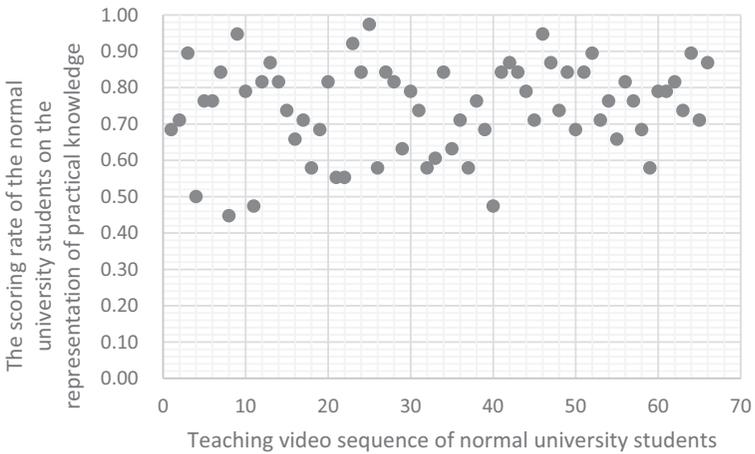
Figure 4.2 The scatter diagram of the score rate of pre-service teachers' representation of practical knowledge
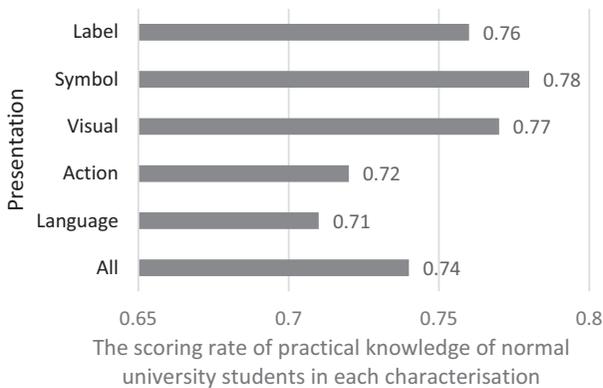

Figure 4.3 The score rate of practical knowledge representation of pre-service teachers

performed type of representation, followed by visual representation (0.77) and labelled representation (0.76). All of these were higher than the average level of 0.74, whereas the performance of actionable and linguistic representation was generally lower than the average level. Although there were differences in the score rates of the various representational forms, the gap between the highest and lowest score rates was 0.07, which accounted for only 7% of the total.

4.2 Differences among disciplines

As primary education in China is subject-specific, initial teacher education in teachers' colleges is classified according to different disciplines. Discussing the representation of practical knowledge of pre-service teachers cannot be separated from the characteristics of their subjects and cannot ignore the gap with other subjects. We first analysed the differences between the three macro disciplines, followed by an analysis of the intra-disciplinary differences. Finally, we carried out a more detailed comparative analysis among the seven specific disciplines.

4.2.1 Differences between disciplinary categories

The representations of pre-service teachers' practical knowledge across disciplines differed significantly (average score rate of 0.74), as can be seen in Figure 4.4. Mathematics and science pre-service teachers performed the best, and their score rate was higher than that of language pre-service teachers (0.78). The representation level of language pre-service teachers' knowledge was lower (0.72) than the sample's average, whereas the score rate of art pre-service teachers (0.77) was lower than that of mathematics pre-service teachers but still slightly higher than the average level.
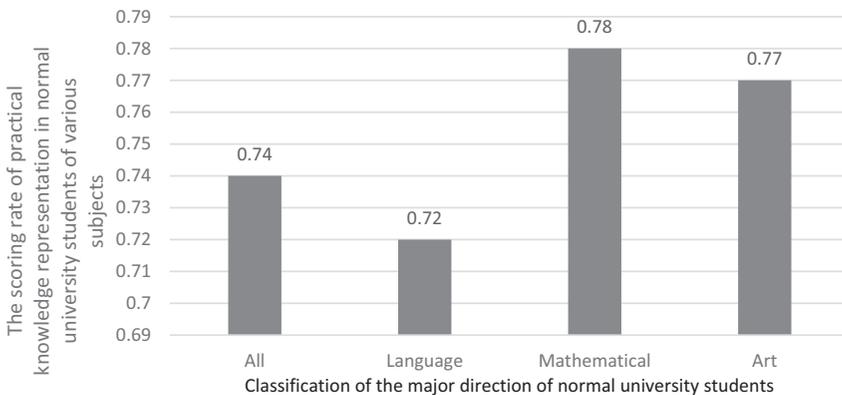

Figure 4.4 Score rates across various disciplines

To visually compare the representation of pre-service teachers in different disciplines, we combined the score rates of pre-service teachers' practical knowledge into three categories of disciplines (e.g. art, mathematical, language). The scores and differences in each representation were then calculated. The ten items with the largest difference were combined with the same category, and the top 20 results were summarised and analysed (see Table 4.3).

Table 4.3 Summary of the greatest difference among pre-service teachers of the three disciplines

Presentation	Presentational classification	Specific characterisation	Language	Mathematical	Art
Label	Education belief	Build a sense of self-efficacy	0.83	0.88	1
		Fully enlighten students	0.79	0.88	1
	Personal philosophy	Connect with lived realities	0.57	0.94	0.88
		Focus on topics that students are interested in	0.64	0.94	0.75
	Teaching style	Excellent design of blackboard writing	0.45	0.31	0
Symbol	Situation symbol	Incorporate traditional, school, or class culture	0.5	0.63	1
		Carefully design how knowledge is presented	0.93	0.94	0.75
		Use effective auxiliary teaching resources	0.64	0.75	0.88
		Carefully design the content	0.69	0.88	0.88
		Pay attention to students' differences	0.67	0.5	0.88
Visual	Image	Pay attention to the students as a whole	0.81	1	0.88
		Understand the learning situation in place	0.52	0.75	0.38
Action	Action rules	Use the course knowledge effectively	0.31	0.44	0.75
		Effective use of subject teaching knowledge	0.86	0.94	1
	Practice rules	Visit class and answer questions	0.81	1	0.75
		Consciously check whether students understand what is taught	0.21	0.5	0.5
Language	Express rules	Variety of questions	0.79	1	0.88
		Conclusion in place	0.45	0.63	0.63
	Logic rules	Strengthen the logic of teaching content	0.6	0.75	0.38
		Sublimate students' viewpoints by combining knowledge points	0.29	0.13	0.5

Mathematics and science pre-service teachers were found to be good at using situated cases. Their performance was stronger than language and art pre-service teachers on 26 items, whereas their performance on 4 items was the same and was slightly lower on 8 items. The main reason for their higher representation score is their enhanced labelled, symbolic, visual, and linguistic representations. For example, Jiang's teaching video for the subject of double digits cleverly presented numerical problems based on examples of real school activities (i.e. roller skating). This kind of integration is typical and effective, as it not only makes the class activity engaging but also simplifies the knowledge being imparted. Thus, mathematical pre-service teachers display a stronger use of symbolic representations in the classroom setting. They are good at using examples from real life, paying attention to students' interests, and setting up practical problems. This fully reflects the application of their personal philosophy in combination with their mathematical knowledge.

Art pre-service teachers focus on the humanistic orientation. They performed better than other pre-service teachers with regard to 20 items, whereas their performance on 6 items was the same characteristics and was poorer on 12 items. Similar to mathematics and science pre-service teachers, pre-service teachers of art displayed a better overall representation score. The main reason for this was their strong representation of labels, symbols, actions, and languages, which can reflect a greater degree of educational beliefs. For example, in the class where they taught an Australian folk song called 'Sheep Shearing', Kong designed a link that took up almost a quarter of the teaching time to introduce the history and culture of the song, which served as a strong foundation for students to learn and understand it. Therefore, teachers should not only make better use of their knowledge of the subject but also possess the corresponding interdisciplinary consciousness (i.e. incorporate humanistic knowledge into the classroom and have a good reserve of course knowledge) to enhance the applicability of the knowledge acquired by the students.

The overall representation level of the practical knowledge of language pre-service teachers was lower than that of their counterparts, but they emphasised the systematisms of the classroom. Due to the characteristics of the subject, pre-service teachers of language focus more on designing classroom links as opposed to conducting classroom exercises and activities. This requires a strong teaching design and in-depth excavation of foundational knowledge. For example, Lan provided an excellent class summary in the Chinese class on 'Describing Plants'. After providing students with time to imitate and practice, she chose to sublimate the theme of nature from the perspectives of labour education and life education. She guided students to reflect on and understand the intimate relationship between nature and human beings. The students resultantly developed a deeper understanding of life and nature.

4.2.2 Differences within the same discipline

There were significant differences in the individual forms of knowledge representations within the same discipline (see Table 4.4). Comparing the actionable representations of art pre-service teachers, we observed that the degree of music pre-service teachers' attention to students was evidently weaker than that of art pre-service teachers. The former rarely patrolled the classroom to answer questions or organised student interactions, which made it difficult for some students to concentrate for long periods.

In mathematics classes, there were obvious differences in the representation of labelled, visual, and linguistic representations. Pre-service teachers who majored in ICT scored 0.64 with regard to their labelled representations, whereas pre-service teachers who majored in math and science scored 0.8 and 0.86, respectively. According to the analysis, ICT pre-service teachers generally did not establish educational beliefs, which resulted in a lack of vitality in the classroom results. However, the visual representation of pre-service teachers who majored in science did not display a complete understanding of the learning situation. This leads to the fragmentation of classroom teaching and lack of systematism. A deficiency in linguistic representation is a common problem among mathematics pre-service teachers, who should thus deliberately strengthen their training with regard to this kind of representation.

Pre-service teachers of language also lacked in terms of their representation of actionable and linguistic types of practical knowledge. The overall classroom representation score of pre-service teachers who majored in English was only 0.7, which was lower than the average level. English pre-service teachers' awareness of subject integration and concern about students' understanding were found to be relatively weak. The classes conducted by Chinese pre-service teachers were slightly more systematic and had a more obvious hierarchy. Moreover, they often elevated the content and guided students to summarise what was taught. On the other hand, English pre-service teachers paid more attention to the tools and applications of the subject.

4.2.3 Differences between specific disciplines

The representation of pre-service teachers' practical knowledge across various disciplines differs owing to their varying levels of performance of specific representations (see Table 4.4). The practical knowledge representation of pre-service teachers who majored in English, ICT, and Chinese was found to be below the average level, whereas the mathematics and arts pre-service teachers displayed a far above average level of practical knowledge representation. In terms of symbolic representation, the average score of mathematics pre-service teachers was slightly lower than that of art pre-service teachers. However, due to their weak auxiliary teaching resources and cultural penetration, in addition to their stronger situational

Table 4.4 The score rate of representational forms in the classes of various disciplines

Presentation Subjects	Label	Symbol	Visual	Action	Language	All
Chinese	0.74	0.71	0.77	0.71	0.74	0.73
English	0.77	0.79	0.71	0.63	0.62	0.7
Mathematic	0.8	0.83	0.85	0.79	0.77	0.8
Science	0.86	0.83	0.63	0.75	0.59	0.74
Information technology	0.64	0.92	0.75	0.83	0.64	0.72
Music	0.7	0.88	0.81	0.67	0.73	0.74
Art	0.82	0.92	0.75	0.96	0.66	0.8

setting and presentation mode, their overall score was still relatively weak. In terms of actionable representation, art classes with strong operability paid more attention to the learning progress of students and aimed to confirm students' understanding before carrying out subsequent class activities. However, mathematics classes focused more on the training logic (i.e., depth rather than breadth), which is why their actionable representation was found to be weak.

In summary, the differences in the representation of pre-service teachers' practical knowledge were primarily found to be reflected in their representation of symbols and labels. Language classes should focus on integrating humanistic contexts, whereas mathematics, science, and art pre-service teachers should incorporate more personal education philosophy and pursue intelligent personalised classes.

4.3 Analysis based on characteristics of representations

Symbols, visuals, and labels represent the complementary relationship among teachers, students, and classrooms, whereas action and language representations further illustrate the importance of practical knowledge in education and teaching.

4.3.1 More context and less culture with regard to symbolic representations

Pre-service teachers' high level of symbolic representation resulted from their good teaching design and presentation state. Most pre-service teachers can build from students' learning interests, attempt to use auxiliary tools, and design reasonable teaching activities (see Table 4.5). However, the performances of pre-service teachers differ in certain respects. For example, the requirement of incorporating cultural connotations into the teaching content is higher for pre-service teachers who teach languages, science, and

Table 4.5 Symbolic representations

Subject-specific characterisation	Chinese	English	Mathematic	Science	Information technology	Music	Art	All
Establish a self-concept	0.69	0.85	0.92	1.00	1.00	1.00	1.00	0.82
Use effective auxiliary teaching resources	0.62	0.69	0.67	1.00	1.00	0.75	1.00	0.70
Improve the situations used in the content that is taught	0.90	1.00	0.92	1.00	1.00	1.00	0.75	0.92
Incorporate traditional, school, or class culture	0.48	0.54	0.67	0.50	0.50	1.00	1.00	0.59
Carefully design how knowledge is presented	0.90	1.00	1.00	0.50	1.00	0.75	0.75	0.91
Carefully design the content	0.69	0.69	0.83	1.00	1.00	0.75	1.00	0.76
All	0.71	0.79	0.83	0.83	0.92	0.88	0.92	0.78

math. The data indicate that pre-service teachers of languages tend to pay more attention to students' instrumental nature as opposed to their humanistic nature. However, they use language, movements, and gestures more consciously than other subjects.

4.3.2 More involvement than understanding with regard to visual representations

All pre-service teachers tended to guide their students to understand information by asking questions, but there were some deficiencies in their understanding of the learning situation and the attention they paid to the differences among students (see Table 4.6).

Pre-service teachers' lack of understanding of the learning situation when they enter unfamiliar classes is a common problem. The lack of connection between the students and what is taught makes it difficult for students to form a system of knowledge. According to the data, science and art pre-service teachers are generally lacking in this respect. However, among language subjects that take discourse as the learning path and actively aim to understand the learning situation and consciously establish a classroom knowledge system, English pre-service teachers performed poorly.

Table 4.6 Visual representations

Subject-specific characterisation	Chinese	English	Mathematic	Science	Information technology	Music	Art	All
Pay attention to students' differences	0.66	0.69	0.58	0.50	0.00	0.75	1.00	0.65
Pay attention to the students as a whole	0.79	0.85	1.00	1.00	1.00	0.75	1.00	0.86
Focus on student participation	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Understand the learning situation in place	0.62	0.31	0.83	0.00	1.00	0.75	0.00	0.56
All	0.77	0.71	0.85	0.63	0.75	0.81	0.75	0.77

Math and science pre-service teachers paid less attention to the differences among their students than art pre-service teachers. In other words, they seldom utilised different guidance methods for students of different genders and personalities in class. However, they still had a good representation of the learning situation. This was because pre-service teachers of mathematics and science often set up review and practice links to effectively guide students to be familiar with and consolidate their previous knowledge, which should be incorporated by pre-service teachers of other disciplines as well.

4.3.3 Stronger beliefs than characteristics with regard to labelled representations

Pre-service teachers generally performed better with respect to understanding and interacting with students (see Table 4.7). For example, their performance in terms of attracting students and strengthening teacher-student interactions was strong. All pre-service teachers were able to conduct teacher-student interactions well, which helped reflect their personal philosophy and teaching style. However, it is challenging for pre-service teachers who are still in the imitation and exploration stage to have a unique teaching style, which requires repeated failed attempts, improvement, and practice.

In addition, certain differences and commonalities were found in terms of the pre-service teachers' blackboard writing design. An excellent blackboard writing design in terms of logic, function, and aesthetics enables students to sort out and construct classroom knowledge and systems. Pre-service teachers should consciously perfect the design of their blackboard writing, which is the most intuitive classroom representation.

Table 4.7 Label representations

Subject-specific characterisation	Chinese	English	Mathematic	Science	Information technology	Music	Art	All
Build a sense of self-efficacy	0.83	0.85	1.00	1.00	0.00	1.00	1.00	0.86
Identify students' learning needs and motivations	1.00	1.00	0.92	1.00	1.00	1.00	1.00	0.98
Fully attract and guide students	0.93	1.00	1.00	1.00	1.00	1.00	1.00	0.97
Fully enlighten students	0.79	0.77	0.92	1.00	0.50	1.00	1.00	0.83
Enhance teacher-student interaction	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Strengthen interaction between parents and children	0.72	0.69	0.83	1.00	0.50	0.75	0.75	0.74
Focus on topics that students are interested in	0.52	0.92	0.92	1.00	1.00	0.50	1.00	0.73
Effectively use the way students receive them	0.93	0.85	0.92	1.00	1.00	0.75	1.00	0.91
Connect with lived realities	0.52	0.69	0.92	1.00	1.00	0.75	1.00	0.70
Pursue a personalised classroom	0.41	0.23	0.08	0.00	0.00	0.00	0.25	0.26
Excellent design of blackboard writing	0.45	0.46	0.33	0.50	0.00	0.00	0.00	0.36
All	0.74	0.77	0.80	0.86	0.64	0.70	0.82	0.76

Labelled representation refers to the self-knowledge formed by teachers during their professional development. It reflects three aspects: educational belief, personal philosophy, and teaching style. It is an essential factor for establishing teachers' practical knowledge. Therefore, such representations must reflect teachers' professional philosophy more intuitively.

4.3.4 Stronger teaching than consciousness with regard to action representations

The lack of action and language representation was reflected in the overall classroom behaviour of pre-service teachers. These two forms of representation account for a large proportion of classroom teaching, are more

Table 4.8 Actionable representations

Subject-specific characterisation specific characterisation	Chinese	English	Mathematic	Science	Information technology	Music	Art	All
Use subject knowledge effectively	1.00	1.00	0.92	1.00	1.00	1.00	1.00	0.98
Use the course knowledge effectively	0.24	0.46	0.42	0.50	0.50	0.75	0.75	0.39
Effective use of subject teaching knowledge	0.90	0.77	0.92	1.00	1.00	1.00	1.00	0.89
Reasonable control of the classroom links	0.93	0.85	1.00	0.50	1.00	0.75	1.00	0.91
Visit class and answer questions	0.90	0.62	1.00	1.00	1.00	0.50	1.00	0.85
Consciously check whether students are clear	0.28	0.08	0.50	0.50	0.50	0.00	1.00	0.32
All	0.71	0.63	0.79	0.75	0.83	0.67	0.96	0.72

intuitive, and are the product of a balanced combination of practice and theory (see Table 4.8).

The pre-service teachers' degree of actionable representation varied. There were not only effective and high-scoring presentations of professional subject knowledge (0.98) but also problems related to the practice of course knowledge (0.39). Achieving good integration among different disciplines is a big challenge to pre-service teachers. Language pre-service teachers and math pre-service teachers seldom expand their teaching content in class, while art pre-service teachers prefer to guide students to learning by actions.

In addition, the results also indicated that most students unconsciously confirm that their understanding of the subject is clear. Students may thus occasionally compromise on learning to allow the class to progress.

4.3.5 More encouragement than logic with regard to language representations

Verbal representation is integral to teaching, and its presentation is an important criterion for judging the level of classroom teaching and organisation (see Table 4.9). Pre-service teachers were found to be poor at asking questions, which can easily lead to a shallow and unengaging classroom

Table 4.9 Language representations

Subject-specific characterisation	Chinese	English	Mathematic	Science	Information technology	Music	Art	All
Ask a variety of questions	0.72	0.69	0.67	0.00	0.50	0.75	0.25	0.65
Ask questions in a variety ways	0.86	1.00	1.00	1.00	1.00	1.00	1.00	0.94
Variety of questions	0.79	0.77	1.00	1.00	1.00	1.00	0.75	0.85
Conclusion in place	0.59	0.15	0.67	0.00	1.00	0.75	0.50	0.52
Use encouraging language	0.97	1.00	1.00	1.00	1.00	1.00	0.75	0.97
Make good use of inquiry	0.69	0.38	0.67	0.50	0.50	0.50	0.75	0.61
Strengthen the logic of teaching content	0.59	0.62	0.83	1.00	0.00	0.25	0.50	0.61
Teaching is based on a knowledge system that progresses from simple to deep	0.48	0.15	0.50	0.00	0.00	0.00	0.50	0.36
Summarise the students' answers according to the knowledge points	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sublimate students' viewpoints by combining knowledge points	0.41	0.00	0.17	0.00	0.00	0.75	0.25	0.27
Combined with the lecture	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
All	0.74	0.62	0.77	0.59	0.64	0.73	0.66	0.71

experience. In summary, almost all pre-service teachers used encouraging language, but only a few of them sublimated students' viewpoints by combining knowledge points or based their teaching a consolidated knowledge system. This led to a 'flat' classroom, where knowledge links were complete but lacked depth. Similarly, science and information technology pre-service teachers showed a maximum variance of 0.1 and a maximum range of 1 in their representation of the logicality of classroom summaries and teaching

contents, which indicates that they should consciously address the rigidity and lack of logicality in their summaries.

5 Implications for initial teacher education programmes

An analysis of pre-service teachers' teaching videos and the development status and needs of their practical knowledge revealed that the current representations of the pre-service teachers' practical knowledge mainly reflect two problems: knowledge insufficiency and stereotypical teaching.

With regard to the practical knowledge of pre-service teachers, tacit representations such as symbols, visuals, and labels were found to be stronger than explicit representations such as actions and language. We believe that this phenomenon can be attributed to two factors.

Due to the influence of the knowledge-based curriculum view and teacher professional development theory, China's current initial teacher education focuses on the professional knowledge and educational philosophy of pre-service teachers, which is conducive to the establishment of a theoretical knowledge system. However, as Van Manen (2006) stated, theoretical knowledge does not automatically lead to appropriate teaching actions. Therefore, pre-service teachers who lack practical teaching experience cannot quickly integrate and express the required knowledge.

On the other hand, the current initial teacher education programmes in China seldom guide pre-service teachers to express educational knowledge in the teaching process, which prevents the establishment of a bridge between theory and practice. For example, most pre-service teachers have a deep understanding of subject integration or student-centredness, but few of them demonstrate such knowledge clearly through their classroom teaching behaviour.

The findings revealed that the classroom subject characteristics of some pre-service teachers were too obvious due to their differing focus and emphasis on different disciplines. This breaks the balance between the acquisition and presentation of practical knowledge and leads to the problem of stereotyping in the classroom.

We believe that there are two possible reasons for this. On the one hand, most areas in China still follow the subject-based primary school teaching system. Pre-service teachers may thus find it difficult to break out of their own academic background. Although normal universities in China set up and teach various disciplines, most normal education managers place inordinate value on career development and select subjects to be taught accordingly. This stunts the professional development of teachers owing to a lack of guidance and regulation.

During the past decade, the process of teacher education reform in China has always been linked to the acquisition of practical knowledge. Looking at the representations of practical knowledge at the early stages of teacher professional development (i.e. digging out the essence of the complex

composition of teachers' occupation) can help us to more clearly define the direction of teacher training and education. This study presents three important implications.

First, paying attention to the practical knowledge of pre-service teachers can facilitate teacher development. The acquisition of practical knowledge is not only an accumulation of experience but also a process of reflecting on one's actions. To cultivate high-quality teachers, teacher educators need to think about how to consolidate the foundation of pre-service teachers' practical knowledge as early as possible and build a platform for pre-service teachers.

Second, the teaching videos of pre-service teachers can serve as important reflection-inducing materials. In contrast to narrative research and case studies, videos not only reflect pre-service teachers' behaviours in a real teaching environment but also convey this information to researchers through objective images. Additionally, reviewing the videos can also aid pre-service teachers' self-reflection.

Third, teacher education curriculum reform should also rely on the support of empirical evidence and data. Just as the research teaching video is a staged review of the practical knowledge of pre-service teachers, the formative evaluation of pre-service teachers at each learning stage is an aspect of their professional development. Under the teacher education system, practical knowledge is gradually integrated through practice, exploration, and summary. It is necessary for teacher educators to always pay attention to the development of the practical knowledge level of pre-service teachers to help them grow into excellent educators.

References

Allas, R., Leijen, A., & Toom, A. (2017) Supporting the construction of teacher's practical knowledge through different interactive formats of oral reflection and written reflection. *Scandinavian Journal of Educational Research, 61*(5), 600–615.

Allas, R., Leijen, Ä., & Toom, A. (2020). Guided reflection procedure as a method to facilitate student teachers' perception of their teaching to support the construction of practical knowledge. *Teachers and Teaching, 26*(2), 166–192.

Athanases, S. Z., Sanchez, S. L., & Martin, L. M. (2020). Saturate, situate, synthesize: Fostering preservice teachers' conceptual and practical knowledge for learning to lead class discussion. *Teaching and Teacher Education, 88*, 231–245. doi:10.1016/j.tate.2019.102970

Chen, X. (2003). Practical knowledge: Knowledge foundation for teacher professional development. *Peking University Education Review, 1*(1), 104–113.

Chen, X. (2011). *Bridging praxis and theory: A study of teacher practical knowledge*. Beijing: Education Science Press.

Clandinin, J. & Connelly, M. F. (1987). Teachers and pre-service teachers s' personal knowledge: What counts as 'personal' in studies of the personal. *Journal of Curriculum Studies, 51*(6), 213–220. doi:10.1080/0022027870190602.

Darling-Hammond, L., & A. Lieberman. (2012). *Teacher education around the world: Changing policies and practices*. New York: Routledge.

Eysenck, M. W., & Keane, M. T. (2004). *Cognitive psychology.* Shanghai: East China Normal University Press.

Li, Z. (2017). The video-image turn in current education research: Production of educational theory in the video-image age. *Journal of East China Normal University(Educational Sciences), 51*(5), 1–12.

Männikkö, I., & Husu, J. (2019). Examining teachers and pre-service teachers s' adaptive expertise through personal practical theories. *Teaching and Teacher Education*. doi:10.1016/j.tate.2018.09.016.

Meijer, P., Verloop, N., & Beijaard, D. (2001).Similarities and differences in teachers and pre-service teachers s' practical knowledge about teaching reading comprehension. *The Journal of Educational Research, 21*(3). doi:10.1080/00220670109599914.

MOE, China. (2011). Curriculum standards for teacher education (for trial implementation). [10–08–2020]. Retrieved from: http://www.moe.gov.cn/srcsite/A10/s6991/201110/t20111008_145604.html

Pi, L. (1995). A new view of knowledge. *Human Education, 1*, 14–15.

Piaget, J. (1984). *Le Structuralisme.* Trans. by Ni, L. &Wang, L. Beijing: The Commercial Press.

Schön, D. (1983). *The reflective practitioner: How professionals think in action.* London: Basic Books.

Toom, A., Tiilikainen, M., Heikonen, L., Leijen, Ä., Mena, J., & Husu, J. (2019) Teacher candidate learning of action-oriented knowledge from triggering incidents in teaching practice. *Teachers and Teaching: Theory and Practice, 25*(5), 536–552.

van Manen, M. (2006). *The tact of teaching: The meaning of pedagogical thoughtfulness.* Trans. By Shuying, Li. Beijing: Education Science in China.

Wei, G. (2020). *Generation of teacher practical knowledge.* Beijing: Education Science Press.

Zuo, P. (2016). An analysis of teacher professional development methods supported by teaching video analysis. *Journal of Higher Education, 04*, 231–232.

5 Epistemic network analysis

Calculating pre-service teachers' practical knowledge

1 Introduction

The professional quality of pre-service teachers is closely related to the amount, depth, and structural characteristics of their professional knowledge. Although we can optimise the structure of their professional cognition by investigating their knowledge mastery, we need to pay more attention to the internal mechanisms of their professional knowledge, especially their practical knowledge. This chapter shares the results of a study that collected assignments submitted online by 150 pre-service teachers majoring in primary education. We constructed a model to analyse their professional cognition structure from the perspectives of epistemic content and epistemic skills.

The practical knowledge of pre-service teachers serves as a foundation for their professionalization (Wei, 2020). It is the key task of teacher education to build a complete professional cognitive structure and consolidate professional competences. In traditional teaching, the epistemic content and epistemic skills of pre-service teachers are evaluated mainly through practice. However, neither of these methods can reflect the strengths and weaknesses of students' epistemic content and epistemic skills. Techniques for earning analysis can be used to explore pre-service teachers' knowledge construction processes and characteristic learning patterns. However, most of the methods are based on the built-in presupposition model of the learning management system, which renders it difficult to explore the cognitive structure of the research object comprehensively and dynamically (Wu & Luo, 2001). For example, although social network analysis (Wasserman & Faust, 1994) is presented as a network structure, it is better at outlining the relationships between individuals rather than cognitive elements. Lagged sequence analysis (Mcardle & Nesselroade, 2014) can be used to explore the process of knowledge construction, but it is mainly from a behavioural perspective as opposed to a cognitive one. Therefore, a new analytical method is needed to evaluate the characteristics of the professional cognition of pre-service teachers.

Based on cognitive framing theory, epistemic network analysis (ENA) is a method that visually represents the network relationship between pre-service

teachers' cognitive elements by constructing a network model (Shaffer, Collier, & Ruis, 2016). The epistemic network structure diagram can elucidate not only the characteristics of learners' cognitive network structures but also the differences in the network structure of different groups.

Research on ENA is still in its infancy, and studies on pre-service teachers are still relatively rare. An ENA was used in this study to explore the characteristics of pre-service teachers' professional cognition in order to provide empirical evidence and suggestions for improving the cultivation of pre-service teachers. To understand the characteristics of the practical knowledge structure formed by primary education pre-service teachers in the context of online learning during the COVID-19 pandemic, the following three questions were addressed:

1   What are the characteristics of the professional cognition structure of pre-service teachers?
2   In what ways do the characteristics of the professional cognition structure of pre-service teachers of different genders differ?
3   In what ways do the characteristics of the professional cognition structure of pre-service teachers in the higher- and lower-score groups of academic performance differ?

2   An analytical framework of primary teachers' professional cognition

Teachers' professional cognition involves the mastery of content knowledge, learner characteristics, teaching strategies, and other aspects (Wang, 2004). Such cognition is acquired through long-term accumulation, practice, and reflection in the process of learning and working (Zheng, 2012). Shulman's taxonomy is a classic method for the division of teachers' professional knowledge. Shulman (1987) noted that teachers should have content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners and their characteristics, knowledge of educational contexts, and knowledge of educational ends, purposes, and values.

Given the characteristics of primary education, many studies have conducted more detailed discussions on the cultivation of practical knowledge of primary education pre-service teachers. Primary school students display unpredictability, poor self-control, and inconsistency, which indicate that they are physiologically and psychologically immature. This requires primary education pre-service teachers to ensure the continuous progress of children and understand the characteristics of primary school students' physical and mental development (Eaude, 2011). The concept based on children's education emphasises paying attention to the needs of children's growth, which is the professional cognition that must be acquired by

pre-service teachers (Liu, 2017). As for the curriculum content and teaching knowledge of primary school education, scholars currently emphasise the shaping of comprehensive professional knowledge structures and the cultural bases of disciplines (Wang, 2007). However, primary education is not limited to the training framework of specialised subjects. It not only meets the needs of primary school students' cognitive and psychological development characteristics but also aligns with the goals of the new curriculum reform of basic education (MOE, 2001). Therefore, pre-service teachers who major in primary education need to have a compound knowledge structure that can adapt to the needs of comprehensive teaching in primary schools. In addition, primary school students are young and undergoing rapid physical and mental development. Teachers not only have the obligation to impart knowledge but are also responsible for helping children to develop good qualities and habits. Some scholars consider nurturance to be the chief characteristic of teaching and education at this stage. They think that contemporary primary education should grasp the direction of children's growth, help children learn to learn, and cultivate their awareness and lifelong learning ability (Liu, 2011).

Epistemic skills are closely related to the process of reading, understanding, thinking, and problem solving. They play an important role in the acquisition, refinement, and development of knowledge. For example, some scholars have proposed that epistemic skills should be considered when attempting to understand English teachers' critical thinking abilities (Zhang, 2019). Most existing research on teachers' cognition has focused on cognitive content. The exploration of professional cognitive characteristics should also include epistemic skills in the process of knowledge construction and expression. The two-dimensional structure model (Facione, 1990) and the revised Bloom's taxonomy for educational objectives (Anderson, 2001) are typical representatives of the theoretical framework of cognitive ability. The former posits that epistemic skills include elaboration, analysis, evaluation, reasoning, interpretation, and self-regulation, whereas the latter divides the cognitive process into memory, understanding, application, analysis, evaluation, and creation.

Through a literature review, we found that most existing research has assessed teaching cognitive ability in the form of preparing examination papers and issuing questionnaires (Ma, Zhao, & Han, 2010). Although this kind of research can compare the development of pre-service teachers' professional cognitive ability in each period and each dimension with the help of scores, it does not address the structure and internal correlation among the elements.

This study included epistemic content and epistemic skills in the professional cognition model. In terms of epistemic content, the coding framework was constructed around the following dimensions: child-oriented, comprehensive, and educational. This was done to ensure the content corresponded to the professional cognition characteristics needed by pre-service teachers.

If the dimension of epistemic skills was encoded using the two-dimensional structure model or the revised Bloom's (1956) taxonomy for educational

objectives, the amount of coding required would be too large and the number of coding results would be relatively small. After an overview of the pre-service teachers' writing, we determined elaboration, application, and analysis to be the dimensions that comprise their epistemic skills network. The selected dimensions belong to the basic and higher-order cognitive features of learners' characteristics (Yan, Li, Sun, & Zhang, 2020). The specific meanings of the epistemic content and epistemic skills are listed in Table 5.1.

During the coding process, we combined the coding items of the two dimensions and constructed a 3 × 3 coding schema for the characteristics of their professional cognition structure, which included the following nine coding items: child-oriented–elaboration, child-oriented–application, child-oriented–analysis, comprehensive–elaboration, comprehensive–application, comprehensive–analysis, educational–elaboration,

Table 5.1 Coding schema

Dimension	Code	Meaning
Epistemic Content	Child-oriented	Student-centred education concept: follow the physical and mental development rules of primary school students and pay attention to the particularity of the primary school stage
	Comprehensive	1 Comprehensive knowledge: have multi-disciplinary cultural knowledge and ability 2 Comprehensive ability: emphasise the teaching strategy with activities and games 3 Comprehensive concept: the educational concept of combining moral, intellectual, physical, aesthetic, and labour education 4 Comprehensive identity: attach importance to teachers' various identities
	Educational	Cultivating Humanity: promote the formation of primary school children's learning attitude, learning enthusiasm, moral character, behavioural habits, and values
Epistemic Skill	Elaboration	1 Classify 2 Understanding meaning 3 Clarify the meaning
	Application	1 Apply the learned knowledge to new situations. This involves the application of concepts, principles, methods, and theories 2 Use information to complete a specific task and solve practical problems effectively
	Analysis	1 Analyse opinions 2 Find out the evidence, analyse the process of the argumentation, and distinguish causality 3 Decompose complex knowledge into components and understand the relationship between them

educational–application, and educational–analysis. We used the nine items to encode the empirical data.

3 Epistemic network analysis as a method

ENA is an analysis method that describes the cognitive framework model of individuals or groups through quantitative analysis of interactive data (Shaffer et al., 2016). ENA replicates the connections between the elements of specialised thinking in a particular area by creating a network model that describes how concepts are interconnected in the discourse data.

To determine the relationships between objects in the data, the content-related discourse data is first divided into the same stanza, and then an adjacency matrix is built for each stanza to quantify the co-occurrence of coded elements in a single stanza. Second, according to the analysis unit, the adjacency matrix that corresponds with multiple stanzas is accumulated to generate a cumulative adjacency matrix, and the latter is transformed into an adjacency vector of high-dimensional space. Third, each adjacency vector was normalised to ensure that the generated network model was not affected by the number of stanzas in each analysis unit. Then, the original high-dimensional space was rotated by singular value decomposition to reduce the number of spatial dimensions and capture the maximum variation in the data (singular value decomposition is similar to principal component analysis, but does not recalculate the data). Finally, the network nodes are displayed in a two-dimensional space, and the relative position and cognitive network structure of each analysis unit are represented through the centroid and the line between nodes to assist researchers in conducting horizontal and longitudinal comparative studies.

In the field of learning analysis, ENA has been widely used because of its unique visual representation ability. Existing academic research has mainly focused on thinking development, learning evaluation, knowledge construction, and so on. For example, some researchers focused on the development process of pre-service teachers' reflective ability to help students recognise and transform themselves (Leng, Yi, & Lu, 2020). By analysing the homework papers submitted by students, some scholars helped teachers complete the summary evaluation of learners and compared the cognitive differences of students in subject learning, which provided strong support for teachers to carry out targeted guidance in the future (Fougt et al., 2018). Another application of ENA in the field of education involves understanding students' knowledge construction processes employing teaching interaction and cooperative learning. Some scholars recorded the whole process of discussion and communication in the process of collaborative programming and divided the students into high-level and low-level groups using a comparative research method to reveal the correlation characteristics and development track of computational thinking ability in different stages of completing collaborative programming tasks (Wu & Wang, 2019).

For certain elements of pre-service teachers' professional cognition, such as professional knowledge, the traditional evaluation method can be effective. However, once the structural characteristics of each element are involved, the role of the score is very limited because it is difficult to conduct an in-depth analysis of internal relations. In contrast, ENAs that analyse the discourse content can more comprehensively present the professional cognitive schema and structural characteristics of pre-service teachers as a whole.

The participants of this study were 150 senior undergraduates who were majoring in primary education, all of whom belonged to a normal university. Influenced by the COVID-19 pandemic, the pre-service teachers had to enrol their programmes online. I was the instructor of a compulsory course in their programme. In the spring semester of 2020, the pre-service teachers studied via an online learning platform, called 'Xue Xi Tong'. During the learning process, the pre-service teachers were required to take 'My Educational Philosophy' as a topic to write a short essay (200 words), which focused on questions such as 'What do we need to teach?', 'What kinds of methods and techniques are needed for good teaching?', 'What is our teaching purpose and goal?', and 'Who is the teaching self?' (i.e. '4W principle'). From the perspective of students' pre-service learning process, they need to possess diverse professional knowledge and professional qualities (Chen, Ma, & Ding, 2018). The task was not confined to the exploration of specific professional knowledge but was more general and typical so that pre-service teachers could illustrate their own understanding of education more comprehensively. The pre-service teachers' knowledge accumulation and logical thinking in the process of teacher education could also be reflected. In this chapter, it was used as a dataset to examine the characteristics of pre-service teachers' professional cognition structure.

The data analysis includes several steps. The first step in this research was pre-processing the text. First, symbols representing the end of a sentence, such as full stops, exclamation marks, and ellipses, were used as the interval points for text splitting. The content between each two interval points was used as a row of data in the ENA, and a total of 1,560 rows of data were obtained. Second, in accordance with the '4W principle' (i.e. the four questions to inquiry 'My Educational Philosophy') proposed by teachers, the answers of each student were set as a stanza to ensure that the elements in the same stanza were interrelated.

After data pre-processing, the coding process was completed by three coders. First, three coders confirmed their understanding of the coding framework and carried out precoding. The SPSS 24.0 analysis showed that the kappa coefficient of precoding was greater than 0.7. To further improve the coding consistency, the coders determined the remaining differences in the precoding results through another discussion. Subsequently, the coders completed the remaining coding tasks.

4 Featuring practical knowledge in epistemic networking

4.1 Knowledge structure of pre-service teachers

We first examined the occurrence frequency of cognitive elements, and the statistical distribution of the results is presented in Table 5.2. Occurrence frequency refers to the proportion of occurrence of a certain encoding item in all data rows, and it has a value range of 0%–100%. However, because a row of data may conform to the description of more than one encoding item, the total frequency of occurrence may be greater than 100%.

With regard to epistemic skills, the proportion of pre-service teachers' expression of elaboration (109.1%) and application (66.2%) was higher than that of their expression of analysis (59.2%). This shows that pre-service teachers were more inclined to expound on educational concepts, theories, and viewpoints or tried to apply them to teaching rather than deeply decompose and analyse them. With regard to cognitive content, pre-service teachers more prominently addressed comprehensive (84.2%) and child-oriented (79.7%) content as opposed to educational (70.6%) content. In general, we found that pre-service teachers mainly expressed comments related to comprehensive and child-oriented content in the form of elaboration (37.4% and 36.5%, respectively), followed by application (25.4% and 27.8%, respectively) and analysis (16.9% and 19.9%, respectively). This was consistent with the conclusion drawn from the comparison of the overall proportion of epistemic skills. When expressing opinions related to educational content, the proportion of analysis (22.4%) was higher than that of application (13.0%). Pre-service teachers displayed more experience in the application of child-oriented and comprehensive content, but there are still certain challenges related to incorporating educational content into practical teaching.

The epistemic network diagram of pre-service teachers according to the encoded data of the text is shown in Figure 5.1. The nodes in the figure represent the positions of each epistemic element, and the lines between the nodes represent the strength of the association between epistemic elements. The thickness of the lines is related to the co-occurrence frequency between the two connected epistemic elements. As shown in Figure 5.1, pre-service teachers were found to have established stronger connections with regard to comprehensive–elaboration and educational–elaboration,

Table 5.2 Statistical analysis of cognitive elements of pre-service teachers

Epistemic skills / epistemic content	Child-oriented (%)	Comprehensive (%)	Educational (%)	Total (%)
Elaboration	37. 4	36. 5	35. 2	109. 1
Application	25. 4	27. 8	13. 0	66. 2
Analysis	16. 9	19. 9	22. 4	59. 2
Total	79. 7	84. 2	70. 6	—
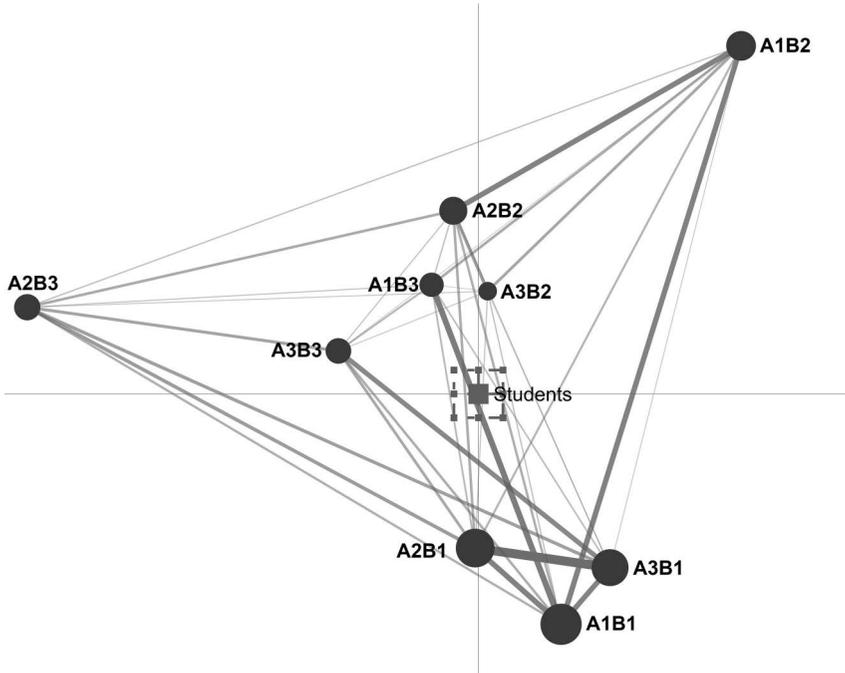
Figure 5.1 Epistemic network of pre-service teachers

child-oriented–elaboration and child-oriented–analysis, child-oriented–elaboration, and child-oriented–application.

4.2 Comparison between genders

An ENA was used to measure and model connections for pre-service teachers of different genders, and the epistemic network diagram of the two groups is shown in Figure 5.2.

To understand the differences in the characteristics of the professional cognition networks of different genders, a t-test was used to compare the differences between the X- and Y-coordinates of the cognition networks generated above, and the difference between the two groups of students was obtained. The results are presented in Table 5.3.

As can be seen from Table 5.3 and Figure 5.1, there was a significant difference in the X-axis coordinates. The female group was inclined to the left half of the X-axis, whereas the male group was inclined to the right half of the X-axis. To understand the differences between the structure of the professional cognition networks of the two groups, this study superseded and subtracted the links in the same position and assigned the resultant
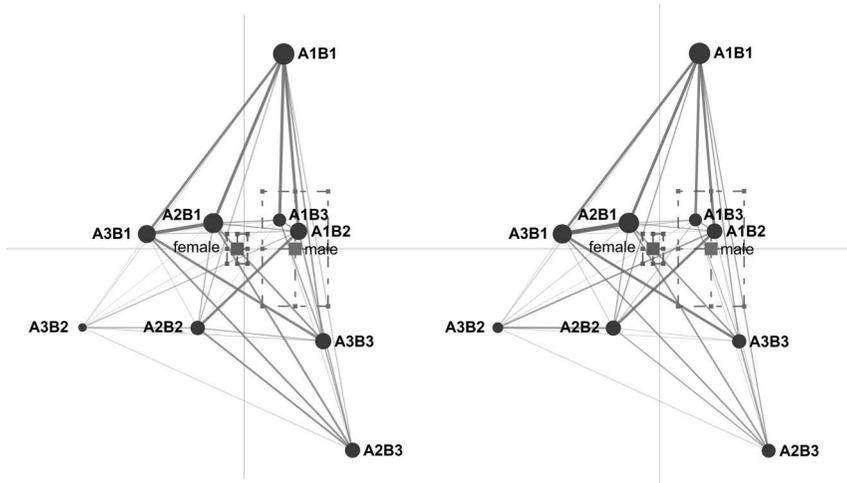
Figure 5.2 Comparison of epistemic networks of the male (left) and female (right)
pre-service teachers

Table 5.3 T-test results of male and female groups

Grouping	X-axis						Y-axis					
	Mean	*SD*	*N*	*t*	*Effect Size(d)*	*P*	*Mean*	*SD*	*N*	*t*	*Effect Size(d)*	*P*
Male	0. 39	0. 48	17	3. 61	0. 97	0. 00	0. 00	0. 88	17	0	0. 00	1. 00
Female	−0. 05	0. 45	133				0. 00	0. 67	133			

connections to the group with a higher co-occurrence frequency. The results
are shown in Figure 5.3. A dotted line represents that the connection weight
of males is greater than that of females, whereas a solid line represents the
opposite.

No significant differences in the number of strong connections between
the two groups were found, but different elements of the strong connec-
tions were emphasised. Male pre-service teachers displayed a stronger
connection to child-oriented–application and comprehensive–analysis,
and comprehensive–application, which shows that these series of connec-
tions are more significant in their professional cognition structure. Female
pre-service teachers were more closely related to comprehensive–applica-
tion, educational–application, comprehensive–elaboration, educational–
elaboration, child-oriented–application, and educational–application, which
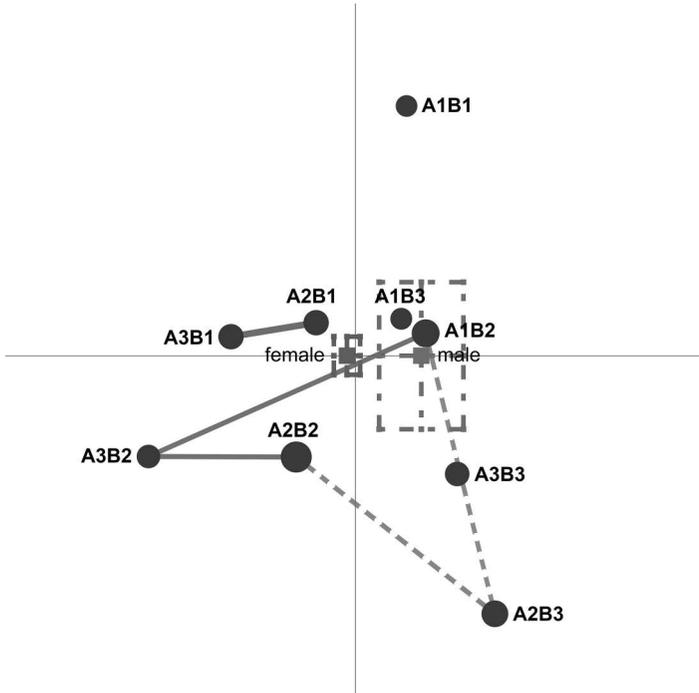
Figure 5.3 Differences in the epistemic network between male (dotted line) and female (solid line) pre-service teachers

indicates that they mentioned the relevant professional cognitive elements simultaneously when expressing educational concepts. Pre-service teachers of both genders paid attention to child-oriented, comprehensive, and educational content, and the breadth of the epistemic content involved was similar. However, male pre-service teachers were able to combine the three thinking modes of elaboration, application, and analysis flexibly, whereas female pre-service teachers were more inclined to integrate a single thinking mode throughout the entire expression.

4.3 Comparison according to different academic performance

To distinguish the performance of the participants, this study selected the final score of this online course as the basis of grouping. This is because the final score is a comprehensive and summative evaluation of daily discussions, tests, and assignments. In total, 70 pre-service teachers were classified in the ordinary group based on their score, whereas 80 were classified in the excellent group. Finally, the epistemic network structure of pre-service teachers in different performance-based groups is shown in Figure 5.4.
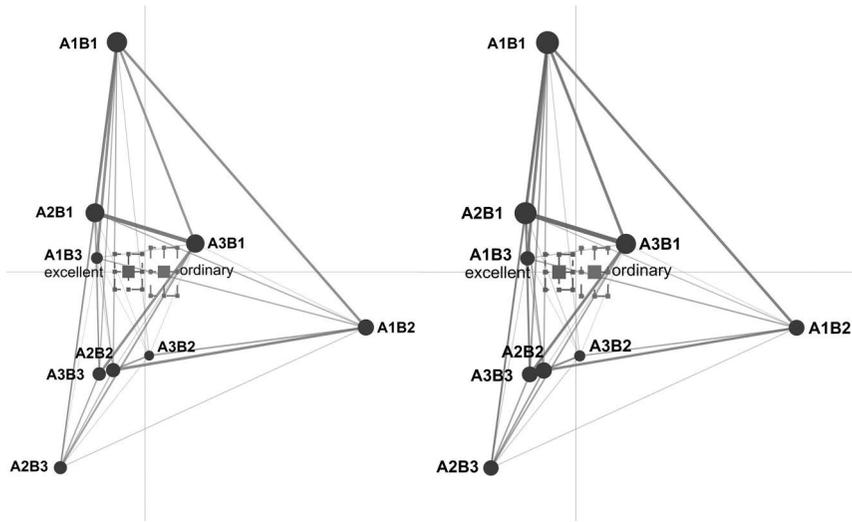
Figure 5.4 Comparison of the epistemic networks of ordinary (left) and excellent (right) pre-service teachers

Table 5.4 T-test results of ordinary and excellent group

Grouping	X-axis						Y-axis					
	Mean	*SD*	*N*	*t*	*Effect Size(d)*	*P*	*Mean*	*SD*	*N*	*t*	*Effect Size(d)*	*P*
Ordinary	0. 15	0. 39	70	4. 17	0. 68	0. 00	0. 00	0. 74	70	0	0. 00	1. 00
Excellent	−0. 13	0. 43	80				0. 00	0. 61	80			

The centroid of the excellent group deviated to the left of the X-axis and was close to the nodes of comprehensive–elaboration, comprehensive–application, and child-oriented–analysis, which indicates that the excellent group tends to express these elements more. Furthermore, the epistemic networks of the two groups were tested using a t-test. The results are presented in Table 5.4.

The results of the t-test showed that there was a significant difference between the ordinary and excellent groups on the X-axis (P = 0. 00). However, there was no significant difference between the two groups on the Y-axis. To locate the differences between the two groups, the overlapped and subtracted networks of the two groups are shown in Figure 5.5. The dotted line represents that the connection weight of the ordinary group is greater than that of the excellent group, whereas the solid line indicates the opposite.
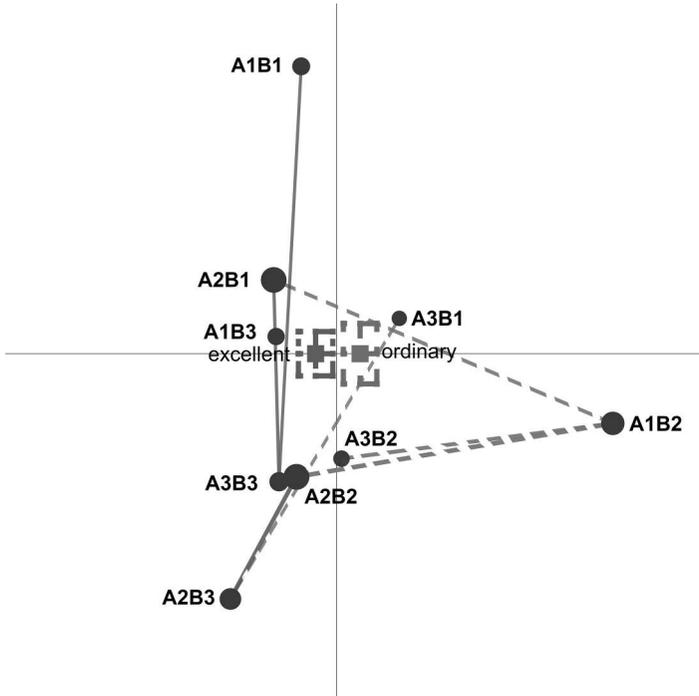
Figure 5.5 Differences in the epistemic network between the ordinary (dotted line) and excellent (solid line) groups

A certain gap was observed between the ordinary group and the excellent group in terms of connection density and intensity. In contrast, the professional cognition network of the excellent group was more complex, especially in terms of the relationship between the nodes of comprehensive–application and comprehensive–analysis.

5 Reflecting pre-service teachers' practical knowledge in online settings

The results showed that the pre-service teachers had a deeper and more comprehensive cognition of children-oriented principles, whereas their understanding of education-oriented principles was found to be slightly inferior. Meanwhile, they displayed more interpretive expressions than practical and analytical ones. In addition, pre-service teachers of different genders displayed their own advantages with respect to cognitive content and cognitive skills, and the professional cognition epistemic network of the excellent group was found to be more complex and more prominent than that of the ordinary one. This chapter revealed the characteristics of the professional

cognition structure of pre-service teachers and the differences between various groups of them. Normal universities should optimise the cultivation of concepts, focus on the education of teachers' morality, and improve their practical ability. Furthermore, pre-service teachers need to emphasise the cultivation of their higher-order thinking and the enrichment of their professional cognition networks.

5.1 Brief conclusions

Based on the ENA method, this study integrated the professional standards of primary school teachers and the revised Bloom's taxonomy for educational objectives to form an analytical framework for pre-service teachers' epistemic content and epistemic skills. The main conclusions are presented below.

First, the development of pre-service teachers' professional cognition structure is not balanced. Pre-service teachers have a stronger perception of child-oriented content and pay less attention to educational content. The ability to elaborate was found to be better, whereas their ability to apply and analyse was weaker. Based on the epistemic network diagram, we found that pre-service teachers have established a stronger connection between the relevant nodes of child orientation. In other words, they have paid more attention to children's physical and mental development. For example, a pre-service teacher stated the following with regard to his own educational philosophy: 'I know that adults cannot help define children's thinking with their own thinking. We always think that we know children very well, but this is a mistake. A class can be successful if the teacher understands the needs and aspirations of the students'. This is in line with the expectation of primary education for the teachers. However, the statistical analysis of epistemic elements indicated that pre-service teachers' understanding of educational elements was relatively inferior.

In addition, the proportion of elaboration was found to be significantly higher than that of application and analysis. This implies that pre-service teachers can often talk freely when they express their educational theories and opinions. However, they face certain challenges when answering questions related to how and why their own educational ideas should be implemented in practice. Some scholars have listed various problems that persist in contemporary normal education. These include the emphasis on academic rather than practical teaching skills in colleges and universities, the separation of scientific research from the reality of primary education, and the lack of solid applied research for primary schools (Zhang, 2009). The prevalence of these issues explains pre-service teachers' lack of practical ability.

Second, pre-service teachers of different genders display their own advantages in terms of epistemic content and skills. We found significant gender-related differences through our analysis of the epistemic network.

On the one hand, we found that female pre-service teachers organically combined different epistemic contents in the same epistemic skill mode. For example, when women explained their opinions, they tended not to be limited to a single direction but combined educational and comprehensive opinions. On the other hand, men tended not to stick to a specific cognitive skill, and their thinking patterns were found to be more flexible and varied.

Studies have shown that gender differences in emotion, thinking, cognition, and ability affect the professional knowledge structure of male and female pre-service teachers. For example, one study found that the masculinity scale included factors such as rationality, whereas the femininity scale included factors such as empathy and mindfulness, which are expressive traits (Liu, Huang, Jia, Gong, Huang, & Li, 2011). Female students' emotions have been found to more delicate than male students, and their experiences are more profound and emotional (Qiu & Tao, 2003). In addition, the level of thinking reflects the relevance and systematisms of thinking. Some studies have found that boys score higher than girls in terms of their level of thinking (Chen, 2014). This is consistent with the conclusions of the present study. Male pre-service teachers attached importance to the breadth of epistemic skills and tended to combine elaboration, application, and analysis more flexibly. Female pre-service teachers were found to be much better with regard to epistemic content. For example, female pre-service teachers were found to have established a close relationship among the three nodes of child-oriented–application, comprehensive–application, and educational–application, which indicates that they have a lot of experience with regard to putting an idea into practice. On the one hand, this difference is influenced by the physiological characteristics of different genders. On the other hand, it is also influenced by social factors such as social role expectations.

Third, excellent pre-service teachers display advantages in terms of the breadth and depth of their epistemic structure. Overall, the strong connections of the excellent group were richer and more diversified, which indicated that excellent students have a deeper understanding of each dimension of professional cognition and a higher level of cognition with regard to course knowledge. These qualities can help teachers think more comprehensively in the face of teaching problems and during decision-making. Taking English teachers as an example, some scholars have demonstrated that the differences in the subject knowledge structure of different levels of teachers are reflected in their degree of knowledge structuration. Excellent teachers were found to have a richer and more comprehensive understanding of the relationship between knowledge elements, whereas ordinary teachers displayed a less clear logical expression of concepts (Lee, 2019). Thus, the cognitive difference between teachers is not only related to the amount of knowledge they possess but also depends on the characteristics of their cognition structure.

In addition, the excellent group displayed a more obvious correlation between comprehensive–application and comprehensive–analysis. The excellent

group illustrated significant advantages with regard to compound knowledge structure, interdisciplinary comprehensive quality, and diversified teaching methods. Additionally, the excellent group was also more mature and displayed a higher level of thinking.

5.2 Implications

Based on the main conclusions of this study, we provide the following suggestions for the reform of normal education according to a systematic analysis of the characteristics of pre-service teachers' professional cognition structure.

First, paying attention to the teachers' ethics deepens the pre-service teachers' cognition of children's life characteristics. In primary schools, education on moral education and habit formation is of great significance. In the process of normal education, we need to explain the importance of morality first. Simultaneously, it is necessary to emphasise the notion that teaching by example is better than teaching by precept, which will enable primary school teachers to realise the exemplary role that they play. In terms of form, online education has the advantages of rapid and wide dissemination, which can be used to build an online ideological and political curriculum that differs from traditional courses. In terms of content, professional knowledge can be combined with traditional Chinese culture, and the cultural genes of the latter can be extracted and integrated into practical teaching. In addition, the emphasis on child-oriented content should be maintained. Children's thinking patterns, emotional worlds, and learning motivations differ from those of adults. This requires teachers to form a child-centred view of education and organise teaching in accordance with the children's cognitive characteristics. For example, teachers can explore the innocence of teaching materials and organise activities that would stimulate children's interest in learning.

Second, expanding the content and form of practical courses improves professional practice. The orientation of colleges and universities determines their mode of academic centeredness, but primary teachers need to have the ability to get along with their students. To achieve both theoretical and practical mastery, the proportion of practical courses needs to be increased or the practicality of educational academic courses needs to be enhanced. This would facilitate the training of pre-service teachers' professional skills, professional quality, and professional spirit. On the one hand, the classic micro-teaching method can be used to improve the teaching skills of normal university students and compensate for their lack of practical teaching experience (Zhao, 2011). On the other hand, consolidating the construction of practice bases and establishing a cooperative education mechanism between universities and primary schools would facilitate the improvement of pre-service teachers' practical ability and foster their practical knowledge.

Third, it is important to strengthen the cultivation of female pre-service teachers' logical thinking structure and foster male pre-service teachers'

ability to capture educational details. Data analysis has indicated that pre-service teachers of different genders show significant differences in their professional cognition structure. Based on this, this study believes that the cultivation of pre-service teachers should adhere to the concept of 'teaching according to gender' and use different teaching strategies to compensate for the professional knowledge development imbalance induced by gender. Male pre-service teachers should be trained to understand diverse epistemic contents. Simultaneously, female pre-service teachers' logical thinking ability should be fostered to help them break through the shackles of singular epistemic skills.

Finally, the overall professional competence and quality of pre-service teachers need to be improved. One of the major differences between the epistemic network structures of the excellent group and the ordinary group pertained to their quality and the comprehensiveness of their knowledge. Therefore, to promote the overall improvement of professional competence and quality, normal education should also involve general interdisciplinary courses that can more effectively integrate science and humanities, historical classics, and cutting-edge applications (Peng, 2014). The excellent group also performed outstandingly in two types of higher-order thinking: application and analysis. This confirmed that in addition to learning factual knowledge and completing simple tasks through memory and understanding, normal students need to learn to analyse, evaluate, and create. Furthermore, students should improve their critical thinking ability, knowledge transfer skills, and problem-solving ability, which requires teacher educators to reform normal education.

To summarise, at the theoretical level, this study dissected and analysed the professional cognition structure of pre-service teachers from the perspective of epistemic content and epistemic skills. With the help of an ENA, this study visualised the cognitive system hidden behind the text, which can help college teachers and pre-service teachers identify the gap between themselves. However, this study has two limitations. First, the proportion of male pre-service teachers in the study was small, which may have led to errors in the gender-differences-related conclusions of this research. Second, the text selected was only one of the forms of data that could reflect the professional cognition structure of pre-service teachers. Follow-up research should introduce more materials, such as micro-teaching videos and reflection logs. In addition, other learning analysis methods should be utilised to explore group characteristics and internal differences from additional dimensions, such as through content analysis and cluster analysis.

References

Anderson, L. W. (2001). Taxonomy for learning, teaching, and assessing. *European Legacy, 114*(458), 1013–1014.

Bloom, B. S. (1956). *Taxonomy of educational objectives: The classification of educational goals.* New York: David McKay Co., Inc.

Chen, K., Ma, H. J., & Ding, X. T. (2018). A study on pre-service teacher learning process–Contents analysis of the case based on an excellent chemistry normal student's weblogs. *China Educational Technology, 6*, 97–106.

Chen, L. J. (2014). The group study of characteristics of problem-finding thinking in the undergraduates. *Studies of Psychology and Behavior, 12*(4), 513–520.

Eaude, T. (2011). *Thinking through pedagogy- primary and early years*. Exeter: Learning Matters.

Facione, P. A. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction.* Millbrae: The California Academic Press.

Fougt, S. S., Siebert-Evenstone, A., & Eagan, B. (2018). Epistemic network analysis of students' longer written assignments as formative/summative valuation. P*roceedings of the 8th International Conference on Learning Analytics and Knowledge.* New York: Association for Computing Machinery, 126–130.

Lee, X. (2019). A study on secondary school English teachers' structure of subject matter knowledge. Doctoral dissertation: Northeast Normal University.

Leng, J., Yi, Y.H., & Lu, X.X. (2020). Research on the development trajectory of reflection ability in collaborative writing among preservice teachers: An epistemic network analysis. *China Educational Technology, 3*, 93–99.

Liu, D. Z., Huang, H. X., Jia, F. Q., Gong, Q., Huang, Q., & Li, X. (2011). A new sex-role inventory (CSRI-50) indicates changes of sex role among Chinese college students. *Acta Psychological Sinica, 43*(6), 639–649.

Liu, H. (2011). The discipline of elementary pedagogy: The discipline base for the specialty of primary education in normal colleges and universities. *Curriculum, Teaching Material and Method, 31*(5), 87–91.

Liu, H. (2017). The cultivation of excellent primary teachers based on children education. Curriculum, *Teaching Material and Method, 37*(2), 114–118.

Ma, Y. P., Zhao, D. C., Han, J. W. (2010). Survey and analysis on teachers' professional knowledge. *Educational Research, 31*(12), 70–76.

Mcardle, J. J., & Nesselroade, J. R. (2014). *Analyses based on cross-lagged regression in changes of factors*. New York: Springer.

MOE. (2001). Outline of curriculum reform for basic education (experimental). Retrieved from: http://www.moe.edu.cn/publicfiles/business/htmlfiles/moe/moe_309/200412/4672.html. 01–10–2012

Peng, S. J. (2004). Setting up inter-disciplinary courses of general education at teachers universities. *Teacher Education Research, 52*(4), 41–45.

Qiu, K. J., & Tao, L. (2003). Research on personality investigation and personality cultivation of normal university students. *Journal of Psychological Science, 26*(5), 951–952+954.

Shaffer, D. W., Collier, W., & Ruis, A. R. (2016). A tutorial on epistemic network analysis: Analyzing the structure of connections in cognitive, social, and interaction data. *Journal of Learning Analytics, 3*(3), 9–45.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the reform. *Harvard Educational Review, 29*(7), 4–14.

Wang, Y. (2004). Teachers' metacognition, and its cultivation in the information age. *China Educational Technology, 26*(6), 27–30.

Wang, Z. Q. (2007). Research and exploration on the cultivation model of professionals for primary education. *Educational Research, 5*(5), 25–30.

Wasserman, S., & Faust, K. (2014). *Social network analysis: Methods and applications.* Cambridge: Cambridge University Press.

Wei, G. (2020). *Generation of teacher practical knowledge.* Beijing: Education Science Press.

Wu, B., & Wang G. (2009). The development trajectory of computational thinking in cooperative programming: A quantitative ethnography approach. *Modern Distant Education Research, 25*(2), 76–84.

Wu, W. D., & Luo, B. W. (2001). A study on the structure and cultivation of teachers' reflective ability. *Education Review, 101*(1), 33–35.

Yan, Z. M., Li, M. F., Sun, C. Y., & Zhang, M. Y. (2020). Reflection and approach of instructional design for core literacy. *China Educational Technology, 12*(12), 105–111.

Zhang, H. (2019). Understanding English language major teachers' cognition on language and critical thinking integrated teaching. *Foreign Languages Research, 36*(4), 57–62.

Zhang, Q. S. (2009). The causes and countermeasures of the weakening of normal education in primary education major in undergraduate colleges. *Education Research Monthly, 111*(4), 79–80.

Zhao, Y. (2011). The practical research on developing the skills of speaking lesson of pre-service teachers preservice teachers based on micro-teaching. *E-Education Research, 1*, 94–99.

Zheng, X. M. (2012). Foreign language pedagogic innovation study in view of technical culture. *Technology Enhanced Foreign Language Education, 60*(5), 56–61.

6 Formative interventions

Developing pre-service teachers' practical knowledge

1 Introduction

The previous chapters have depicted a clear picture and a robust claim: practical knowledge is critical for the professional development of teachers, and the development of such knowledge in advance is important in initial teacher education programmes, particularly in preparing pre-service teachers for day-to-day teaching. A large body of canonical research (e.g. Clandinin & Connelly, 1995; Elbaz, 1983; Meijer, Verloop, & Beijaard, 1999; Shulman, 1987) explores the crucial role of the practical knowledge of in-service teachers who have more professional experience than pre-service teachers. There are growing global concerns in the 21st century regarding teacher quality and effective teacher training (OECD, 2005), in response to which increasing empirical studies have been conducted on the differences in the structural content of pre-service teachers' practical knowledge (e.g. Allas, Leijen, & Toom, 2020; Chaharbashloo, Gholami, Aliasgari, Talebzadeh, & Mousapour, 2020; Debreli, 2019; Maaranen, Pitkäniemi, Stenberg, & Karlsson, 2016). These studies concur that there is the need for effective approaches to develop pre-service teachers' practical knowledge before they commence their teaching career. However, very little research has so far been undertaken to uncover the evolutionary process through which the components of such practical knowledge are acquired.

By conducting a longitudinal study in a Chinese normal university, this chapter, as the last methodology in the book, takes a more progressive stance to help improve the understanding of how pre-service teachers develop their practical knowledge through interventions made by more experienced external parties (e.g., school and university mentors). Through formative interventions (Virkkunen & Newnham, 2013), I examined a series of changes in pre-service teachers' practical knowledge through their performance in a mandatory learning module, *Curriculum and Instruction* (which includes two courses and seven credits), in a bachelor-level initial teacher education programme. Drawing on expansive learning theory (Engeström, 2015), I explored a multi-cyclical learning trajectory of theory and practice during

the 13-month period of the interventions. The following research questions guide this chapter:

1   How is pre-service teachers' practical knowledge developed in the initial teacher education programme?
2   What practical knowledge outcomes are developed through formative interventions?

This chapter is an effective response to the historical crisis of the theory–practice schism in teacher education (Darling-Hammond, 2006). In contrast to a linear input-output teacher training method, formative interventions facilitate the development of pre-service teachers' practical knowledge through active engagement, self-inquiry, and a 'heterogeneous coalition' (Engeström & Sannino, 2020) between pre-service teachers and teacher educators. Thus, the findings of this chapter have global implications for the transformation of initial teacher education programme through the activation of pre-service teachers' professional agency using formative interventions as a new methodology. Meanwhile, it contributes to the research of teacher practical knowledge by regarding it as a complex knowledge system with evolutionary dynamics.

2   Practical knowledge in expansive learning

Educational researchers have been looking for an approach for a long time: an effective strategy of educating instructors that would have a positive impact on daily teaching practices in schools. There is a ton of knowledge available about how instructors may improve their ability to influence student learning, and it would be ideal if teachers used this knowledge (Korthagen, 2017). Dewey (1904) observed this gap between theory and practice, and he proposed different means to mending it. Nonetheless, an inconvenient truth is that the theory–practice split has remained the core difficulty of pre–service and in-service teacher education throughout the 20th century (Lanier & Little, 1986).

   The epistemological foundation of practical knowledge stems from the philosophy of pragmatism. According to Dewey (1929), knowledge is an outcome of problem solving, and knowing is a process of inquiry. Hence, teachers' practical knowledge is inspired by disorder in directly experienced situations and inquired from practices explored to solve practical issues. Studies have been conducted on teachers' practical knowledge for nearly half a century. Elbaz's (1983) seminal work emphasises the practical nature of teacher thinking and knowledge, while Clandinin and Connelly's (1995) holistic approach incorporates teachers' practical knowledge with their life history and self-perception. In the view of Meijer et al. (1999), practical knowledge is a multi-faceted concept comprising diverse characteristics; in particular, it is a personal, contextual, experience-based, tacit, and

content-driven guide to action. More recent studies have shown that practical knowledge guides teachers in various ways, including bridging theoretical learning and practical inquiry (Roblin, Ormel, McKenney, Voogt, & Pieters, 2014), dealing with dilemmas (Chen, Wei, & Jiang, 2017), fostering adaptive expertise (Männikkö & Husu, 2019), and reforming their teaching styles (Chaharbashloo et al., 2020).

Furthermore, there is a form of practical knowledge known as 'phronesis', which is from Aristotel (2009). In this sense, phronesis is also an approach to supporting teachers' knowledge and practice within the context of justification. Teaching is stressed as the best grasp of practical reasoning, which can help teachers think more clearly and make better decisions (Gholami & Husu, 2010). A knowledge base of teaching is defined by Verloop, van Driel, and Meijer (2001) as 'all profession-related insights that are potentially relevant to the teacher's activities' (p. 443). These ideas can apply to formal theory or knowledge generated by university-based scholars, as well as common parts of teachers' practical knowledge. Practical knowledge refers to a teacher's understanding and ideas about their teaching practice (Van Tartwijk, den Brok, Veldman, & Wubbels, 2009). It was created through an integrative process based on teachers' classroom practice, and it serves as a guide for teacher teaching in the classroom. In addition, self-efficacy and practical knowledge have an interactive influence on pre-service teachers. More recently, Georgiou, Mok, Fischer, Vermunt, and Seidel (2020) explored the importance of pre-service teachers' teaching experience and self-efficacy beliefs and concluded that evidence-based teaching can promote teacher educators' learning and development.

In sum, teacher practical knowledge is multi-dimensional, multi-level, and frequently unconscious. It is conceivable to build an effective approach to promoting teacher learning if we accept it as our starting point. Such an approach must be based on the teacher's concerns and gestalts, rather than on a preconceived notion of what this teacher should learn (Korthagen, 2017). The limited research focuses on diagnosing rather than fostering and cultivating pre-service teachers' practical knowledge through the employment of different methods such as video-based reflection (Allas et al., 2020), shadowing techniques (Debreli, 2019), and journaling combined with interviews (Maaranen et al., 2016). Thus, it is important to determine the manner in which initial teacher education programmes could be organised to develop pre-service teachers' practical knowledge optimally with the view to improving teaching quality. For this purpose, I reference the relevant literature internationally (Chaharbashloo et al., 2020; Fenstermacher, 1994; Gholami & Husu, 2010) and indigenously (Chen, 2011; Wei, 2020; Wei & Chen, 2018) to define pre-service teachers' practical knowledge as an amalgam of four components:

1   knowledge about self, which leads teachers in defining their professional identity;

2   knowledge about disciplines, which enables teachers to master their subject area and draw from various teaching methods and strategies;
3   knowledge about students, which helps teachers develop positive relationships with students and motivate them to learn better; and
4   knowledge about context, which refers to teachers' understanding of the macro-social and educational circumstances and their sensitivity towards problematic situations in teaching.

My justification of categorising teachers' practical knowledge into four components relates to the points of focus and realistic values of practical knowledge. It should be noted that our definition of teachers' practical knowledge fully admits its complexity and holisticality. Yet, our analytical definition, especially based on our precious studies in Chinese context (e.g., Wei, 2019, 2020; Wei & Chen, 2018), render teachers' practical knowledge be accessibly traced with profound and systematic analyses. These components make up the research framework I adopted to examine the content of pre-service teachers' practical knowledge at different intervention stages.

But how does the interventionist trajectory happen? Then, I found the theory of expansive learning which helps me to design the study. Development of pre-service teachers' practical knowledge is essentially a process of learning. Individual cognitivism defines learning as an individual mental process, whereas social cognitivism is the transmission of cultural knowledge and competence from one generation to the next. Criticising both theories, Paavola and Hakarainen (2005) argued that neither examines knowledge creation as being critical to the continuous professional development of teachers. Expansive learning, on the other hand, emphasises the practice of collaborative knowledge creation (Engeström, 2015). Expansion denotes 'the multidirectional movement of learners' construction and the implementation of new objects in their practice' (Engeström & Sannino, 2010, p. 2). In this connection, Paavola, Lipponen, and Hakkarainen (2004) suggested knowledge creation as a new approach to theorising field-based learning in initial teacher education programmes.

Expansive learning theory proposes an unclosed cycle of seven learning actions (Figure 6.1): questioning the accepted practice, analysing the situation, modelling the newly found explanatory relationship, examining the model, implementing the model, reflecting on and evaluating the process, and consolidating its outcomes into a new stable form of practice (Engeström & Sannino, 2010). The cycle is open to new cycles of exploration and learning within which pre-service teachers construct and practically implement their professional knowledge.

Expansive learning theory contributes an ideal model that can be adopted in this chapter not only to probe the generative process of pre-service teachers' practical knowledge but also to design and negotiate interventions to

7. Consolidating the new practice   1. Questioning

                                                         1. Analysing

5. Implementing the new model

4. Examining the new model   3. Modeling the new solution
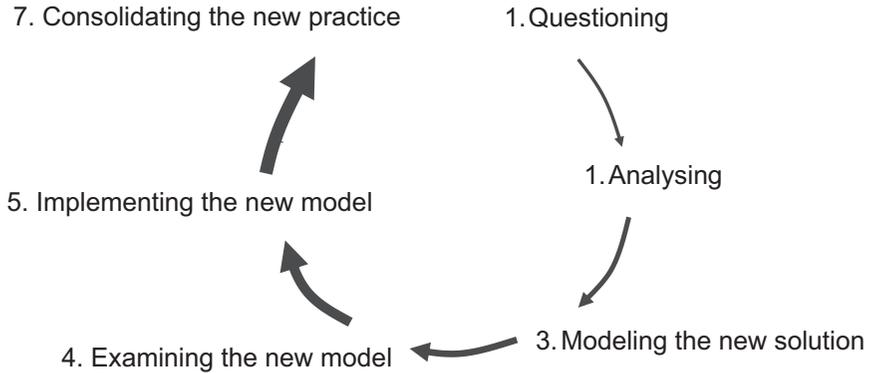
Figure 6.1 Sequence of learning actions in an expansive learning cycle (adapted from Engeström & Sannino, 2010, p. 8)

nurture pre-service teachers' practical knowledge in initial teacher education programmes. Drawing on this perspective, I performed a series of formative interventions at different stages in a mandatory learning module of an initial teacher education programme.

3 Formative interventions as a progressive methodology

Expansive learning by pre-service teachers does not develop naturally but needs an intervention, which is construed as a deliberative and systematic set of actions that serve as an interlude in practitioners' business-as-usual processes, allowing them to self-examine their daily practices (Virkkunen & Newnham, 2013). By playing the role of interventionists, researchers offer participants theoretical and methodological resources to engage in experimentations that can lead to generative, novel outcomes. Through such deliberate and methodical interventions, researcher-interventionists enable pre-service teachers to generate knowledge about their practice (Lampert, 2010) and accordingly, explore alternative directions for self-development and transformation.

In social science research (e.g. Engeström, Rantavuori, & Kerosuo, 2013; Haapasaari & Kerosuo, 2015; Sannino, Engeström, & Lemos, 2016), formative interventions are recognised as a progressive methodology in facilitating systemic changes and particularly, in the professional development of teachers (e.g. Augustsson, 2021; Morselli & Sannino, 2021). In addition to improving pre-service teachers' performance, the use of formative interventions in initial teacher education programmes invokes pre-service teachers'

professional agency through their active engagement, self-inquiry, and a 'heterogeneous coalition' (Engeström & Sannino, 2020) between pre-service teachers and teacher educators.

This chapter describes a case-study-based research between October 2017 and November 2018 at the College of Elementary Education at a normal university in Beijing. With effect from the 2017–2018 academic year, the normal university has restructured its bachelor-level initial teacher education programme to promote practice-oriented teacher education. This chapter is intended as a contribution to the university's reform efforts by highlighting the need for new approaches that combine educational theories and pre-service teachers' practical competences in initial teacher education programme.

Participants in the interventions were third-year pre-service teachers enrolled in a mandatory seven-credit module (i.e., *Curriculum and Instruction*), the learning objectives for which were the application of pedagogical theories in teaching and the development of their practical knowledge about teaching. Of the 398 students who registered for the module, 66 volunteered to participate in this study. Their majors included Chinese ($N = 30$), mathematics ($N = 12$), English ($N = 13$), science ($N = 3$), and the arts ($N = 8$). During the first two years of their bachelor's programme, the pre-service teachers have completed four semesters each in general education studies and discipline-based courses. Starting from the third year, the initial teacher education programme pays more attention to pre-service teachers' practical competence of teaching.

I, as a researcher and interventionist, am the supervisor of the module and collaborated with the pre-service teachers to generate solutions. The formative interventions were made in the course of teaching the module. I chaired discussions, facilitated joint expansive learning (Virkkunen & Newnham, 2013, p. 107), and supported participants in their exploration of new strategies to develop their practical knowledge. The objective of me serving as both a teacher educator and researcher was to create a balance between 'understanding the setting as an insider' and 'describing it to and for outsiders' (Patton, 2002, p. 268, Figure 6.2).

Data collection and its focus were closely linked to the mandatory module of the initial teacher education programme. Data were collected from pre-service teachers' course assignments, whose objectives were to promote pre-service teachers' teaching competence and reflection on their beliefs. All pre-service teachers participated in the two compulsory courses of the module: *Theories of Didactics* (four credits, February–June 2018) and *Interdisciplinary Curriculum and Teaching* (three credits, September–December 2018). This study maintained two datasets during the 13-month interventions, one for each of the research questions.

The first dataset was based on a series of discussion meetings conducted for pre-service teachers to make suggestions for initial teacher education

Figure 6.2 The change laboratory settings

programme. For this purpose, the participants were divided into six discussion groups. Each session lasted about 60–90 minutes. All sessions were videotaped to facilitate the determination of the interventionist trajectory.

The second dataset was based on the manifestations of pre-service teachers' practical knowledge through their teaching activities and reflective journals. For this purpose, each participant's imitative teaching at the university (February 2018) and public teaching at primary schools (May 2018) was video recorded, a measure intended to help the researchers ascertain pre-service teachers' practical knowledge (e.g., Allas et al., 2020). The duration of the teaching practice was roughly 40 minutes for each participant. The pre-service teachers also recorded their reflections during the workshops (September–October 2018) in their journals. The two datasets revealed pre-service teachers' practical knowledge in the form of thinking (verbal discussions) and actions (teaching videos and reflective journals).

We combined different strategies to analyse the different types of data. As recommended by Li and Kuo (2003), videos should be analysed in three steps: indexing, browsing, and abstraction. Video indexing helps create a conceptual index, browsing entails the scanning of videos to understand the overall content, while abstraction distils the video content and presents it in a more meaningful manner. I employed these techniques to analyse the eight recordings of the group discussions and 132 teaching videos. This process was conducted in two steps.

In the first step, my assistants and I referenced expansive learning theory to identify the trajectory of formative interventions reflected in the transcripts. We focused on attention-demanding events that required pre-service teachers to stimulate their demands for practical teaching. Next, we identified

learning actions in the material by discerning critical episodes according to their substantive content and specified actions and formulated a preliminary description of these actions by analysing the dialogue in each episode. We used the notions of 'cycles' and 'cyclicity' (Engeström et al., 2013) to formulate the consecutive implementation of the formative interventions. The seven expansive learning actions were then used to determine the epistemic functions of the pre-service teachers' teaching actions.

In the second step, we examined the development of pre-service teachers' practical knowledge through the different cycles of interventions. We studied the video recordings of the pre-service teachers' imitative teaching at the university and actual teaching in primary schools. Each video

Table 6.1 Coding list for pre-service teachers' practical knowledge

Components of PSTs' practical knowledge	Themes	Samples in videotaped teaching activities	Excerpts from reflective journals
1 Knowledge about self	**1.1 Sensitivity to prior experience** **1.2 Emergence of self-concept** **1.3 Construction of self-efficacy**	• Interpretation of life experiences in teaching • Identification with the prestige of the teaching profession • Enthusiasm towards and engagement in teaching	• 'I was influenced by my dad to become a teacher'. • 'I am still a student teacher with a lot to learn'. • 'Teaching increases my self-esteem'.
2 Knowledge about disciplines	**2.1 Depth of subject knowledge** **2.2 Breadth of subject knowledge** **2.3 Use of supplementary resources**	• Clear demonstration of knowledge • Linkage of lesson with the curriculum • Use of instructional tools, e.g. PPT	• 'I need to understand the text step by step'. • 'Whole-book reading is popular now'. • 'Multimedia could activate students in practicum'.
3 Knowledge about students	**3.1 Associations between teaching and student experiences** **3.2 Provision of scaffolding for various learner needs** **3.3 Promptness of feedback**	• Warm-up lesson from familiarity • More focus on students with learning difficulties • Good encouragement skills	• 'Students' experience could be a curriculum resource'. • 'Education equality is very important'. • 'Teaching is a relational profession that spreads care'.
4 Knowledge about context	**4.1 School culture** **4.2 Characteristics of communities and societies** **4.3 Changes in education**	• School as an environment for teaching • Social context as a basis to teach • New pedagogies to organise teaching	• 'School is like a big family'. • 'Government requirements should not be ignored'. • 'I prefer inquiry-based teaching in my class'.

recording was for 40 minutes, which is the duration of a formal lesson at the schools. Using the four components, we estimated the participants' practical knowledge during various sessions and the inner structures of the change process.

In addition, we examined their reflective journals using a theory-driven approach (Dey, 1993), based on the categories and components of the teachers' practical knowledge. During the last session of the intervention, we investigated a consolidation of pre-service teachers' learning outcomes from the programme. For this purpose, all data on pre-service teachers' practical knowledge, including videotaped teaching activities and written journals, were analysed using a coding list (Table 6.1). The relative changes in the four knowledge components demonstrated the development of pre-service teachers' practical knowledge.

My research assistants and I performed double checks to ensure credibility (Silverman, 2011). Ensuring reliability, discussing and questioning interpretations, and attending to transparency by outlining the steps taken through the data analysis (Tracy, 2010) are key efforts made to widen the scope of our data analysis.

4 Trajectories of the development of pre-service teachers' practical knowledge

Pre-service teachers' practical knowledge could be developed in the 13-month learning and practice. The development trajectory of the pre-service teachers' practical knowledge should be depicted by some accumulative manifestations, such as their enacted teaching activities and summarised reflective journals.

4.1 How is pre-service teachers' practical knowledge developed in the initial teacher education programme?

To address the first research question, I adopted expansive learning theory to identify the trajectory of the formative interventions developed in the exploratory process. The trajectory of formative interventions is defined as the cyclicity of expansive learning actions (Engeström et al., 2013). Figure 6.3 illustrates the cyclicity of the intervention process. The results showed that the seven expansive learning actions functioned as analytical tools to map the pre-service teachers' learning and development. However, the analysis also revealed several deviations, disruptions, and practical actions of design during the process. In other words, the trajectory was not designed in advance but explored and discussed during the 11 sessions in 13 months. The pre-service teachers framed and reframed their demands of professional development in collaboration with the researcher-interventionist.

According to Engeström et al. (2013), the cyclicity of expansive learning actions can be investigated at the process, cycle, and session levels.

Session2 (Nov 2017):
Analysing the realistic constraints of 'too many credits' in ITE programmes

Session3 (Dec 2017-Jan 2018):
Modelling a new method to integrate theory and practice in ITE

Session1 (Oct 2017):
Questioning the traditional theory-based model of ITE

Cycle 1:
Imitative teaching at the university

Session4 (Feb 2018):
Implementing imitative teaching at the university

Session6 (Apr 2018):
Analysing & Modelling the de-contextualised training model and modelling a situated manner

Session5 (Mar 2018):
Reflecting &Re-questioning the low engagement of the audience

Session7 (May 2018):
Implementing placement and public teaching at primary schools

Cycle 2:
Real teaching at primary schools

Session8 (Jun 2018):
Reflecting & Re-questioning the teacher-centred approach in school placement

Session9 (Jul-Aug 2018):
Analysing & Modelling a student-centred approach to teaching as a future career

Cycle 3:
Reflective workshops on student-centred teaching

Session10 (Sep-Oct 2018):
Implementing reflective workshops for PSTs

Session 11 (Nov 2018):
Reflecting &Consolidating PSTs' learning outcomes

Figure 6.3 Trajectory of formative interventions

Hereinafter, I explain the consecutive process in these three cycles, the expansive learning actions, and the critical turning points in pre-service teachers' learning.

First, at the process level, the formative interventions were composed of three cycles concerning the reconfiguration of objects (Engeström, 2015). A change in the object, for example, from the improvement of quasi-practical competence in cycle 1 to the strengthening of teaching competence, called for a change in the location of the interventions, which might be challenging to achieve under the present conditions. The participants' reflection and re-questioning of the current practice (see Figure 6.3) may lead to a new sequential cycle. A reconfiguration of the object and the re-equilibration of activities into the next cycle resulted in new contradictions between the

existing form and the new model of the activity system, which was based on the fundamental force of the progression of the three cycles.

Second, at the individual level, cyclicity was denoted by the appearance of at least three expansive learning actions in a meaningful order. Here, 'meaningful order' refers to the general directionality of the theoretically formulated expansive cycle (Engeström et al., 2013). Ideally, each action contributes to a cycle of expansive learning, which logically follows from one to another. Compared with the ideal model of expansive learning, however, pre-service teachers' learning actions in the present study did not occur in the complete order of 'analysing > modelling > implementing > reflecting'. Instead, we observed the order of 'analysing > modelling > examining > implementing'. This arbitrary order, however, did not reoccur in the same cycle but served as an impetus in the progression towards a new stage of intervention. Thus, the formative interventions are flexible cycles that are based on specific situations and produce new issues and solutions.

Finally, at the session level, the emergence of contradiction and subsequent prompt analyses facilitated each session. For example, the issue of 'too many credits' in pedagogical theories adopted in initial teacher education programmes was highlighted in the first session. Imitative teaching practicum at the university as a solution was also re-questioned because of the pre-service teachers' low engagement at the end of the first cycle, and it re-emerged in the sixth session of analysing deficiencies in de-contextualised training models in teacher education. Further, the new reconfigured object (i.e., real teaching at primary schools) was criticised as a teacher-centred approach. This contradiction set the agenda for sessions 9 and 10, which focused on modelling student-centred workshops for pre-service teachers. Considering the propulsive sessions in each cycle, we argue that contradictions as forces of development and change differ from simple conflicts or problems, in that they are historically accumulated structural tensions within the initial teacher education systems. When the contradictions in initial teacher education programmes are magnified, pre-service teachers and educators begin questioning and diverging from the established norms. The pre-service teachers engaged in a collective and purposeful effort to innovate and then achieved an expansive transformation by reconceptualising the motive for their development.

In sum, from the perspective of expansive learning theory, pre-service teachers' learning is reflected in their criticisms of existing practices in the initial teacher education programmes. Each cycle of formative interventions does not result in an ending point but a hinge (namely the polygonal sessions in Figure 6.3) leading to the next session. This spurred innovation or new ideas of objects and future-oriented practical knowledge (Engeström & Sannino, 2020), which also implies that teacher learning and development is an ongoing process.

4.2 *What outcomes of practical knowledge are developed?*

Using different types of data to investigate pre-service teachers' practical knowledge, I further examined the validity of the formative interventions in the four components of practical knowledge from both a general and comparative viewpoint.

In cycle 1, I analysed pre-service teachers' practical knowledge in imitative teaching using data from the video recordings. In cycle 2, I examined pre-service teachers' practical knowledge in real teaching at primary schools by conducting a video analysis. In the final cycle, I studied pre-service teachers' practical knowledge using information from the reflective journals they kept during the workshops. This dataset was analysed using the inductive coding list (see Table 6.1). From 66 quasi-practical teaching videos, 66 practical teaching videos, and 66 reflective journals, we coded and abstracted 3,920 clips on pre-service teachers' practical knowledge components, of which 1,078, 1,507, and 1,335 were generated in cycles 1, 2, and 3, respectively. We calculated the rate of each pre-service teacher's practical knowledge components and then summarised the changes observed in the continuing trajectory (Table 6.2).

Throughout the process, the most significant changes resulting from the formative interventions were observed in pre-service teachers' knowledge about disciplines (–39%) and students (+25%). The least significant changes were in pre-service teachers' knowledge about self (+6%) and the context in which they live (+10%).

Pre-service teachers' practical knowledge was strongly influenced by the disciplines they taught, although this effect showed a declining trend. Primary school teachers in China have taught specific subjects since the education system was implemented in 1949 by the Soviet Union (Ye, Zhu, & Lo, 2019). Discipline-based initial teacher education and qualification at the primary level remain the predominant approach in China and explains why pre-service teachers prioritised discipline-based knowledge and struggled to shift their focus to students at the beginning of the formative interventions.

Table 6.2 Relative changes in pre-service teachers' practical knowledge in the three cycles

	Knowledge about self	Knowledge about disciplines	Knowledge about students	Knowledge about context
Cycle 1	13%	70%	5%	10%
Cycle 2	6%	49%	18%	27%
Cycle 3	19%	31%	30%	20%
Trends	U-curve	Decline	Rise	Inverted U-curve

Pre-service teachers' knowledge about students increased during the three cycles. I examined teaching based on pre-service teachers' individual values, ideals, and qualities; collaboration with students; and prioritisation of welfare (Athanases, Sanchez & Martin, 2020). I observed an increase (+13%) in pre-service teachers' understanding of students from imagined teaching in the university to actual teaching in placement schools. The reflective workshops during cycle 3 increased pre-service teachers' awareness of their students (+12%).

The wane and wax of pre-service teachers' attention on disciplines and students was represented from several pre-service teachers' cases. For example, Ran and Vong, teaching English and Chinese language, looked back their change of views on teaching in their reflective journals:

> Before enrolling into this module, I have paid a lot attention to analysing national curriculum standards and textbooks. After the practicum in a primary school, I noticed that I was teaching textbooks instead of teaching students through textbooks. In a word, giving more spaces to students is very critical.
>
> (Ran, on 29, 10, 2018)

> Students' questions deepen my thinking on the teaching content. As Confucius said, teaching benefits teacher and students alike. I will encourage my students to be the masters of teaching and learning.
>
> (Vong, on 05, 11, 2018)

Notably, pre-service teachers' knowledge about self and the context in which they live formed two reverse kinked lines, with the change taking the form of a U-shaped curve. In cycle 1, my assistants and I recorded videos of pre-service teachers' imitative teaching in the university classroom, during which most of the pre-service teachers presented their teaching plans and imagined situations in the course of their teaching activities. The pre-service teachers' interpretation of their teaching experiences and expectations during these sessions revealed their self-knowledge. However, in the placement schools, pre-service teachers shifted their attention from self to their students, which led to a decline in self-knowledge in cycle 2. In cycle 3, the rise in self-knowledge stemmed from the reflective workshops focused on building interpersonal relationships between teachers and students.

In contrast, pre-service teachers' knowledge about their contexts, including educational and societal circumstances, was represented by an inverted U-shaped curve. In cycle 1, most pre-service teachers demonstrated their knowledge of the requirements of the national curriculum reform, but the level of such knowledge was not high in the four categories of practical knowledge. However, pre-service teachers' understanding of contexts rapidly increased during cycle 1. In the placement schools, the formative interventions enriched pre-service teachers' knowledge about school cultures

and the communities in which they worked. The change in location from university to primary schools and the shift in roles from student to teacher increased the situational aspects of pre-service teachers' practical knowledge during the study. Thus, we observed a sustainable influence in cycle 3, where pre-service teachers became more aware of contextual factors that influence their work.

In terms of the dialectical relationship between self and context, pre-service teachers formed equilibrium through the formative interventions. Such as Deng and Ong, both of them stated that their awareness of themselves as promising teachers improved their understanding of the context where they would work in the future.

> In the imitative teaching, I just teach. While at the primary school, I have to concern the authentic society. The news, stories, and the experiences of me and my students are all resources of teaching and learning.
> (Deng, on 05, 11, 2018)

> We can not get rid of the exam-oriented teaching and learning, unless the evaluation system make any changes. But I could do something different in the context because I do not think our education only aims to get high scores. I would like to be a teacher who help my students to get well-rounded development.
> (Ong, on 29, 10, 2018)

Overall, pre-service teachers' knowledge about self and contexts slightly increased. In the final session of the interventions, their practical knowledge achieved relative equilibrium within all four knowledge categories, thus proving the practical validity of formative interventions in reforming initial teacher education programmes.

5 Enacting a utopia in initial teacher education

This chapter responds to the need for appropriate methodological tools that support the development of pre-service teachers' practical knowledge. The progressive method of formative interventions enacts a utopia in initial teacher education programmes. This methodology depicts the trajectory of pre-service teachers' development of practical knowledge. Stetsenkom and Arievitch (2004) have noted that pre-service teachers' learning is a journey of self-transformation from a university student to a professional teacher. This transformation warrants affordances such as interventions (Virkkunen & Newnham, 2013). Several researchers have recently explored the synthesis of teacher knowledge about diverse resources using various interventions (Athanases et al., 2020; Bronkhorst, Meijer, Koster, Akkerman, & Vermunt, 2013; Ellis, Gower, Frederick, & Childs, 2015), concluding that reforms in initial teacher education programme should be more practice and interventionist

oriented. In the same vein, this study proposes formative interventions as a new and effective methodology to stimulate change and develop practice in initial teacher education programmes. With intervention research in the social sciences being subject to persistent tension between practical relevance and rigorous analysis (Gutiérrez & Penuel, 2014), formative interventionist research is likely to result in improved rigour in studies that answer difficult questions in complex situations (Ellis et al., 2015). My study resolved this dilemma by stimulating pre-service teachers' potentiality and agency. Drawing on expansive learning theory, I examined pre-service teachers' practical knowledge by adopting evidence-driven tools (i.e. videos and journals) with a practitioner-centred focus on the development of pre-service teachers' practical knowledge, which generated a new type of dialogue between practical impact and rigorous analyses in intervention research. In addition, throughout the 11 sessions, the researcher-interventionist collaborated with the pre-service teachers to identify new approaches to teacher training that would enhance pre-service teachers' learning and transform current initial teacher education programmes. This is in line with Engeström and Sannino's (2020) finding that formative interventions involve the creation of new knowledge and new practices for a newly emerging activity.

This progressive interventionist stance reiterates the point that pre-service teachers have the potential to develop practical knowledge even if they lack teaching experience. The development of pre-service teachers' practical knowledge warrants expansive transformations, wherein pre-service teachers and teacher educators question and deviate from established norms. Pre-service teachers must engage in collective design efforts to conceive a new model for re-organising their teaching activities and implement that model while continually improving and adjusting it (Morselli & Sannino, 2021). Furthermore, the chapter's comparative analysis showed the need for initial teacher education programme to focus on developing pre-service teachers' awareness and knowledge about the contexts in which they work and live, a finding which is consistent with that of Chaharbashloo et al. (2020).

A significant contribution of this chapter is the adoption of a novel methodological approach in initial teacher education programmes to engage pre-service teachers in the development of complex practical knowledge. Pre-service teachers must build their knowledge through practice and by reflecting on their experiences. Accordingly, initial teacher education programmes should offer pre-service teachers with multiple learning opportunities to develop their practical knowledge. It is acknowledged that pre-service teacher education courses do not adequately prepare graduates for the reality of teaching, according to researchers and practitioners (Darling-Hammond, 2006). Teacher education must be based on a more holistic understanding of what teachers know about teaching and learning (Black & Halliwell, 2000). The previous reform efforts were generally unsuccessful

because they failed to take into consideration teachers' prior knowledge, beliefs, and attitudes. The action-oriented and person-bound nature of teachers' practical knowledge is conceived. This study approved that practical knowledge combines experienced and formal knowledge and personal beliefs as it is developed by teachers in the context of their profession (Van Driel, Beijaard, & Verloop, 2001). Pre-service teachers' learning processes cannot always be predicted, because each pre-service teacher should be treated seriously, and the process should be based on his or her worries, gestalts, personal strengths, and mission, all of which should be considered within the context of their actual work (Fullan, 2007). It thus suggests that initial teacher education programmes can adopt formative interventions to enhance teaching practices and pre-service teachers' development of practical knowledge. In addition, making pre-service teachers responsible for their own learning energizes motivates them and helps them better prepare for their teaching careers.

References

Allas, R., Leijen, Ä., & Toom, A. (2020). Guided reflection procedure as a method to facilitate student teachers' perception of their teaching to support the construction of practical knowledge, *Teachers and Teaching, 26*(2), 166–192.

Aristotle. (2009). *The nicomachean ethics*. Ed. by Brown, L. Trans. By Ross, D. Oxford: Oxford University Press.

Athanases, S. Z., Sanchez, S. L., & Martin, L. M. (2020). Saturate, situate, synthesize: Fostering preservice teachers' conceptual and practical knowledge for learning to lead class discussion. *Teaching and Teacher Education, 88*. https://doi.org/10.1016/j.tate.2019.102970

Augustsson, D. (2021). Expansive learning in a change laboratory intervention for teachers. *Journal of Educational Change*. https://doi.org/10.1007/s10833-020-09404-0

Black, A. L., & Halliwell, G. (2000). Accessing practical knowledge: how? why?. *Teaching and Teacher Education, 16*(1), 103–115.

Bronkhorst, L. H., Meijer, P. C., Koster, B., Akkerman, S. F., & Vermunt, J. D. (2013). Consequential research designs in research on teacher education. *Teaching and Teacher Education, 33*, 90–99.

Chaharbashloo, H., Gholami, K., Aliasgari, M., Talebzadeh, H., & Mousapour, N. (2020). Analytical reflection on teachers' practical knowledge: A case study of exemplary teachers in an educational reform context. *Teaching and Teacher Education, 87*, 102–131.

Chen, X. (2011). *Bridging theory and praxis: Research on teacher practical knowledge*. Beijing: Educational Science Press.

Chen, X., Wei, G., & Jiang, S. (2017). The ethical dimension of teacher practical knowledge: A narrative inquiry into Chinese teachers' thinking and action in dilemmatic spaces. *Journal of Curriculum Studies, 49*(4), 518–541.

Clandinin, D. J., & Connelly, F. M. (1995). *Teachers' professional knowledge landscapes*. New York: Teachers College Press.

Darling-Hammond, L. (2006). *Powerful teacher education: Lessons from exemplary programs.* San Francisco, CA: Jossey-Bass.

Debreli, E. (2019). Teacher shadowing as an empowering technique for EFL student teacher practical knowledge development: Insights from three-week shadowing programmes. *Asia-Pacific Journal of Teacher Education, 47*(4), 432–452.

Dewey, J. (1904). The relation of theory to practice in education. In C. A. McMurry (Ed.), *The relation between theory and practice in the education of teachers: Third yearbook of the national society for the scientific study of education*, Part 1 (pp. 9–30). Chicago, IL: The University of Chicago Press.

Dewey, J. (1929). *The quest for certainty: A study of the relation of knowledge and action*. New York: Minton Balch & Company.

Dey, I. (1993). *Qualitative data analysis: A user-friendly guide for social scientists.* London: Routledge.

Elbaz, F. (1983). *Teacher thinking: A study of practical knowledge*. London: Croom Helm.

Ellis, V., Gower, C., Frederick, K., & Childs, A. (2015). Formative interventions and practice-development: A methodological perspective on teacher rounds. *International Journal of Educational Research, 73*, 44–52.

Engeström, Y. (2015). *Learning by expanding: An activity-theoretical approach to developmental research* (2nd ed.). Cambridge: Cambridge University Press.

Engeström, Y., Rantavuori, J., & Kerosuo, H. (2013). Expansive learning in a library: Actions, cycles and deviations from instructional intentions. *Vocations and Learning, 6*(1), 81–106.

Engeström, Y., & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review, 5*, 1–24.

Engeström, Y., & Sannino, A. (2020). From mediated actions to heterogeneous coalitions: Four generations of activity-theoretical studies of work and learning, *Mind, Culture, and Activity*. https://doi.org/ 10.1080/10749039.2020.1806328

Fenstermacher, G. D. (1994). The knower and the known: The nature of knowledge in research on teaching. *Review of Research on Teaching, 20*(1), 1–54.

Fullan, M. (2007). *The new meaning of educational change*. New York: Routledge.

Georgiou, D., Mok, S. Y., Fischer, F., Vermunt, J. D., & Seidel, T. (2020). Evidence-based practice in teacher education: The mediating role of self-efficacy beliefs and practical knowledge. *Frontiers in Education*, https://doi.org/10.3389/feduc.2020.559192

Gholami, K., & Husu, J. (2010). How do teachers reason about their practice? Representing the epistemic nature of teachers' practical knowledge. *Teaching and Teacher Education, 26*(8), 1520–1529.

Gutiérrez, K. D., & Penuel, W. (2014). Relevance to practice as a criterion for rigor. *Educational Researcher, 43*(1), 19–23.

Haapasaari, A., & Kerosuo, H. (2015). Transformative agency: The challenges of sustainability in a long chain of double stimulation. *Learning, Culture and Social Interaction, 4*, 37–47.

Korthagen, F. (2017). Inconvenient truths about teacher learning: Towards professional development 3.0. *Teachers and Teaching, 23*(4), 387–405.

Korthagen, F. A. (2010). How teacher education can make a difference. *Journal of Education for Teaching, 36*(4), 407–423.

Lampert, M. (2010). Learning teaching in, from, and for practice: What do we mean? *Journal of Teacher Education, 61*(1–2), 21–34.

Lanier, J. E., & Little, J. W. (1986), Research on teacher education, In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 527–569). New York: Macmillan.

Li, Y., & Kuo, C. J. (2013). *Video content analysis using multimodal information*. New York: Springer.

Maaranen, K., Pitkäniemi, H., Stenberg, K., & Karlsson, L. (2016). An idealistic view of teaching: Teacher students' personal practical theories. *Journal of Education for Teaching, 42*, 80–92.

Männikkö, I., & Husu, J.(2019). Examining teachers' adaptive expertise through personal practical theories. *Teaching and Teacher Education, 77*, 126–173.

Meijer, P., Verloop, N., & Beijaard, D. (1999). Exploring language teachers' practical knowledge about teaching reading comprehension. *Teaching and Teacher Education, 15*, 59–84.

Morselli, D., & Sannino, A. (2021). Testing the model of double stimulation in a change laboratory. *Teaching and Teacher Education, 97.* https://doi.org/10.1016/j.tate.2020.103224

OECD. (2005). *Teachers matter: Attracting, developing and retaining effective teachers*. Paris, FR: OECD.

Paavola, S., & Hakkarainen K. (2005). The knowledge creation metaphor: An emergent epistemological approach to learning. *Science & Education, 6*, 535–557.

Paavola, S., Lipponen, L., & Hakkarainen, K. (2004). Models of innovative knowledge communities and three metaphors of learning. *Review of Educational Research, 74*, 557–576.

Patton, M. Q. (2002). Two decades of developments in qualitative inquiry: A personal, experiential perspective. *Qualitative Social Work, 1*, 261–283.

Roblin, N. N. P., Ormel, B. J. B., McKenney, S. E., Voogt, J. M., & Pieters, J. M. (2014). Linking research and practice through teacher communities: A place where formal and practical knowledge meet? *European Journal of Teacher Education, 37*(2), 183–203.

Sannino, A., Engeström, Y., & Lemos, M. (2016). Formative interventions for expansive learning and transformative agency. *Journal of the Learning Sciences, 25*(4), 599–633.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(19), 1–22.

Silverman, D. (2011). *Interpreting qualitative data: A guide to the principles of qualitative research*. London: Sage.

Stetsenkom, A., & Arievitch, I. (2004). The self in cultural-historical activity theory. *Theory and Psychology, 14*(4), 475–503.

Tracy, S. J. (2010). Qualitative quality: Eight a "big tent" criteria for excellent qualitative research. *Qualitative Inquiry, 16*(10), 837–851.

van Driel, J. H., Beijaard, D., & Verloop, N. (2001). Professional development and reform in science education: The role of teachers' practical knowledge. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching, 38*(2), 137–158.

van Tartwijk, J., den Brok, P., Veldman, I., & Wubbels, T. (2009). Teachers' practical knowledge about classroom management in multicultural classrooms. *Teaching and Teacher Education, 25*(3), 453–460.

Verloop, N., Van Driel, J., & Meijer, P. (2001). Teacher knowledge and the knowledge base of teaching. *International Journal of Educational Research, 35*(5), 441–461.

Virkkunen, J., & Newnham, D. S. (2013). *The change laboratory: A tool for collaborative development of work and education*. Rotterdam: Sense.

Wei, G. (2019). Teaching gender: Narrative inquiries into teacher practical knowledge for gender equality and social justice. In H. Sautson & J. Kjaran. (Eds.), *Schools as queer transformative spaces: Global narratives on sexualities and genders* (pp. 68–83). New York: Routledge.

Wei, G. (2020). *Generation of teacher practical knowledge*. Beijing: Educational Science Press.

Wei, G., & Chen, X. (2018). Emergence and development of research on teacher practical knowledge. *Journal of East China Normal University, 6*, 107–117.

Ye, J., Zhu, X., & Lo, L. (2019). Reform of teacher education in China: A survey of policies for systemic change. *Teachers and Teaching, 25*(7), 757–781.

7   Reimaging pre-service
teachers' practical knowledge

1 Introduction

Reimaging means creating new images for something, for example, to form a new mental picture, to impress a new concept, and/or create a new representation. Reimaging pre-service teachers' practical knowledge means to re-understand and re-construct pre-service teachers' practical knowledge before and during they encounter authentic teaching context, which leads to a re-image of teacher education and research as well.

In order to broaden the significance of this book to international readerships, I further discuss the implications of studying pre-service teachers' practical knowledge to our global colleagues. Although this monograph reports a research project in mainland China, it reflects the global concern on high-quality teacher education in the rapidly changing global community. Globalisation is defined by Goodwin (2020) as 'the intersection of and connections across countries, the blending and blurring of borders, the mutuality of their trajectories resulting from the intertwining of economies and cultures, and the trade-in ideas (and ideologies), practices, technologies, and people' (pp. 2–3). The rapid spreading of the COVID-19 shows the inevitable crossing of multiple networks and the global sharing of tensions and responsibilities. The globalisation shows the need for a shared perspective on teacher professionalism. Considering the recent experience of the global crises due to the COVID-19, a new view of the future and what it means to be a teacher in this changing and largely unknowable context have to be shaped in a broader global discussion. In its disruptive impact, the COVID-19 crisis accelerates the assumption of taking a risk in adopting new perspectives of teacher learning. A central role in teacher education is given to teacher educators, a particular group of professionals with specific responsibilities, expertise, and commitments in their respective educational systems (Swennen & White, 2020). In a nutshell, we need to reconsider teacher education and high-quality teacher learning in advance. The present book, proposing '*Designing learning for future*', innovates an instrumentality-supported approach based on five methodologies. The previous chapters illustrate these methods by evidence.
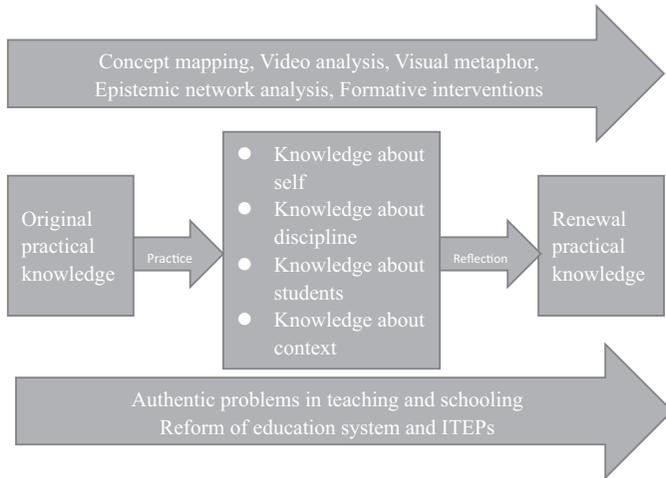
Figure 7.1 Instrumentality-supported pre-service teachers' practical knowledge development

Figure 7.1 is an overview of the new orientation to developing pre-service teachers' practical knowledge. After completing five sub-ordinated studies, an instrumentality-supported approach to develop pre-service teachers' practical knowledge reframes nowadays teacher learning and development models. According to the cultural-historical theories (e.g. Vygotsky, 1978), instruments are mediations by which humans solve problems and retain higher mental functional development. In this book, the five methodologies supply mediators bridging theory and practice in pre-service teachers' professional learning and development. These instruments, for instance, concept maps, teaching videos, and visual metaphors, help pre-service teachers to reflect their practical knowledge in authentic and complex situations and then renew and restructure their understanding of teaching profession. In the final chapter, I am going to develop the idea of instrumentality-supported initial teacher education and interpret how it reimages our understanding of teacher practical knowledge and teachers' work.

2 Re-understanding teacher practical knowledge

American educationist Palmer (1988) said, teachers teach what they know; teachers also teach who they are. Teachers teach what specific situation, each teachable moment, pulls out of their practical knowing. Compared to the popular artificial intelligence (AI), teachers are humanised knowers: as knowers of themselves, as knowers of children, as knowers of situations, as knowers of subject matters, as knowers of pedagogy, as knowers of learning, and as knowers of the circumstance. In this book, I define these knowing as

teacher practical knowledge, an amalgam of pre-service teachers' knowing of all resources and constraints around them, and locate in their past experience, present mind and body, and future plans and actions. It is seen and found in pre-service teachers' practices.

From the perspective of the professional knowledge structure of pre-service teachers, the key to leading teacher education curriculum reform with a practical orientation lies in cultivating the practical knowledge of them. Literally, practical knowledge is formed after teachers reflect on and refine their own educational and teaching experience, and their belief in education and teaching through their own actions (Chen, 2011). Existing research focused on practical knowledge of in-service teachers, especially experienced teachers, but paid less attention to pre-service teachers. They generally believe that the ontological knowledge, such as subject knowledge, and conditional knowledge, such as pedagogical knowledge, of pre-service teachers are relatively inadequate; thus, there are few opportunities for long-term teaching practice. Therefore, they often think that the practical knowledge of pre-service teachers has shortcomings and it is difficult to be studied. The neglect of the research on the practical knowledge of pre-service teachers has led to the fact that the research results in the field of practical knowledge have not really entered the period of initial teacher education.

However, could we conclude that pre-service teachers have little practical knowledge, only because they have little teaching experience? If so, should our teacher education programmes ignore the responsibility of nurturing pre-service teachers' practical knowledge? These two realistic questions guided my research spanning three years.

By using the five methodologies, my research team and I have constructed a whole picture of pre-service teachers' practical knowledge, which relates to their living and learning spaces, their intellects and emotions, and their personal and social context. Re-understanding teacher knowledge from a holistic perspective, it is consistent much with their practice and informs their practice respectively. Moreover, my research on the cohort of pre-service teachers reconceptualises the definition of practical knowledge. It is not only the knowledge reflecting on practice but also the knowledge designing for practice: It is a future-oriented knowledge.

The instrumentality-supported approach is a continuous commuting between practice and theory. By using various research methodologies, teacher education research should study the real situations of teaching practice, which meets with pre-service teachers' concern. It also guides to reinvention of adopting these methodologies as reflective tools in teacher training. Resonating to Korthagen (2017), if this book contributed theories to teacher education based on the five methodologies, then it should be the theories with small 't' instead of capital 'T'. It is worth mentioning that this book is an evidence-based agenda. Not only have the methodologies been explained but the empirical data have also examined the validity and trustworthiness of these. Our series of studies reflect pre-service teachers' practical knowledge

while in the process of learning and professional development. If they do develop such practical knowledge, and if this knowledge starts to influence their behaviour, they have developed themselves.

As a result, I aim to develop a heuristic framework that allows for positioning the methodologies with their instruments in relation to one another, along an integrated perspective. Their theoretical groundings, empirical research, and forms of implementation in initial teacher education to mediate professional learning in the previous five chapters contribute to a possible reconstruction of teacher education programmes.

3 Re-constructing teacher education programmes

The link between theory, practice, and research in initial teacher education has been widely discussed in international literature (e.g. Darling-Harmmond, 2017; Flores, 2018). However, more needs to be done to foster these components in existing teacher education programmes. Over the recent years, the demand for improved quality of teaching and learning and for increased accountability and higher academic standards has put issues related to effective professional development on the agenda of educators, researchers, and policy-makers. Pre-service teachers' development is usually used in a broad sense, frequently encompassing 'all types of learning undertaken by teachers beyond the point of their initial training' (Craft, 2000, p. 9). According to Guskey (2000), the term 'teacher learning' refers to those processes, actions, and activities designed to enhance the professional knowledge, skills, and attitudes of teachers so that they might, in turn, improve the learning of students. Yet, the possible ways to build high-quality initial teacher education programmes have been discussed and experimented for many decades.

Zeichner (1983) identified and described the four representative paradigms in teacher education and professional development. Paradigm is a 'matrix of beliefs and assumptions about the nature and purposes of schooling, teaching, teachers, and their education that gives shape to specific forms of practice in teacher education' (p. 3). Through reviewing the history, Zeichner (1983) proposed that the first paradigm is the *traditional apprenticeship model* as craft, focusing on the accumulation of tacit skills, based on the field experiences of teaching involving the trial and error of practitioners. The second paradigm is what Sprinthall, Reiman, and Thies-Sprinthall (1996) call the *expending the repertoire* paradigm. The focus of this approach is less on highly explicit and discrete instructional strategies and teaching skills, but more on the acquisition of comprehensive instructional models of teaching, like direct instruction, inductive inquiry, and inter-personal approaches to learning. Then, predominant in teacher education is the *competency-based paradigm* also known as the *expert paradigm*. Based on a technical production metaphor and positivistic epistemology, this paradigm

focuses on mastery of knowledge and teaching skills identified by expert academics and university researchers. Finally, the *inquiry-oriented paradigm* is more like a metaphor of liberation, which emphasises the development of teachers' capacity for reflective action through an examination of the moral and political implications of their teaching.

Merging elements of different paradigms are also supported by Zeichner (1983) himself who argues that these traditions are not uniform, that they overlap and contain contradictions and tensions but that the principles that underlie them are helpful in analysing the implications for teacher education and teaching in general. Similarly, Feiman-Nemser (2012) claimed that *the personal orientation* of pre-service teacher education reminds us that learning to teach is a transformative process, not only a matter of acquiring new knowledge and skills. Because prospective teachers are no strangers to classrooms, resocialisation is necessary especially if new ways of teaching are to be fostered. *The critical orientation* of pre-service teacher education highlights the teacher's obligations to students and society, challenging teacher educators to help novices learn to align school practices with democratic principles of justice and equality. The critical orientation also underscores the need to develop the habit of questioning taken-for-granted assumptions about teaching, learning, knowledge, schooling, and so forth. *The technological and practical orientations* represent different ideas about the nature and sources of knowledge about teaching and how it can be acquired and developed. The former stresses on scientific knowledge and systematic training while the latter on the wisdom of practice and learning from experience. Clearly, both have a contribution to make to the content and processes of teacher preparation. Finally, *the academic orientation* of pre-service teacher education focuses attention on the distinctive work of teaching. It follows that preparing someone to teach means helping them develop ideas and dispositions related to this goal. The academic orientation has been a missing paradigm in teacher education (Shulman, 1987). Historically viewed as someone else's responsibility, preparing teachers to teach academic content has rarely been a central concern of teacher educators. The current reform movement with its concern for improving the academic quality of teaching and the new research emphasis on the role of subject matter knowledge in teaching provide the impetus to give serious attention to this neglected aspect of teacher preparation.

In fact, among the practical field of teacher education, a plurality of orientations and approaches exists because people hold different expectations for schools and teachers and because, in any complex human endeavour, there are always more goals to strive for than one can achieve at the same time. Teacher educators cannot avoid making choices about what to concentrate on; thus, deliberation about worthwhile goals and appropriate means must be an ongoing activity in the teacher education community. These deliberations would be aided by a conceptual framework that identifies central

tasks of teacher preparation, those core activities that logically and practically belong to the pre-service phase of learning to teach. Helping prospective teachers make a transition to pedagogical thinking, to thinking about teaching in terms of what students are and should be learning is an example of such a task.

Generally, pre-service teachers have not thought much about the reciprocal relationship of teaching and learning that defines the essence of their professional responsibilities. All the five methodologies could provide guidance to teacher educators in programme development and evaluation by identifying issues or tasks that programmes should address whatever their orientation. In a field like teacher education that has been shaped more by external factors than by a clear sense of purpose, this kind of instrumentality-supported framework is essential. While some of the methodologies focus on essential tasks of teacher preparation, collectively they do not represent a set of equally valid alternatives from which to choose. Rather they constitute a source of ideas and practices to draw on in deliberating about how to prepare teachers in a particular context.

In discussion of personal factors that present challenges to learning to teach, pre-service teachers are likely to bring to their prior experiences a host of assumptions that shape the pedagogical skills and routines they learn in normal universities. In many cases, these beliefs about how students learn and the teacher's role in facilitating learning – beliefs acquired over years of experience as students in traditional educational settings – are incompatible with the views of learning underlying the instructional approaches advocated by teacher education programmes. These beliefs often remain implicit, serving as filters that help to shape how novice teachers interpret and learn new instructional strategies and approaches.

Because the knowledge and beliefs that prospective teachers bring to their teacher education programmes exert such a powerful influence on what and how they learn about teaching, programmes that hope to help novices think and teach in new ways must challenge participants' pre-existing beliefs about teaching, learning, subject matter, self as teacher, and learning to teach. They must help prospective teachers make their implicit beliefs explicit and create opportunities for them to confront the potential inadequacy of those beliefs. They should also provide opportunities for prospective teachers to examine, elaborate, and integrate new information into their existing systems of knowledge and beliefs.

It is of critical importance of making explicit and examining student teachers' preconceptions and beliefs as a critical initial step in initial teacher education. In spite of repeated calls for attention to the personal dimensions of becoming a teacher, all too often teacher education programmes appear to prioritise other elements of teacher preparation. It might be a provocative assertion that directs our attention to what might be missing in pre-service teacher preparation: Most pre-service programmes concentrate

```
                        Theory
              Reflection          University-based TE
   Self-learning                              Co-learning

              Trial and errors       Apprenticeship
                        Practice
```
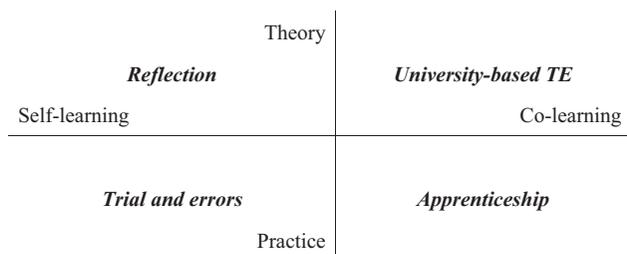
Figure 7.2 Four domains of teacher learning

almost entirely on teaching pre-service teachers to teach; little attention is placed on helping them become teachers.

I would like to use Figure 7.2 to portray the four domains and categories of teacher education. For the sake of cultivating their practical knowledge, it is necessary to immerse them together in a practical way.

In the present book, each methodology highlights different issues that must be considered, but none offers a fully developed framework to guide programme development. Hence, we were unable to distinguish or scrutinise between the different methodologies as to how each might lead to or promote a unique aspect of teacher learning. The emergent message across the board seems to be that all the five methodologies of mediation can be potentially conducive to quite similar types of learning outcomes, such as the development of teacher's professional self, knowledge of the discipline, knowledge of the profession or of the professional context. Indeed, a comprehensive examination of the learning outcomes as reported in studies on different methodologies of mediation suggests that most studies point to the contribution of the particular methodology for the same types of outcomes: Acquiring pedagogical content knowledge, skills and attitudes; supporting teacher identity construction and reconstruction; promoting reflection as a means of improvement; encouraging collaboration; increasing self-efficacy; engaging in student-centred pedagogy and meeting learning needs; promoting teacher autonomy and independent learning; linking theory and practice; and encouraging critical thinking related to real-life professional events.

The research findings in this book have revealed that professional development is more effective if the teacher has an active role in constructing knowledge (*teacher as action researcher*), collaborates with colleagues (*collective critical reflection*), the content relates to, and is situated in, the daily teaching practice (*emphasis on teaching skills*), the content is differentiated to meet individual developmental needs (*linked with formative evaluation results*), and the possibilities and limitations of the workplace are taken into account. These characteristics are further elaborated below, and their

implications for developing teacher training and professional development programmes are also discussed.

- The content of the programme should have a clear focus on specific skills which are linked to the daily teaching and have been found to be positively related to student progress.
- The content of the training programme should be differentiated so as to meet the participants' different priorities for improvement and to address contextual issues influencing quality of teaching.
- The programme should provide opportunities for active participation and engagement of the teachers and provision of feedback for each teacher.
- The programme should provide opportunities for collaboration and networking among teachers in the same school, the same class, or teaching the same subject.
- The programme should last for a sufficient period of time.
- The programme's impact on teaching skills and student achievement should be evaluated.

4 Designing teacher learning for future

What is learning? As Sfard (1998) summarised, we have three metaphorical expressions on learning. First, an acquisition mode regards learning as an input-output process. Based on information processing paradigm, learning is acceptance of the knowledge and skills which has already existed there. For instance, students learn the knowledge from the textbooks or digitalised tools. Second, a participatory mode views learning as interaction among agents from the peripheral moving to the centre of a group. According to Lave (1988), humans learn by participating in a community with a kind of membership. The tacit identity is a sort of participatory learning. Finally, an innovative mode breaks the hypothesis that we could only learn the existed things. On the contrary, for instance, Engestrom (1987) claimed that a knowledge-innovative approach renders us learn what is not yet there, namely an expansive learning metaphor. In the 21st century, knowledge and technology has been renewed with high speed. We need a new definition of learning when AI is applied, as Niemi (2021) summarised: (a) Learning is an active process in which a human being is involved as a unique person. (b) Learning is a social process, and learners are part of the social and cultural environment and context of his/her life. (c) Learning happens in interactions with other people and artefacts that enhance human development. (d) Human beings have agency in learning, and they monitor their learning through meta-cognitive strategies that include self- and co-regulative strategies. Motivational strategies, including engagement, and attributions of own learning, such as self-efficacy, have a strong impact on learning

processes and products. And, (e) Human learning is based on knowledge constructions that create meaningful entities.

Based on our shared understanding of human learning, what is the contribution of this book to teacher learning? The value of this book is to use various methods to manifest, diagnose, and cultivate pre-service teachers' practical knowledge. All these methods could be seen as 'interventions' (Gutiérrez & Penuel, 2014). Methodologies for pre-service teachers' professional learning have been traditionally discussed and conceptualised as applied expressions of a particular approach to knowledge use. Hereinafter, I then extend the trajectory by adding a perspective which designs a future-oriented approach across methodologies for teacher learning. This crystallised for us the diverse character of methodologies of mediation, shedding light on the distinctive forms of practice that a methodology takes when positioned in relation to different approaches to professional learning.

Previous study of mediated learning and mediation tools is fragmented. Research agendas are mostly about inquiry into a particular teaching-learning tool, seldom addressing points of convergence and divergence across tools, methodologies, and paradigms. Breaking with such isolation calls for opening a panoramic window into how the different methodologies (distinctively and in combination) address common core issues, questions, and dominant approaches to the mediation of professional learning. At the same time, it needs to examine points of convergence across methodologies in terms of purpose, process, and reported outcomes and to consolidate shared insights, implications, and applications for teacher education programmes. The aim was to begin developing a common language (guided by shared criteria), which represents the wide spectrum of methodologies of mediation in professional learning, both for researchers and practitioners. This was a challenging task, given that the educational research milieu is propagated by competing paradigms, each within its own conceptual and empirical language, very often not taken to another. Thus, one of the contributions in this book is to identify distinctiveness alongside interconnectedness (or overlap) across all five methodologies, in an effort to direct new channels of communication between research agendas and approaches to professional learning. To surface and establish connections between theoretical, empirical, and practical dimensions of the five recognised methodologies in teacher learning, both teacher education programmes and teacher education research could explore a new reform direction by the mediations of concept mapping, visual metaphor, video analysis, epistemic network analysis, and formative interventions.

Comparing these five methodologies, alongside the respective instruments and supportive empirical evidence, there exist possibilities to find a holistic way by integrating the five methodologies. In other words, the ontological groundings and epistemological values and assumptions regarding practical knowledge and practical knowing underlie all five methodologies, which could enlighten our future design for teacher learning.

Practical knowledge is mediated in the social sphere both collectively and individually. As a social encounter, mediation is associated with dialogue which takes place in participation, action, and reflection, in cultural responsiveness, and in social transformation (Gadotti, 1996). The underlying ontological grounding is the assumption that the individual and the social sphere exist as interconnected in the world. Therefore, epistemologically, the practical knowledge of pre-service teachers is entrenched in the social world that surrounds them. Corresponding to the nature of practical knowledge, the five methodologies of mediation are of a praxical character embedding action (Gadotti, 1996). Thus, they encourage informed and disciplined understandings of professional action towards the development of rituals of practice appropriate for specific concrete cases and complex or ambiguous situations (Korthagen & Kessels, 1999). This is grounded in the epistemological assumption by which knowledge creation is based on reciprocating relations between action (as participating in the social world) and thinking (as internalising values from the social world). Of a discursive character, methodologies for the mediation of professional learning and knowledge are sensitive to the historical, social, cultural, and institutional conditions of the larger contexts of practice, including the specific resources available and the explicitly and implicitly articulated constraints (Orland-Barak, 2010). Epistemologically, this touches upon the idea that knowledge is historically grounded and on the perception that thought and language, as cultural means, mediate social values to shape higher mental functions in knowledge creation and mediation.

The instrumentality-supported approach to developing pre-service teachers' practical knowledge encourages the identification and resolution of problems in activity while attending to the tensions and potential contradictions through co-operative work (Hawkey, 1997). Teacher learning is dynamic and constantly reshaped by the boundaries within which professionals work and participate (Putnam & Borko, 2000), which is also a dialectical process of looking inwards and outward at personal theories, beliefs, and actions. In the process, professionals challenge beliefs and assumptions and examine instances of dissonance in their practice (Larrivee, 2000). Settings for the mediation of professional learning should constitute potential spaces for educating reflective practitioners to make meaningful connections between and adaptations of theory and practice. Within these spaces, pre-service teachers acquire models and build repertoires of best practices, develop strategic thinking, frame and reframe problems, and evaluate gaps and contradictions that emerge between personal theories and beliefs, and practice or actions in the classrooms (Miettinen, 2000). In a nutshell, these endeavour draws on the assumption that instrumentality-supported learning connect thinking and actions together which leads to practical knowledge.

When we propose the new idea of developing pre-service teachers, one of the main challenges in implementing a new model for teacher education

relates to the co-existence of different conceptions on the part of teacher educators. Thus, there is a need for teacher educators to develop a scholarship of teacher education in order to examine the relevance, adequacy, and feasibility of approaches to teacher development, to confront and negotiate understandings and epistemological beliefs, and to build practices that improve the quality of their practice (Flores, 2016). This raises questions related to the role of cooperating teachers and university supervisors who need to position themselves in an inquiry stance.

Among all the five cases, teacher educator plays a crucial function as a 'praxical' bridge in the mediation of learning. Mentors and teacher educators are those responsible for assuming the challenging task of mediating professional learning. Their role requires connecting between the mentor's professional knowledge and the student's vicarious and formal learning experiences at various levels. At one level, they need to be aware of the complexities that characterize the workplace as a practical setting of learning. At the other level, they need to understand how their expertise and 'wisdom of practice' can be translated into a coherent model of learning for the teacher/ student teacher. Thus, they need to create opportunities for professionals and student teachers to be exposed to a variety of professional interactions, codes, and norms of behaviour, core practices and routines of practice at the workplace. They also need to show how patterns of practices and standards of the profession adapt to the dynamics of reality, while moving from case to case, from person to person and from situation to situation. The challenge of instrumentality-supported professional learning lies, then, in the teacher educator's ability to create meaningful 'praxical' bridges between the fixed and the dynamic, the structured and the messy, and the expected and the unexpected (Orland-Barak, 2010). Creating these bridges calls for the use of particular strategies to 'dig out' implicit, unarticulated knowledge in practice in order to encourage teachers' representations, explanations, and sense making of their enacted practices (Orland-Barak & Maskit, 2017).

Apart from this, it is, therefore, argued that there is a need to reconsider the teacher education curriculum in order to respond to the increasing uncertainties and complexities of teaching in the 21st century, especially at a time when more pressure and demands are placed upon them in contexts marked by growing accountability and greater multiculturalism (Ben-Peretz & Flores, 2018). Teachers will need to use their professional judgement 'rather than being driven solely by research evidence or data' (Nelson & Campbell, 2017, p. 128). As such, a redefinition of university and school roles with a growing emphasis on strong, coherent, and supportive partnerships is clearly at the heart of challenging the binary of theory and practice through the combination of teaching and research, researching teaching and teaching research. It implies, therefore, moving beyond a view of teaching practice as a process of adaptation or of application of theory (Flores, 2016), one in which pre-service teachers and in-service teachers are not only consumers but also producers of their professional knowledge. For

this to happen, besides the research dimension of teaching, it is crucial to include and develop the ethical, social, cultural, and political elements in order to promote initial teacher education as a space of transformation. Teaching practice and research become then two crucial elements which also need long-term commitment requiring strong and more consistent collaboration between schools and universities.

At the sprouts of the Anthropocene and the Metaverse, professionals are called to meet the challenges brought about by an era of globalisation, AI, big data, and seamless living. In this context, there is an urgent need to recognise that the traditional competencies that have formed the profile of the efficient professional must undergo radical changes, adaptations, and modifications to fit these growing demographic shifts. In addition, the 'new world' of technology has amplified mobility, enhanced virtual communication, and developed tools for supporting simultaneous forms of practice. These developments have created new challenges and opportunities for managing the rapid changes occurring in the professional scenario of the 21st century. As such, they compel the acquisition and execution of new skills and competencies in the daily work and activity of professionals across disciplines, geographies, and cultures.

In particular, teacher education programmes see now a growing demand for developing teachers' practical knowledge across a range of settings of teaching practice. Some of these new emerging practical knowledge include, for example: Adapting to the local culture through systematic observation skills and developing the ability to think and function flexibly; accessing data from multiple sources simultaneously; navigating in cyberspace to establish new, creative connections within the professional domain; communicating intelligibly, fluently and appropriately with people from diverse cultural, ethnic, and geographical backgrounds; gaining competence in learning through virtual modalities; managing emergent ethical conflicts in a globalized context of work; improving inter-personal communicative skills to both adapt and add one's singular contribution to the new working environment. The above developments point to three major interrelated modalities for supporting the mediation of learning: Technology-enhanced environments; professional mentoring frameworks of interaction and the systematic study of professional discourse and discourse practices.

We thus need to develop methodologies of instrumentality-supported learning that guide the conceptualisation and implementation of the above modalities for the preparation of professionals: Professional learning and technology, including learning design methodology that integrates the needs and realities of professionals; mentoring and curriculum development in professional education; professional discourse awareness; and social and academic adaptation in cross-cultural migration and knowledge cultures and learning in professional education and work. The new conditions and demands for the labour force raise acute challenges to be faced by

institutions of professional qualification – to respond appropriately to the rapidly changing nature of the 21st-century world of work. Specifically, such challenges could become pressuring in complex organizations with traditional autonomy to set their liberal educational objectives. This is especially evident in professional education programmes at the universities.

Further developments are needed to improve the research dimension within the initial teacher education curriculum in a more explicit and articulated way, namely in regard to the understanding of professional development underpinning student teachers' pedagogical projects and learning experiences as well as the training of student teachers in research methods. Darling-Hammond (2017), drawing on well-developed systems for teacher education around the world, identifies a set of leading practices that might be considered as 'promising strategies' for improving teaching and teacher learning. Also, more recently, in discussing and conceptualising the problems and possibilities of knowledge mobilisation and professional development in schools, Dimmock (2016) identified three main issues: (a) bridging the research-policy-practice gap by mobilising knowledge more effectively through knowledge producers and consumers working collaboratively; (b) valuing and integrating both tacit knowledge and academic coded knowledge; and (c) raising the professionalism and reflexivity of teachers and leaders. These suggestions all orient a promising direction of teacher education by redesigning teacher learning for future.

Last but not the least, in the current years, teachers around the world are experiencing crises due to the COVID-19 pandemic. In different countries, the sanitary conditions forced teachers to spend time at home or isolated in the classroom, delivering teaching through an online learning platform such as video conferencing systems. As well as changes in the teacher education programmes, instructional design modality, and daily teaching practices, teacher educators have to deal, like many professionals, with new emotional stress and sometimes also new social arrangements and spatial configurations in the family environment. Indeed, a crisis causes some change in the role to perform and assume and a necessary adaptation to the situation, in material, social and cognitive forms, not always supported by conscious and explicit assumptions. Although we don't know the exact time of the COVID-19 to be controllable, the instrumentality-supported learning model can be adopted as an analytical framework to review pre-service teachers' learning trajectory in a more blended learning setting. Supported by the instrumentalities, teacher educators recognise pre-service teachers' needs and refine instruction, and in review, react by adapting and modifying mentoring practices. Through these actions, we see results that demonstrate how we moved our teacher education practices. In these troubling times, pre-service teachers with adequate practical knowledge mean to develop a better connection with reality, taking sensitive eyes to seeing the vulnerable, and dealing with crises situation in a propositive attitude.

References

Ben-Peretz, M., & Flores, M. A. (2018). Tensions and paradoxes in teaching: Implications for teacher education. *European Journal of Teacher Education, 41*(2), 202–213.

Chen, X. (2011). *Bridging theory and practice: Research on teacher practical knowledge*. Beijing: Education Science Press.

Craft, A. (2000). *Continuing professional development: A practical guide for teachers and schools*. London: Routledge/Falmer.

Darling-Hammond, L. (2017). Teacher education around the world: What can we learn from international practice? *European Journal of Teacher Education, 40*(3), 291–309.

Dimmock, C. (2016). Conceptualising the research-practice-professional development nexus: Mobilising schools as 'research engaged' professional development learning communities. *Professional Development in Education, 42*(1), 36–53.

Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Helsinki: Orienta-Konsultit.

Feiman-Nemser S. (2012). Teacher preparation: Structural and conceptual alternatives. In W. R. Houston (Ed.), *Handbook for research on teacher education*. New York: Macmillan.

Flores, M. A. (2016). Teacher education curriculum. In J. Loughran and M. L. Hamilton (Ed.), *International handbook of teacher education* (pp. 187–230). Dordrecht: Springer.

Flores, M. A. (2018). Linking teaching and research in initial teacher education: Knowledge mobilisation and research-informed practice. *Journal of Education for Teaching*. doi: 10.1080/02607476.2018.1516351

Gadotti, M. (1996). *Pedagogy of Praxis. A Dialectical Philosophy of Education*. New York: SUNY Press.

Goodwin L. (2020): Teaching standards, globalization, and conceptions of teacher professionalism. *European Journal of Teacher Education*. https://doi.org/10.1080/02619768.2020.1833855.

Guskey, T. R. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press.

Gutiérrez, K. D., & Penuel, W. (2014). Relevance to practice as a criterion for rigor. *Educational Researcher, 43*(1), 19–23.

Hawkey, K. (1997). Roles, responsibilities, and relationships in mentoring: A literature review and agenda for research. *Journal of Teacher Education, 48*(5), 325–336.

Korthagen, F. A. (2017). Inconvenient truths about *teacher learning*: Towards professional development *3.0. Teachers and Teaching, 23*(4), 387–405.

Korthagen, F. A., & Kessels, J. P. (1999). Linking theory and practice: Changing the pedagogy of teacher education. *Educational Researcher, 28*(4), 4–17.

Larrivee, B. (2000). Transforming teaching practice: Becoming the critically reflective teacher. *Reflective Practice, 1*(3), 293–307.

Lave, J. (1988). *Cognition in practice: Mind, mathematics and culture in everyday life*. Cambridge, MA: Cambridge University Press.

Miettinen, R. (2000). The concept of experiential learning and John Dewey's theory of reflective thought and action. *International Journal of Lifelong Education, 19*(1), 54–72.

Nelson, J., & Campbell, C. (2017). Evidence-informed practice in education: Meanings and applications. *Educational Research, 59*(2), 127–135.

Niemi, H. (2021). AI in learning: Preparing grounds for future learning. *Journal of Pacific Rim Psychology*, *15*, 1–12. https://doi.org/10.1177/18344909211038105

Orland-Barak, L., & Maskit, D. (2017). *Methodologies of mediation in professional learning.* New York: Springer.

Orland-Barak, L. (2010). *Learning to mentor-as-praxis. Foundations for a curriculum in Teacher.* New York: Springer.

Palmer, P. J. (1998). *The courage to teach: Exploring the inner landscape of a teacher's life.* New York: Jossey-Bass.

Putnam, R. T., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29*(1), 4–15.

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher, 27*, 4–13.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Education Review, 57*(1), 1–21.

Sprinthall, N., Reiman, A., & Thies-Sprinthall, L. (1996). Teacher professional development. In J. Sikula, T. Buttery, & E. Guyton (Eds.), *Handbook of research on teacher education* (2nd ed., pp. 666–703). New York: Macmillan.

Swennen, A., & White, E. (2020). *Being a teacher educator: Research-informed methods for improving practice.* London: Routledge.

Vygotsky, L. (1978). *Mind in society.* Cambridge, MA: Harvard University Press.

Zeichner, K. M. (1983). Alternative paradigms of teacher education. *Journal of Teacher Education, 34*(3), 3–9.

Epilogue

William Shakespeare said, 'know thyself'. This is the last piece of remarks in the monograph by which I would like to say something more about the study and the field of teacher education by knowing ourselves as teacher educators.

For teacher educators, understanding better *how* pre-service teachers learn from initial teacher education programmes provides a frame for examining the degree to which teacher education programmes prepare student teachers for the role of a real teacher. It may also enable us to challenge the accepted staffroom folklore that the first-year survival phase is the way we learn to teach. The pre-service teachers' initial responses signal a number of questions that can be asked of teacher education:

- To what degree do pre-service programmes provide opportunities for student teachers to examine aspects of personal beliefs about teaching and being a teacher?
- How can we ensure that student teachers have opportunities to examine and experience relationships as a basis of teaching and learning?
- How can we support student teachers to develop dispositions required to learn from experience and thus support becoming a teacher as a process of lifelong learning?

In the present monograph, I employed 'practical knowledge' as a key word to unfolding the possible reform in teacher education. Similar to the recent literature that points to the importance of becoming a teacher rather than learning how to teach, the importance of taking time within pre-service programmes to articulate and examine student teachers' beliefs and personal conceptions of teachers and teaching is reinforced, which privileges the voices and stories of his student teachers in the following statements that intellectual and experiential knowledge are important to the ongoing development of teaching skills, but preferring personal knowledge builds confidence in the power of self and self-study. When personal knowledge is in the forefront, conscious epistemological changes are feasible.

Participating in practice-based training curriculum, like school place-ment, reinforced the importance of initial teachers purposefully interrogat-ing, 'Who do you want to be as a teacher?'. In responding to the question that sought their advice to pre-service programmes, they stressed the im-portance of student teachers taking time to 'know thyself' and being clear on their philosophy as a teacher. We suggest that the data in this limited in-vestigation call for us to give greater attention in pre-service programmes to the degree to which we do enable student teachers to articulate and examine their personal conceptions of teaching and being a teacher.

The pre-service teachers' responses suggest that establishing relation-ships with students is fundamental to both their students' learning and their own learning and development as teachers. The ways in which teachers es-tablish relationships grounded in trust and an ethic of care are certainly an important element of pre-service teacher education. The data emerging from the beginning teachers suggest that more time might be given to this dimension across pre-service teacher education. Their responses indicate that their practicum experiences did not provide the opportunity for such development. All respondents emphasized the difference associated with being solely and completely responsible for the learning of their students, in contrast to their practicum experiences where their associate teacher had ultimate responsibility and had built the initial teacher-student relationship on which they subsequently 'intruded'.

As teacher educators, we need to consider ways in which we can struc-ture student teachers' real personal and collective experiences that enable them to establish sustained relationships with students over a time period that supports the development of autonomy and responsibility as teachers. It must be acknowledged, however, that there will always be limits on the student teacher's ability to feel full responsibility, and it may well be more important to acknowledge explicitly these inherent restrictions on student teachers' relationships with students in an associate teacher's classroom. In most practical situations, the student teacher arrives after the 'real' teacher-student bond has been established and leaves before it concludes. The first-year teachers contributing data to this chapter indicate clearly that establishing their own personal relationships with students without compe-tition from another and more experienced teacher launched them to a new level of professional learning from experience.

The pre-service teachers' responses demonstrate that becoming a teacher is an ongoing process that is initiated, not completed, in the formal pre-service teacher education programme. This suggests that the practicum, while typically identified as the most important part of the pre-service expe-rience, is *not*, in hindsight, interpreted by these participants as an authentic experience of being a teacher. Through these teachers' responses we are re-minded that it is only during the first year of teaching that these participants took on the identity and responsibility of teachers. As student teachers they

were not given the responsibility and autonomy that appear to be critical to their identification with the role of teacher that is grounded in sustained relationships with *my* students in *my* class.

In reviewing all the 400 participants' responses, it also became clear that there is significant potential for teacher educators to be more involved in the early years of teaching, supporting, and working with beginning teachers.

This monograph with my humbleness hopefully emphasizes the reciprocity of research and practice. In the age of AI and visual reality, our teacher education should be designing learning for future. Last remark send to the promising teachers:

Try to firm up what your philosophy is as a teacher.

If you are not sure what your beliefs are, it will be easier to be led astray from them by outside forces.

Index

Note: **Bold** page numbers refer to tables; *italic* page numbers refer to figures.