Exploring the Effects of an Evidenced-based Professional Development Programme on Teaching and Learning in Chinese Kindergartens



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"The greatest a university lies, not in having magnificent buildings, but in having exceptional scholars." (所謂大學者，非謂有大樓之謂也，有大師之謂也; Stated by Mei Yiqi) I'm absolutely so lucky to meet many brilliant scholars and friends and enjoy their love and support to open up my eyes and broaden my horizons.

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List of Abbreviations

CECERS Chinese Early Childhood Environment Rating Scale

CLASS The Classroom Assessment Scoring System

DAP Development Appropriate Practice

ECEC Early childhood education and care

ECERS-E Early Childhood Environment Rating Scale-Extension

ECERS-R Early Childhood Environment Rating Scale-Revised

EF Executive Function

EL Emergent Literacy

EN Emergent Numeracy

FEEL Fostering Effective Early Learning study

IDELA The International Development and Early Learning Assessment

LfL Leadership for Learning

MOE Ministry of Education

NTTP National Teacher Training Programme

NQF National Quality Framework

NQS National Quality Standard

PD Professional Development

RCTs Randomised Controlled Trials

SE Social-emotional

SSTEW Sustained Shared Thinking and Emotional Well-being Scale

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Abstract

Teachers' professional development (PD) has become a frequent response to raising the quality and impact of early childhood education and care (ECEC). However, due to the lack of rigorous PD design and evidence-based PD programmes in China, providing PD programmes to improve the quality of ECEC is considered as high cost and low return. In order to improve early childhood teachers' instruction and children's learning outcomes, this study adapted (both educationally and culturally) an evidence-based PD programme - the Leadership for Learning (LfL, Siraj et al., 2018; 2023) - for early childhood practitioners and evaluated its effects on classroom quality and children's literacy, numeracy, executive function, and social-emotional skills in Shenzhen, China.

The cluster-based randomised controlled trial (RCT) design was utilised to evaluate the effects of PD on classroom quality and child development. The project involved 95 classrooms, 202 teachers and 547 children from 24 preschools, with 12 preschools in the intervention group and 12 preschools in the control group. In order to evaluate the PD effects on classroom quality, Early Childhood Environment Rating Scale-Extension (ECERS-E; Sylva, 2010) and Sustained Shared Thinking and Emotional Wellbeing (SSTEW; Siraj et al., 2015) scales were employed in the pre- and post-test. In terms of child development, the International Development and Early Learning Assessment (IDELA; Save the Children, 2011) was used to measure children's emergent literacy, numeracy, executive function, and social-emotional skills. In addition, teachers in the intervention group completed a follow-up semi-structured questionnaire to reflect on their perceived changes and the factors that influence the PD impacts.

Regarding the impacts on classroom quality, this research employed two-level models, in which classrooms were nested within kindergartens, to test the PD effectiveness. Results of multilevel regression analysis indicated the significant effects of PD on ECERS-E

(B = 1.060, $p < .001$, SE = 0.103) and SSTEW (B = 0.990, $p < .001$, SE = 0.146). Regarding the impacts on child development, several two-level models were constructed with children being nested within classrooms. These analyses indicated significant PD effects on emergent literacy (B = 11.057, $p < .001$, SE = 3.535), emergent numeracy (B = 14.072, $p < .01$, SE = 4.632) and executive functions development (B = 6.775, $p < .05$, SE = 2.645), but non-significant effects on social-emotional skills (F (1, 555) = 3.285, $p > .05$) as compared to the control group. The qualitative analyses indicated that teachers perceived the impacts of the PD programme on the classroom environment, teachers' teaching and learning, children's developed skills, and colleagues' improvements. They attributed the impacts to the contextually-appropriate PD content, continual evaluation, regular classroom visits and feedback, kindergarten support and peer recognition.

This research indicated that the adapted LfL PD significantly accounted for improving classroom quality and child development outcomes. In addition, this research offered the first rigorous test of the cross-national adaptations of a PD programme, which can contribute to cross-cultural studies. Constructing PD programmes in terms of the "what", "how", and "who" framework, and integrating evidence-based elements into this framework with contextually- and culturally-appropriate adaptations could be used in future PD designs. The contributions, limitations and implications are also discussed in this thesis.

Chapter 1 Introduction

Early childhood education and care (ECEC) has come to play an essential role in promoting children's learning and development, cultivating lifelong learners, combatting the effects of family poverty, and increasing social mobility (Heckman, 2008; Sayre et al., 2015; Siraj et al., 2018; 2023). The impacts of preschool attendance on children's behaviour and learning sustain till adolescence (Taggart et al., 2015). Supported by research evidence, public investment in ECEC has been growing worldwide, and this trend is especially evident in China. In particular, around 2.39 billion pounds from Chinese governments were invested in in-service training for preschool and primary school teachers during 2010-2021 (Ministry of Finance of the People's Republic of China, 2021). Meanwhile, the number of preschools serving 3-6 years old of children rose from 0.27 million to 0.29 million in 2018-2022, and there were 3.19 million preschool teachers in 2022 (Ministry of Education of the People's Republic of China (MOE, 2022).

However, expanding the quantity of kindergartens and teachers without improving teaching quality and children's classroom experiences might make little difference in children's learning and development (Wolf et al., 2018). For example, Sylva et al. (2011) conducted a large-scale longitudinal study involving 141 preschool settings and over 3000 children in England to exploring the impact of preschool quality on children's cognitive and behavioural development. They found that the developmental outcomes of low-quality preschool children did not show significant differences from their cohorts who never received formal ECEC services (Sylva et al., 2011). Therefore, there is an urgent need to foster effective teaching through in-service professional development (PD) for early childhood teachers, particularly in areas where initial training is fragmented, low-quality and serves diverse populations. Several PD interventions have been designed and implemented, including the Fostering Effective Early Learning (FEEL) programme in Australia (Siraj et al.,

2018; 2023) and MyTeachingPartner (MTP) in the US (Pianta et al., 2008). These PD interventions in early childhood settings, among others, have been shown to enhance pedagogical quality and child developmental outcomes significantly (Egert et al., 2018).

Despite the internationally growing concern about providing effective PD to improve ECEC quality, there is a lack of research on delivering and evaluating effective PD programmes for early childhood teachers in the Chinese context (Hu et al., 2014). Moreover, Loyalka et al. (2019) have identified most PD programmes as having high-cost and low returns. For example, China's flagship National Teacher Training Programme (NTTP, MOE, 2010) cost more than one billion; however, it showed little difference in promoting teaching practice. Furthermore, the Chinese government faces a significant challenge in training around 4.1 million early childhood teachers by 2022. This challenge occurs against the backdrop of having an early childhood workforce that historically holds low social status, low entry qualifications and fragmented training systems (Li et al., 2017; Zhang et al., 2019). Therefore, this study aims to fill the research gap by adapting an evidence-based PD from the FEEL study (Siraj et al., 2023) to enhance the teaching quality of Chinese early childhood teachers and further improve children's learning outcomes.

1.1 Promoting Effective Teaching and Learning through PD in Early Years Settings

PD refers to the "facilitated teaching and learning experiences that are transactional and designed to support the acquisition of professional knowledge, skills, and dispositions as well as the application of this knowledge in practice" (NPDCI, 2008, as cited in Buysse et al., 2009, p. 239). In the field of ECEC, various in-service training opportunities, such as coaching, consultation, mentoring, and communities of practice, are offered to improve teaching and benefit children's learning (Buysse et al., 2009; Egert et al., 2018; Winton et al., 2008).

Impacts of effective PD. Research in ECEC generally indicates that effective PD programmes can improve teachers' practice by offering theoretical and content knowledge as well as alternative instructional methods to challenge their current beliefs and support improvement (Mitchell & Cubey, 2003). For example, Early et al.'s (2017) randomised controlled trial (RCT) research showed that Making the Most of Classroom Interaction (MMCI) and MTP PD programmes can significantly enhance teachers' emotional support and instructional support for children. Additionally, participating in more coaching cycles leads to better instructional support (Pianta et al., 2021).

Furthermore, engaging teachers in effective PD programmes also improves child learning outcomes with a small to medium effect size (Egert et al., 2018). For example, the Leadership for Learning (LfL) PD has been demonstrated to effectively promote children's literacy and numeracy skills (Siraj et al., 2018; 2023). In order to explore the working mechanism, Mitchell and Cubey (2003) analysed experimental studies that led to improvements in pedagogical practice. They identified four shared core elements: a) focusing on scaffolding children's learning; b) supporting interactions between children and the environment; c) addressing children's questions; and d) facilitating adult engagement and child involvement. According to the bio-ecological theory, these key elements are part of the proximal process, directly related to child outcomes, as daily interaction is the "primary engine of development" (Bronfenbrenner & Morris, 2006, p. 799). PD programmes promoting teacher-child interaction help teachers become more aware of children's ideas and tailor their pedagogical practice to extend children's thinking. Additionally, PD programmes renew and strengthen teachers' beliefs and practices of effective teaching, which play a vital role in supporting child learning outcomes.

Influencing factors of PD programme. It has been found that teachers typically spend around 10.5 days per year engaging in in-service PD training, such as courses,

workshops, and seminars (Sellen, 2016). However, not all PD programmes are effective in helping teachers apply what they have learned in practice. Research has shown that some forms of PD, such as lectures and workshops, may not benefit teachers' learning or instructional strategies (Joyce & Showers, 1982). For example, only 10% of teachers demonstrated knowledge gains following typical lecture-based activities. In comparison, the percentage of teachers with knowledge gains jumped substantially to 95% when the coaching component was introduced (Joyce & Showers, 2002). These findings suggest that whether teachers apply what they have learned in practice is crucial to the effectiveness of PD.

Therefore, many studies have shown that coaching for early childhood educators promotes teacher practices and child development (e.g., Egert et al., 2018; Neuman & Cunningham, 2009). In particular, on-site coaching facilitates PD effectiveness by helping individuals to gain a deeper understanding of the training content and acquire new abilities to renovate existing ones (Rush & Shelden, 2005). In addition, continual assessment of classroom practice has also been demonstrated to facilitate teacher change (Borko, 2004) since its results could identify the current weakness and thus guide the direction of improvement.

Moreover, the absence of a shared understanding of training content and high teacher turnover rates can be detrimental to PD effectiveness (Darling-Hammond et al., 2017). For example, overly theoretical content and passive learning experience can make it challenging for teachers to remember, understand or implement what they have newly learned (Loyalka et al., 2019). Subject-specific PD tends to be more effective in addressing this issue than general pedagogical knowledge, as teachers can directly apply domain-specific knowledge to their daily activities. Additionally, PD must be sustainable as teachers need time to assimilate new knowledge and replace their previous teaching behaviours with newly acquired ones. High teacher turnover rates prevent teachers from sustaining or practising their new teaching

approaches. Therefore, it is essential to have stable teachers to conduct intervention research and evaluate PD effectiveness in preschools.

In addition, Darling-Hammond et al. (2017) identified seven characteristics of effective PD programmes by reviewing 35 methodologically rigorous studies. The seven shared features are (1) training teaching strategies that are discipline-specific; (2) emphasising teachers' active learning; (3) facilitating knowledge-sharing and collaboration among teachers; (4) modelling effective instruction to help teachers understand what the best practice is; (5) providing coaching and expert support to address teachers' individual needs; (6) encouraging reflection through soliciting feedback; and (7) ensuring the training duration. These characteristics align with the theory of change (Connell & Kubisch, 1998), emphasising clear goals, relevant activities, and supportive contexts to drive meaningful transformation. Therefore, the current study has integrated these seven key elements into the PD design in this study, focusing on providing discipline-specific training and emphasising active learning through discussion, collaboration, modelling of effective practice, and on-site mentoring. By incorporating these characteristics, this study aims to facilitate lasting change in teachers' practices and enhance the educational experience for preschool children.

1.2 Professional Development for Early Childhood Teachers in China

The urgent need for PD in Chinese kindergartens. Kindergartens (or "you-er-yuan" in Chinese) are the primary ECEC institutions for children aged 3-6 years in China. In 2010, the Chinese government set out to increase its investment in ECEC and achieve national coverage of kindergarten education within a decade, as stated in the *Outline of the Chinese National Plan for Medium and Long-term Education Reform and Development (2010-2020).* However, with the expansion of kindergarten enrollment comes growing concerns about the quality of kindergartens. Li and colleagues (2019) measured the quality of 428 classrooms in 193 Chinse kindergartens using the Chinese Early Childhood Environment

Rating Scale (CECERS, Li et al., 2016). The results indicated that observed classroom quality was moderately low on average (Li et al., 2019). Furthermore, there is a lack of continuous PD or other support to help teachers improve pedagogical quality in classrooms. As a result, teachers rely on whole-class teaching and neglect one-on-one or small-group pedagogical interactions, especially in rural areas (Hu et al., 2016). Therefore, continuous in-service PD is needed to improve teaching quality and enhance children's learning in Chinese kindergartens.

The fragmented landscape of PD in Chinese kindergartens. Although many PD programmes have been implemented to improve the quality of ECEC, the effectiveness of these programmes remains limited (Jiang et al., 2017). Zhang and Xie (2019) reviewed the research on Chinese kindergarten teachers' in-service training over the past decade. They found that collective lectures, online courses, classroom observation, consulting experienced teachers, school-based professional communities, and workshops were the primary PD approaches for in-service teachers. School-based training is the most widely used approach, accounting for 42.9% of in-service training (Jiang et al., 2017). However, current PD programmes have significant problems, such as a lack of clear training goals, weak relevance to the school curriculum and teaching practices, and a lack of follow-up evaluation of PD effectiveness (Zhang & Xie, 2019; Zhu, 2012). For example, many PD programmes in China aim to promote teachers' basic skills, such as singing, dancing and playing the piano, rather than pedagogical knowledge, content knowledge, or other teaching strategies, resulting in little improvement in teaching quality (Hu et al., 2014; Yang & Rao, 2020; Zhang & Xie, 2019). Furthermore, the effectiveness of school-based training is greatly influenced by school resources, teacher qualifications, principal characteristics, and individual school leadership, which results in a lack of PD programmes in rural or low-quality kindergartens (Yang & Rao, 2020).

The lack of PD on effective teaching. Previous PD programmes in China have traditionally focused more on assisting teachers with conducting well-planned teaching rather than on how to help children with their learning. This approach reflects the importance of teachers' authority and children's obedience in Chinese culture. As a result, teachers are often accustomed to using teacher-directed activities with clear structures and teaching goals. However, this approach can result in PD providers neglecting to evaluate teachers' training needs before designing programmes. As previously mentioned, the NTTP was launched by the Chinese government in 2010, which involved collective lectures, online discussions, and visits to high-quality kindergartens (MOE, 2018). Despite the significant resources devoted to this nationwide PD programme, its effectiveness was limited. Loyalka et al. (2019) found that approximately 52% of the materials were identified as "theoretical", with little application to actual practice (Loyalka et al., 2019). Moreover, the programme did not provide PD content that helps teachers understand children, identify their needs, or scaffold their current thinking. Against this backdrop, this study aims to address this gap by constructing a PD programme based on research evidence of teachers' strengths and weaknesses in teaching. This evidence-based approach aims to support children's learning and teachers' teaching/leadership for learning.

1.3 The Research Setting: Shenzhen

Breath-taking socio-economic growth. Shenzhen is a coastal city in South China, adjacent to Hong Kong and Macao. It holds the distinction of being China's first Special Economic Zone (SEZ) to ignite economic growth in 1980. As a national pilot city for comprehensive reform, Shenzhen has undergone a remarkable transformation from an agriculture-based County into a modern metropolis. The per capita disposable income of residents has increased significantly, rising from 1,915 RMB in 1985 to 72,718 RMB in 2022 (Shenzhen government, 2023). With the land area of 1997.47 square kilometres, it currently

has over 17.68 million people. In the first three quarters of 2022, the city's GDP reached 2292.5 billion RMB, placing it third in China after Shanghai and Beijing. Thus, Shenzhen has experienced unprecedented growth and prosperity over the years, positioning it as an influential participant in China's socio-economic landscape.

Dramatic educational reforms. As a SEZ, Shenzhen is directly governed by the central government of China, serving as an important site for national experiments in economic, educational, and political reforms. Embodying the ethos of 'reform and openness', the city has been at the forefront of transformative socio-economic and educational reforms. Following the opening-up policy in 1978, Shenzhen has embraced heavy foreign investment and experienced a high demand for labour, thus attracting a substantial number of young people all over the country. Notably, the average age of the city population was 31, creating significant pressure on the ECEC system since 1990 (Li & Wang, 2008).

Confronted with these challenges, the Chinese government responded by acknowledging the need for privatization of ECEC. Accordingly, the local authorities in Shenzhen initiated a process of commercializing public preschools in 2006. This policy mandated that all public kindergartens in Shenzhen should become self-sustaining institutions within three years (Li & Wang, 2008). This transformation moves the ECEC funding system from government-supported to market-driven to cope with the escalating demands of the rapidly growing population (Li & Wang, 2008). Although Shenzhen's pioneering commercialization of ECEC was a ground-breaking endeavour in China, it resulted in notable challenges related to accessibility, affordability, and accountability (Li et al., 2016; Qi & Melhuish, 2017). Specifically, it has led to rising costs for families seeking ECEC services and a decline in quality of both the formerly public, now market-driven kindergartens, and private kindergartens, despite the increased preschool enrolment in Shenzhen.

To address these problems, the Chinese government has called for the establishment of a public service ECEC system supported jointly by public and private sectors since 2010. The ministry of education in China subsequently released the Third Phase of the Action Plan for Preschool Education Implementation. This plan set a target for the coverage rate of universal kindergartens (combining public and universal private kindergartens) to reach approximately 80% by 2020. This marked a shift in China's ECEC system, moving away from marketisation towards a balance between public and private kindergartens. In Shenzhen, local authorities took decisive action in 2019 by setting a goal known as the "5080" task, aiming to achieve a 50% enrolment rate in public kindergartens and an 80% enrolment rate in kindergartens by the end of 2020. To fulfil this task, a significant number of new public kindergartens were built, and many private kindergartens underwent transformation into public institutions. In 2020, there were 859 public kindergartens, accounting for 45.98% of total kindergartens, with 658 private kindergartens converted into public ones. The percentage of children enrolled in public kindergartens increased from less than 4% in 2018 to 50.85% in 2020, with 19,677 preschool teachers involved (Tang, 2022).

Contextual needs preschool teachers. In 2021, the city of Shenzhen had 1,896 kindergartens catering to approximately 600,000 children, facilitated by a teaching workforce of approximately 42,400 educators (Shenzhen Bureau of Statistics, 2022). The expansion of public preschools has contributed positively to addressing concerns of accessibility and affordability. However, ensuring accountability in preschool education remains an ongoing challenge. While the number of kindergartens has increased, there remains a shortage of qualified teachers. The Kindergarten Staffing Standards (provisional, MOE, 2013) stipulate that each classroom should have a minimum of two class teachers and one nurse. The expansion of kindergartens highlights the significant demand for preschool educators,

necessitating urgent efforts in Shenzhen to recruit and foster high-quality teaching professionals.

Consequently, in 2022, the Shenzhen government responded by issuing the "Notice of Shenzhen Municipal People's Government on the issuance of the 14th Five-Year Plan for the development of education in Shenzhen". This plan outlined key objectives for ECEC over the next five years, including the cultivation of high-quality education, facilitating smooth school transitions, enhancing teachers' remuneration and retirement benefits, and strengthening the evaluation and monitoring of preschool education (Shenzhen government, 2022). To align with these goals, a series of professional development programmes have been implemented to improve teaching quality. However, the effectiveness of these training initiatives remains relatively unexplored. Furthermore, observations of preschool classrooms in Shenzhen have revealed that teachers often employ whole-class, teacher-directed instruction in large class settings, failing to provide adequate scaffolding for children's learning and development through challenging questioning (Huang et al., 2019). Consequently, policymakers, scholars, and practitioners in Shenzhen share a common concern regarding the need to enhance the provision of quality teachers to improve teaching and learning outcomes. Thus, Shenzhen presents an ideal context for implementing professional development interventions and examining their impacts. Therefore, this study was conducted within the city of Shenzhen.

1.4 The Leadership for Learning PD Programme

What is the Leadership for Learning (LfL) PD? The LfL PD was developed based on robust research evidence, involving the baseline assessment of classroom quality, global research on effective PD programmes, and national standards of ECEC quality in Australia. This PD programme aimed to enhance the process quality (i.e., pedagogy, curricula knowledge, and interactional quality) and child outcomes through three training phases. Phase 1 involved two full-day intensive face-to-face sessions, focusing on evidence that

supports quality in ECEC. Phase 2 consisted of five fortnightly half-day sessions that emphasised professional competence and curriculum content, such as literacy, numeracy, self-regulation, science and critical thinking. During each session, trainers offered practical examples for educators to discuss the underlying theoretical concepts and reflect on improvements. After each session, teachers were required to practice what they had learned and provide feedback at the next session. Finally, phase 3 consisted of a continuous online support programme that provided resources and initiated online discussions, along with one half-day face-to-face session that responded to teachers' evaluative feedback in Phase 2 (Siraj et al., 2018; 2023). Ninety educators from 38 intervention centres attended PD sessions at three training hubs. These participants included teachers and directors from the same centres who attended the training together to contextualise their learning and ensure the implementation of new strategies and skills. The LfL PD has been demonstrated to be effective in promoting effective teaching and children's literacy, numeracy and social-emotional development.

The rationale for adapting LfL PD. Although an increasing number of studies are evaluating the effects of PD on teaching quality and child outcomes, most PD programmes are discipline-specific, such as focusing on literacy-related teaching or mathematics instruction (e.g., Neuman & Cunningham, 2009; Justice et al., 2009; Landry et al., 2006). However, while primary or secondary school teachers teach separate subjects, preschool teachers are responsible for teaching multiple subjects and require comprehensive training in diverse learning domains. To address this need, Siraj et al. (2018, 2023) designed the LfL PD programme, which is evidence-based and covers a wide range of foundational principles related to child learning and development. This PD programme includes a relatively full range of foundational principles of child learning and development, aiming to promote teachers' leading role in intentional and relational teaching (Siraj et al., 2018, 2023). This

cluster-randomised controlled trial study demonstrated significant improvements in curricular and pedagogical quality among participating teachers compared to the control group. Additionally, children in the intervention classrooms showed significant improvements in language and numeracy skills. This recent project suggests that evidence-based PD programmes aimed at enhancing teachers' pedagogical interaction across various domains can positively influence professional practices and foster child development. Given the lack of evidence-based PD programmes for Chinese teachers and the effectiveness of LfL PD, this study adapted it in China and explored its effects on classroom quality and child development.

1.5 Research Objectives

This research primarily concentrates on the following research objectives:

Adapting the LfL PD programme. The primary aim of this study is to adapt the evidence-based LfL PD programme for the Chinese context in a way that is both educationally and culturally appropriate. Notably, participants in most randomised controlled trials (RCTs) PD programmes are in high and middle-income countries or regions with advanced educational systems, which may exacerbate educational inequality (Rathod et al., 2019). As Elliot and Mihalic (2004) suggest, the new frontier in intervention research is to build a knowledge base for replicating and disseminating programmes that have been demonstrated to be effective. Thus, this research adapted the LfL PD programme based on research evidence of ECEC quality in Chinese kindergartens, effective PD characteristics, the national curriculum, and a preliminary assessment of teachers' PD needs. The adaptations include engaging Chinese experts to deliver curriculum knowledge, recording and evaluating teachers' practice, and providing on-site mentoring.

Exploring the effectiveness of the adapted LfL PD programme. The second objective of this study is to assess the effectiveness of the adapted PD programme on

classroom quality and child development using both outcome and process evaluations. Quantitative analysis was conducted using the Early Childhood Environment Rating Scale-Extension (ECERS-E, Sylva et al., 2003) and the Sustained Shared Thinking and Emotional Well-being Scale (SSTEW, Siraj et al., 2015) to measure classroom quality. Child outcomes in emergent literacy, numeracy, and social-emotional development were directly assessed by The International Development and Early Learning Assessment (IDELA). To explore the qualitative impact of the PD program, teachers were invited to complete a questionnaire to express their perceptions of the PD programme's influence and reflect on their PD experience.

Exploring the influencing factors of the PD effects. The third objective of this study is to investigate whether the impacts of the adapted PD programme on classroom quality and child development vary according to school characteristics, teachers' demographic characteristics, and children's baseline ability. Previous research on PD interventions has mainly focused on exploring their effects without examining whether all participants experience the same extent of changes or what factors influence the effectiveness of PD. Therefore, this study examines whether the impacts of PD on classroom quality vary according to school locations (urban vs suburban), types (public vs private), and classifications (i.e., province level, city level and district level). Moreover, it investigates to what extent teachers' qualifications, age, and years of experience influence the PD programme's impacts on children.

Exploring why the adapted PD works or fails to work. The fourth objective of this study is to explore the underlying mechanism by which the adapted PD programme functions in teachers' practice and child outcomes. Although previous research identified the positive impacts of PD programmes on classroom quality and child development, few studies explored how this happened or whether improvements in classroom quality result in

improved child development. Therefore, this study aims to identify factors that enhance or weaken PD effectiveness by examining teachers' PD experiences. The results of this study will inform the design of future PD programmes.

1.6 Research Contributions

Practical contributions to effective teaching and learning. This research has presented an effective PD programme model for kindergarten teachers in China. The findings indicate that teachers who participated in this research significantly improved their pedagogical practice, teacher-child interaction and children's development. The result means that around 96 classrooms and over 3,000 children directly benefited from the PD programme. In addition, the effective PD programme model presented in this study can be replicated in other ECEC settings to improve pedagogical practice and enhance child development. The results provide valuable insights into improving ECEC quality and could have important implications for other low- and middle-income countries facing similar challenges.

Research contributions to cross-cultural PD adaptation. This study represents the initial thorough evaluation of the transferability of the LfL PD model across different countries, which was successfully adapted from Siraj et al.'s (2018, 2023) work. The results of this study can provide valuable insights for larger-scale and cross-national research about PD intervention. In addition, this research has highlighted the importance of considering cultural and contextual factors when adapting and implementing PD programmes. By involving Chinese experts, recording and evaluating teachers' practice, and providing on-site mentoring, the programme was tailored to meet the specific needs of Chinese kindergartens and teachers. The adaptations made to the programme could inform future efforts to adapt evidence-based PD programmes for other cultural contexts, and contribute to building a more

comprehensive knowledge base for replicating and disseminating effective programmes globally.

Research contributions in filling the knowledge gap of PD effectiveness in China. Prior studies in China have predominantly focused on measuring classroom quality or assessing PD effectiveness solely based on teachers' change. To our knowledge, a dearth of research examines the effects of PD programmes on child development in mainland China. Thus, as one of the first RCT studies investigating the PD effectiveness on both classroom quality and child development in mainland China, this research has filled an important research gap.

Theoretical contributions in modelling teachers' professional growth. Prior research on PD interventions aimed at improving teaching quality has mostly focused on quantitatively analysing the impacts on classroom quality, child outcomes and teacher self-report knowledge and beliefs (i.e., Early et al., 2017; Gore et al., 2017; Pianta et al., 2021; Sutherland et al., 2018). However, according to Clarke and Hollingsworth's (2002) Interconnected Model of teachers' professional growth, teachers' personal changes, practice changes, and outcomes work together during and after the PD programme. To capture this complexity, this study adopted a mixed-methods approach to investigate the impacts of the PD programme on teachers' professional growth. Using both outcome and process evaluations provides a comprehensive understanding of the PD effectiveness, influencing factors, and working mechanism, thus contributing to a more nuanced understanding of teachers' professional growth.

Policy contributions. This study indicated that effective PD programmes could lead to improved classroom quality and child development outcomes, which is especially important given the critical role that ECEC plays in shaping children's long-term academic and socio-emotional outcomes. These findings can help policymakers develop evidence-

based PD programmes for kindergarten teachers to improve the overall ECEC quality. This is especially relevant for Chinese teachers, as they may be uncertain about which pedagogical practices are most beneficial for child development due to the lack of adequate evaluation amidst several rounds of educational reforms. Therefore, this research offered a practical means of improving ECEC quality and promoting optimal child development.

1.7 Thesis Structure

The final thesis includes the following ten chapters.

Chapter 1: Introduction. This chapter provides readers with essential information regarding the research background, context, objectives and contributions of this study. It begins by discussing the crucial role of high-quality ECEC in promoting positive child development, highlighting the fragmented training provided to ECEC teachers, and the lack of PD intervention research in China. The chapter then outlines the research objectives and contributions of the current study. The final section presents an overview of the structure of the thesis, giving readers a clear understanding of what to expect in the coming chapters.

Chapter 2: Literature review. This chapter critically reviews previous research on classroom quality, child development, and preschool teachers' PD programmes. Specifically, this chapter re-examines the concept of ECEC quality and highlights the current challenges and potential strategies for improving it. After that, the second section critically analyses the characteristics of effective teachers, which can help identify the strategies to improve teaching effectiveness. The third section reviews evidence-based PD programmes that aim to enhance teachers' training and improve child learning in ECEC. Drawing on the analysis of ECEC quality, effective teaching, and characteristics of PD provision, this chapter identified the research gaps and proposed the research aims. The final section presents an overview of the research context in China, with a focus on ECEC quality and PD. It aims to underscore the pressing need for effective in-service PD in China by outlining several rounds of

educational reforms, the current quality of Chinese kindergartens, the fragmented nature of PD provision and the lack of rigorous evaluation of the PD effectiveness.

Chapter 3: The pilot study. This chapter introduces the objectives, methods, and findings of the pilot study conducted in 11 kindergartens and 12 classrooms. It aims to identify the strengths and weaknesses of preschool teachers' pedagogical practice and their PD needs. In addition, this chapter outlines the research design, data collection methods, and data analysis techniques employed in the pilot study. Furthermore, it presents the key findings from the pilot study that provide valuable insights into the adaptation of the LfL PD programme.

Chapter 4: The adaptation of the LfL PD. This chapter provides a detailed description of the adaptation process of the LfL PD programme was adapted. To begin with, it outlines the program's core components, including its objectives, methodology, and target audience, using the "what", "how", and "who" framework. Next, it introduces a conceptual framework based on three key elements: contextual-, cultural- and child-development appropriateness (3CAPs) and three approaches to cross-national research. This framework serves as a guide for adapting the programme to a new cultural and educational context. Finally, the chapter delves into the specifics of the adapted program, highlighting the key elements that were modified to better suit the needs of Chinese preschool teachers.

Chapter 5: Methodology. This chapter presents a comprehensive overview of the research design, including research questions, participants, randomisation, PD intervention process, measurements, and data analysis plan. The research questions include exploring the impacts of the PD intervention on classroom quality and child development and the influencing factors. Next, the PD intervention is described, followed by an overview of the measurements used to assess classroom quality and child development outcomes. Finally, the

data analysis plan is presented, outlining the statistical methods used to analyse the data collected from the study.

Chapter 6: Quantitative results: The PD effects on classroom quality and child development. In terms of classroom quality, this chapter consists of four sections. Firstly, the descriptive analysis presents the characteristics of participating classrooms. Secondly, the correlational and multi-level modelling analysis explores the main effects and moderation effects of PD on the instruction quality measured by ECERS-E. Thirdly, the correlational and multi-level modelling analysis explores the main and moderation effects of PD on the interaction quality measured by SSTEW. The findings suggest that the adapted PD has significantly improved classroom quality. Lastly, the final section summarises the key findings and highlights their significance for future research and practice.

In terms of child development, this chapter uses multi-level modelling to analyse the main and moderation effects of PD intervention on child literacy, numeracy, executive function and social-emotional development. The results demonstrate a significant positive impact of PD on children's literacy, numeracy, and executive function, while there was no significant impact on children's social-emotional skills. These findings provide important insights into the potential benefits of evidence-based PD interventions for improving young children's cognitive development in ECEC settings.

Chapter 7: Qualitative results: How and why the PD works? This chapter presents the qualitative analysis of teachers' questionnaires, focusing on their perceptions of the impacts and influencing factors of the PD programme. The first section of the chapter scrutinises the effects of the programme on various stakeholders, including teachers, classrooms, children, and schools. The second part explores the influencing factors by examining the "what", "how", and "who" components of the adapted PD programme. This part includes a comprehensive analysis of the programme's content, delivery methods, and

facilitators. By examining these factors, this chapter provides valuable insights into how PD programmes can be designed and implemented to achieve optimal outcomes in educational settings.

Chapter 8: Discussion. This chapter discussed the primary findings of this project. It involved four parts. First, the main effects and moderation effects of PD on classroom quality are discussed. Second, it further focuses on the main and moderation effects of PD on children's literacy, numeracy, executive function and social-emotional development, thereby highlighting the programme's effectiveness. The third section of the chapter presents teachers' perceptions of the PD programme, comparing and contrasting quantitative and qualitative findings to gain a more nuanced understanding of the programme's impact. Finally, the fourth section explores the various factors that influence the effectiveness of PD programmes, providing insights into how future programmes can be designed and implemented to maximise their impact.

Chapter 9: Conclusion. This chapter provides a comprehensive summary of the findings related to the PD effects and its influencing factors. Then, drawing on the insights gained from the research findings, this chapter presents a nuanced analysis of the implications for future research, practice, and policy.

Chapter 2 Literature Review

2.1 Understanding ECEC Quality

2.1.1 Process Quality Matters in Children's Effective Learning

Decades of international research have consistently shown that children who receive early childhood education tend to exhibit better cognitive, behavioural, and social-emotional outcomes than those who do not (Siraj et al., 2016). Furthermore, the positive impacts are significantly pronounced when the early years' settings are high quality (Slot et al., 2018). Quality in ECEC can be viewed in two parts. The first is structural quality, which includes school facilities, teacher-child ratio and teacher qualifications. This aspect can be considered a prerequisite for children's learning. The second is process quality, which includes learning materials, daily schedules, learning centre arrangements, and teacher-child interaction (Melhuish & Gardiner, 2019; Pianta et al., 2016).

Research on ECEC has consistently highlighted the importance of process quality in enhancing children's learning outcomes (e.g. Hu et al., 2017; Slot et al., 2018). While structural characteristics such as smaller class sizes, well-educated teachers and full-day programmes are essential, they alone cannot guarantee adequate educational provision or optimal learning for children (Pianta et al., 2016; Slot et al., 2018). Instead, teachers' ability to create a high-quality learning environment through effective interactions has been identified as a key factor in promoting children's learning (Farquhar & White, 2014; Fukkink & Lont, 2007). Therefore, process quality, which directly shapes children's experiences, significantly influences their learning outcomes. This aligns with Vygotsky's sociocultural learning theory, which suggests that children's development is optimised when educators scaffold their learning by providing challenging tasks (Vygotsky, 1978). As such, this section focuses on identifying the key elements of process quality and exploring how they influence children's learning, thus providing important insights into improving ECEC quality.

2.1.2 Key Elements of Process Quality

A growing number of studies have provided evidence that children who are cared for and educated in classrooms with higher process quality tend to have better language, literacy, mathematics, self-regulation, and social-emotional skills (e.g. Lin & Magnuson, 2018; Siraj-Blatchford et al., 2002; Vernon-Feagans et al., 2019). Specifically, substantial longitudinal studies, state-funded programmes, and meta-analyses have highlighted the critical role of high-quality teacher-child interactions in supporting young children's learning (e.g., Fukkink & Lont, 2007; Howard et al., 2018; Siraj-Blatchford et al., 2003). For example, Mashburn et al. (2008) conducted a large-scale study that involved 2,439 children and 671 preschools in exploring the association between classroom quality and child development. They found that the quality of instructional and emotional support significantly predicts children's academic and social skills (Mashburn et al., 2008). Schmitt et al. (2018) employed the Classroom Assessment Scoring System (CLASS, Pianta et al., 2008) to measure the quality of teacher-child interaction and found that it was moderately related to children's social competence. Similarly, in China, Li et al. (2016) used CECERS to measure the classroom quality in 91 kindergartens that enrolled 1012 children. This research revealed that only the Teaching and Interactions subscale was associated with children's language and math learning. These findings reinforce the growing consensus that teacher-child interaction is a crucial component of process quality (Pianta et al., 2016).

Teacher-child interactions are the dynamic behavioural and verbal engagement process between teachers and children (Downer et al., 2010). Warm, sensitive, and responsive interactions promote children's social competence, whereas teacher-child conflict predicts behaviour problems in early settings (NICHD ECCRN, 2002). The associations between teacher-child interaction and children's social-emotional development can be explained by attachment theory (Ainsworth, 1989). In particular, frequent, consistent and

sensitive interactions with primary caregivers ensure a stable and secure developmental environment for the child, thus promoting their prosocial behaviours and wellbeing.

Additionally, exposure to a socially complex dynamic with high-quality instruction, timely feedback on children's behaviour and sensitive interactions promote children's self-regulation, which can predict their later academic performance (Howard & Melhuish, 2017). For example, open-ended questioning in pedagogical interactions is associated with children's enhanced cognitive development (Siraj-Blatchford et al., 2002). These findings align with Bandura's social cognitivist theory (1986). According to Bandura, imitative learning is the first step of learning, and an individual will eventually construct a self-concept through internalising and imitation. When teachers interact with children in the pedagogic environment, specific language patterns, behaviours, and attitudes emerge, which contribute to children's cognitive, social and dispositional outcomes (Siraj-Blatchford et al., 2002).

2.1.3 Research Gaps and Possible Ways Forward

Although process quality is a crucial factor in child development, only measuring it without providing the corresponding professional development (PD) may not improve practice. Research has revealed a significant research-practice gap: even if the existing research has revealed the importance of process quality, quality teacher-child interactions remain challenging for many educators in practice. Few teachers can stimulate children's thinking and scaffold their knowledge (La Paro & King, 2019). Teachers often focus on teaching basic skills and tasks with specific answers instead of engaging children in challenging tasks that foster deep analysis, reasoning, or problem-solving skills (Pianta et al., 2016). Addressing this gap requires targeted and continuous evidence-based PD programmes for teachers. Such programmes have been shown to be effective in improving teachers' interactions with children and fostering children's learning and development (e.g., Pianta et al., 2016; 2021; Siraj et al., 2023). As such, there is a need for evidence-based PD

programmes that target process quality and teacher-child interaction to bridge this gap and improve practice.

In addition, it is important to acknowledge that most randomised controlled trials (RCTs) of PD programmes are conducted in areas with advanced educational systems, which might exacerbate educational inequality. Few studies have examined teacher-child interactions and child outcomes in the Eastern context, let alone tested PD programmes to improve teacher-child interactions (Hu et al., 2016). In this regard, adapting effective PD programmes from other areas to China can help build a knowledge base for replicating and disseminating programmes that have been demonstrated to be effective. However, it is crucial to ensure contextual appropriateness. To address this issue, further research should first examine the quality of Chinese kindergartens by localising existing measurement tools and then adapting existing PD programmes based on contextual needs and research evidence. Therefore, this study aims to validate established measurement tools in the Chinese context and use the results to inform the adaptation of delivering an evidence-based PD programme to improve teachers' pedagogical interactions and children's developmental outcomes.

2.2 Influencing Factors of ECEC Quality and Children's Learning

Despite the associations between process quality and child development, it is essential to acknowledge that children learn from interactions within different environmental systems, as outlined by ecological theory. These systems include proximal systems, such as the family and school, as well as distal systems, such as the social and cultural context (Bronfenbrenner & Morris, 2006). As such, it is crucial to consider the influence of teachers' characteristics and contextual factors on children's effective learning. These factors can significantly influence teacher-child interaction and children's outcomes and must be considered when designing and implementing effective PD programmes for teachers.

2.2.1 Teachers' Characteristics

Personal characteristics. In order to maintain high quality in preschools, policymakers have established professional standards for teachers as they expand the quantity of preschools. Research has consistently examined the relationship between classroom quality and various teacher characteristics, including degree, major, qualifications, age, and working experience, to support the implementation of evidence-based standards. According to Pianta et al. (2005), teachers' education levels significantly predict process quality. Those with bachelor's degrees or higher tend to exhibit higher quality classrooms than those with lower degrees. However, the strength of this link varies as other structural features, such as qualifications and teacher-child ratio, may either strengthen or weaken the association. A professional certificate is another indicator of a teacher's level of professionalism. Teachers with such certificates have demonstrated to be better at supporting children's academic skills than those without during their preschool years (Pianta et al., 2005).

Regarding working experience, there is a dearth of research evidence supporting the notion that beginning teachers are less competent than their experienced peers. In fact, Graham et al. (2020) found no evidence of significantly lower quality among new teachers compared to their experienced counterparts, but did observe a decline in teaching quality among teachers with 4-5 years of experience. Wiswall's (2013) long-term study of all 5th-grade public school teachers in North Carolina explored the relationship between working experience and teaching quality. This study demonstrated that teachers with 30 years of experience exhibit over one standard deviation higher measured quality than new, inexperienced teachers. Although there is a large body of research revealing that teachers' degrees, qualifications, and working experience are all crucial factors in teaching quality, those associations have been found to be complex, non-linear, and cyclical.

Teacher professionalism. Teachers' mastery of instruction or conditions is related to teacher-child interactions (Kunter et al., 2013; Hu et al., 2017). Pre-service education and in-serve training are two primary sources of knowledge for teachers, and they play a crucial role in shaping teachers' views of children and their pedagogical practice (Early et al., 2007; Pianta et al., 2005). Teachers with more years of education and training are more likely to provide more high-quality interactions with children in the classroom environment. Qualified teachers are able to create an environment that encourages children to initiate and engage in higher cognitive challenging activities (Siraj-Blatchford et al., 2002). They are more competent in providing coherent instruction, appropriate demonstration, clear explanations, and constructive feedback, which are all important in promoting children's learning and development (Kunter et al., 2013).

Teachers' knowledge. Effective teaching in early childhood education requires complex skills and expertise in child development, including knowledge of child development, pedagogy, curriculum, and assessment. For example, although being a skilled reader can enhance an individual's ability to teach literacy, this ability does not automatically translate into effective pedagogical practices since reading skills do not equal to pedagogical knowledge required for teaching reading (Cunningham et al., 2009). This is where pedagogical content knowledge (PCK) becomes crucial, as it enables teachers to connect subject matter knowledge with appropriate teaching strategies (Siraj-Blatchford et al., 2002). Furthermore, a solid understanding of child development and assessment enables teachers to provide developmentally appropriate learning experiences for their students.

Teacher belief. Teaching belief is a salient predictor of pedagogical interactions and is an invisible teaching guideline. Teachers' beliefs reflect their educational philosophy that influences their decision-making during instruction (Li et al., 2012). Teachers with child-centred beliefs place children's interests and needs at the centre of the teaching process. They

are more likely to adopt participatory pedagogies that encourage children's active engagement and extend their thinking. They tend to interact with children as partners in learning, providing sensitive feedback to motivate their learning desires and help children construct knowledge through exploration and discovery (Rao et al., 2010). While teachers who value teacher-centred beliefs are likely to view themselves as the primary source of knowledge and authority in the classroom, thus preferring transmissive pedagogies, such as direct instruction, collective teaching, structured content and a fast-paced teaching style (Hu et al., 2017). Although this approach can be effective for delivering information efficiently, it limits children's opportunities to engage in critical thinking or creativity. Meanwhile, teachers with a balanced view tend to adjust their teaching approach to meet children's needs and interests, balance the duration of teacher-led and child-led activities and transform child-initiated activities into focused learning opportunities. Therefore, teachers' beliefs are related to their pedagogical practice.

Teachers' emotional intelligence. Personality traits play a significant role in how people view and respond to others, particularly in their interactions with children (Kokkinos, 2007). Research has shown that high-level pedagogical interactions require teachers to possess certain social, sensitive, optimistic, caring and talk-active personality traits. Moreover, a teacher's personality traits can predict their emotional intelligence levels, reflecting their ability to perceive, understand, and manage their own and children's emotions (Hu et al., 2017). Teachers who lack adequate perception and management skills are less likely to notice children's emotional cues and may become emotionally exhausted, leading to a decrease in their interactions with children, particularly when dealing with children's challenging behaviours (Jennings & Greenberg, 2009).

Besides, teachers' ability to perceive children's cues and regulate their own stress and emotion also significantly influences their classroom behaviours and interactions with

children. Hamre et al. (2012) conducted an intervention study that demonstrated a significant positive association between the quality of teacher-child interaction and their observation and video-analysis skills. Teachers who were exposed to more video examples of effective teaching exhibited improved interactions with children (Pianta et al., 2014). In addition, teachers' self-awareness and ability to manage their emotions influence their teaching behaviours (Pianta et al., 2016). For example, teachers are less likely to interact effectively with children when they are under stress or negative emotions. On the contrary, teachers who participated in mindfulness-based PD programmes and reduced burnout stress would improve the classroom environments (Jennings et al., 2013). Thus, it is critical to developing teachers' emotional regulation skills.

Pedagogical leadership. It involves supporting teaching and learning, and it has a significant impact on teaching and learning through the establishment of organisational standards that promote continuous quality improvement. Teachers who exhibit leadership qualities such as vision, collaboration, and effective communication can positively influence student achievement (Harris, 2008). In addition, it predicts teachers' job performance since teachers tend to be more committed to implementing the decisions when participating in the decision-making process (Hulpia & Devos, 2010). For example, Lai and Cheung (2015) found that teachers' participation in school curriculum decision-making can lead to a tailored curriculum that meets children's needs.

Additionally, teacher leadership can foster a culture of continuous improvement and innovation in schools. This is because teacher leaders are more likely to engage in ongoing professional development, share their knowledge and skills with colleagues, and model effective teaching practices (York-Barr & Duke, 2004). Those teachers who are self-efficacious in instruction tend to be more reflective, show more substantial commitment to improving students' learning, and engage more at schools (OECD, 2016). Furthermore,

teacher leadership can extend beyond the classroom and school levels to the community and policy levels. For example, teacher leaders foster greater collaboration and partnerships between schools and communities and provide resources and support for students and their families (Ho, 2012; Lieberman & Miller, 2008). Therefore, teacher leadership is an important indicator of teacher job performance, student outcomes, school culture, and community engagement.

2.2.2 *Contextual Factors*

School location. The associations between pedagogical interactions and school characteristics have been investigated by substantial literature with focuses on location, class size and the provision of activities (Pianta et al., 2005; Rao et al., 2012). Pianta et al. (2005) conducted large-scale research in urban and rural settings. They found that the location of the school had little impact on the quality of the pedagogical climate. However, the availability of educational resources significantly influenced the quality of teacher-child interactions. For example, preschools located in rural villages with less or little funding resources tended to have lower-quality teacher-child interactions (Hu et al., 2016). In addition, research from the National Institute of Child Health and Human Development Early Child Care Research Network (2006) has shown that classrooms with a higher proportion of disadvantaged children tend to exhibit lower quality, highlighting the association between classroom quality and the served population.

Class size. In terms of class size, existing studies suggest that a lower teacher-child ratio tends to foster higher quality pedagogical interactions (Burchinal et al., 2008; Hu et al., 2016) since teachers have more opportunities to respond to children's different needs. On the contrary, high teacher-child ratios would make it challenging for teachers to engage in small-group or individual interactions with children or conduct differentiated instruction in a classroom (Leyva et al., 2015). However, several studies identified the non-linear

associations between class size and children's learning outcomes and found that their associations could be influenced by other variables, such as teachers' qualifications and experience and classroom resources. Therefore, there is a lack of consensus on the relationship between teaching quality and class size.

Social-cultural context. Different social-cultural contexts contain different expectations of the roles of teachers and children. Cultural backgrounds can influence teachers' beliefs about the role of students in the learning process. For example, teachers who view students as active co-constructors of knowledge are likely to use participatory construction methods, which involve collaborative learning and critical thinking, while those who see students as passive receivers of knowledge tend to use traditional methods of instruction, such as lectures and memorisation (Cordoba & Sanders-Smith, 2018). Distinct pedagogical approaches have been categorised into progressive vs. the traditional method, knowledge transmission vs. participatory construction, teacher-directed vs. child-centred learning, and so on, with actual teacher-child interaction falling somewhere into the spectrum of these approaches (Cordoba & Sanders-Smith, 2018). Research suggests that cultural values play a significant role in shaping pedagogical approaches, and in some cultures, such as China, teachers tend to adopt teacher-directed learning and knowledge transmission as there is a greater emphasis on teacher authority and children's compliance (Zhu & Zhang, 2008). Understanding the social-cultural context can help educators develop more effective and equitable educational practices.

2.2.3 Research Gaps and Possible Ways Forward

Although existing research has identified the aforementioned factors, existing literature suggests that the association between these factors and classroom quality is complicated, non-linear, and interrelated. Therefore, a comprehensive research approach is necessary to gain a more nuanced understanding of these associations. Specifically, a

comprehensive study could be conducted that incorporates all relevant personal and classroom characteristics to explore the influencing factors systematically. This approach would allow for the construction of a comprehensive model that accounts for the interrelationships between personal and contextual factors, providing valuable insights for quality improvement.

Furthermore, despite the significant associations between these factors and process quality, there is a lack of research exploring how they influence teachers' participation in PD programmes and subsequent learning outcomes. To better understand these associations, Clarke and Hollingsworth (2002) developed the Interconnected Model, which conceptualises teachers' professional changes as a systematic system. This model proposes that professional learning generates changes in various aspects, including personal beliefs, practice, disposition, professional experimentation, and sources of information. However, there is a lack of empirical studies examining this model. Therefore, further research can explore whether these factors can moderate PD effectiveness.

2.3 Promoting Teaching and Learning through PD in Early Years Settings

2.3.1 What Counts as PD?

Education systems cannot rely solely on pre-service training to adequately prepare teachers for the various challenges they will encounter throughout their careers. This is particularly true in the ECEC sector, where there is often a gap between theory and practice (Peña-López, 2009). Therefore, to maintain a high standard of teaching quality, in-service PD is essential. PD is defined as facilitated teaching and learning experiences designed to support the acquisition of professional knowledge, skills, and dispositions as well as their application in practice" (NPDCI, 2008, as cited in Buysse et al., 2009, p. 239).

There are multiple PD approaches, including coaching, consultation, mentoring, communities of practice, and technical assistance (e.g., web-mediated method) (Buysse et al.,

2009; Winton et al., 2008). However, PD is not just about participating in individual activities; it is about teachers' ongoing learning, what they learn, and how they apply their learning to support students' learning (Avalos, 2011). Therefore, other activities that fall under the PD umbrella emphasise the interactive and social nature of learning, such as teachers' interactions with colleagues (Desimone, 2009). Consulting with fellows is a primary way for teachers to improve their teaching skills, while senior teachers can serve as mentors to support new teachers in acquiring instructional and leadership skills. Professional communities also facilitate learning through reflective inquiries, discussion about teaching materials, collaboration and shared goals (OECD, 2016; Taylor et al., 2011). Thus, as Peña-López (2009) has noted, PD can take various forms, from formal to informal.

Types of professional development (retrieved from Peña-López, 2019*, p. 50)*

- *Course/workshops: subject-based topic or other ECEC-related themes;*
- *Conference or seminars: teachers learn from researchers' work or present their work or research;*
- *Qualification programme: degree-related programme;*
- *Visit other classrooms or schools: observe others' practice;*
- *Participation in a network of teachers: professional discussion, consultation;*
- *Individual or collaborative research: research-based learning;*
- *Mentoring and/or peer observation and coaching: school-based training programme;*

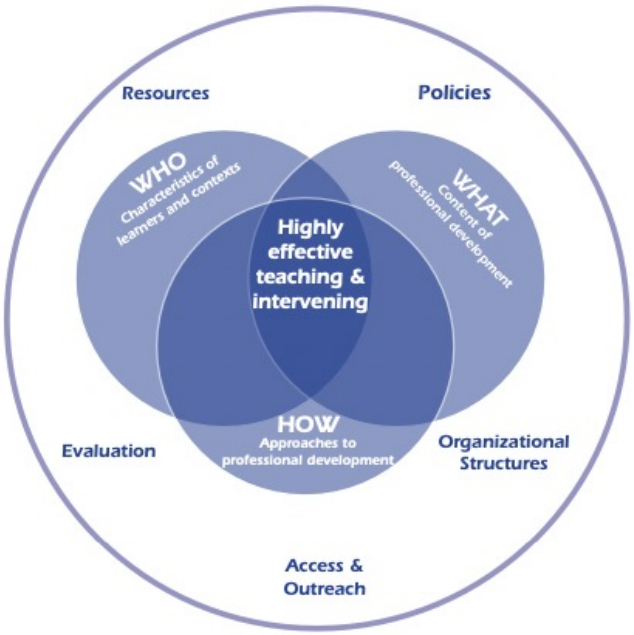
Given the complex interplay of learning opportunities in the ECEC sector, it can be challenging to distinguish between different activities and define PD programmes. To address this, the National Professional Development Centre on Inclusion (NPDCI, 2008) has conceptualised PD as consisting of three intersecting components: (1) the "who" component, which includes characteristics of providers, learners, children and families served, and the context; (2) the "what" components, which refers to the content; and (3) the "how" component, which involves the organisation and facilitation of learning experience. This conceptual framework can guide the design and implementation of PD programmes, which should involve providers and targeted receivers, such as teachers, care providers, and

administrators. The characteristics of providers, receivers and the organisational context can influence whether learners actively engage in the learning experience, acquire professional knowledge and skills, and apply the knowledge in practice.

As shown in Figure 2.1, the "what" component defines the knowledge, skills, and dispositions that receivers are expected to obtain. The "how" component emphasises the approaches used to facilitate professional development. To be effective, PD programmes should be content-specific, align with the educational goals, quality standards, and curriculum used in practice, and be sustained over time. Additionally, PD programmes should include feedback on how to apply specific approaches through coaching, consultation, and collaboration (NPDCI, 2008). The effectiveness of PD programmes is also influenced by factors such as resources, policies, evaluation, and organisational structure. In summary, given the diverse nature of professional development experiences, defining PD programmes requires considering the critical elements of the "what", "how", and other factors that affect the effectiveness of PD programmes.

Figure 2.1

Conceptual framework for the PD programme (retrieved from NPDCI, 2008, p. 4)



2.3.2 What are the Characteristics of Effective PD

Effective PD could enhance teachers' teaching practice and improve student learning (Borko, 2004; Darling-Hammond et al., 2017). Recent research has identified several critical characteristics of effective PD, including delivery of content knowledge, support from coaches, a community of practice, reflective engagement in large group, small group, and one-on-one sessions (i.e., Brenneman et al. (2019; Darling-Hammond et al., 2017; Desimone et al., 2009; Sims & Fletcher-Wood, 2021).

First, PD has been demonstrated to be more effective when it provides focused content, such as subject and pedagogical content knowledge (Desimone et al., 2009; Dunst, 2015; Darling-Hammond et al., 2017; Popova et al., 2022). General knowledge, such as classroom management, may not be effective since different subjects may require unique pedagogical approaches (Shulman, 1986). Meanwhile, combining subject knowledge and general pedagogical techniques has been found to be most effective, as teachers must understand children's current learning, how their understanding develops, the gap between their existing knowledge and the subject matter, and how to bridge the gap when they effectively guide students' learning. Therefore, PD programmes should develop teachers' subject knowledge, understanding of students' thinking, and pedagogical strategies (Borko, 2004; Vangrieken et al., 2017). Providing teachers with subject-specific content knowledge, combined with instructional strategies that can be used to promote student learning, is an essential component of effective PD.

Second, adult education works best with straightforward, practical applications rather than a theoretical focus (Knowles et al., 2005). Concrete and realistic goals, coupled with formative evaluation, are necessary for adult learners to monitor and evaluate their learning progress towards their desired objectives, as adult learning is self-directed (Bourgeois & Nizet 1997). An example of effective PD is Cognitively Guided Instruction (CGI) project, in

which teachers learn to explore children's thinking, understand their strategies for problem-solving, identify typical misconceptions through clinical interviews and build on their thinking accordingly (Neale et al., 1990). Research has shown that this project is highly effective in promoting teaching and learning. By providing practical and relevant content, coupled with clear goals and ongoing evaluation, PD can enhance adult learners' engagement and promote positive outcomes in teaching and learning.

Third, PD is claimed to be effective when teachers are engaged in an active learning experience. Studies have shown that voluntary PD is more effective than obligatory PD, as it allows for greater motivation and engagement (Alderman, 2013). In addition, PD programmes that are linked to teachers' incentives, such as promotion, qualifications, and salary, have been found to foster greater student learning gains (Popova et al., 2022). Despite incentives, different stages of teachers' careers require different approaches to PD. Providers must recognise that new and senior teachers have different needs and provide tailored PD programmes to match these needs (TNTP, 2015). Furthermore, the quality of trainers is crucial to the success of PD programmes (Knowles et al., 2005). Effective trainers possess professional, pedagogical and transversal skills and competencies that enable them to not only convey knowledge and skills, but also support teachers in practical education. In conclusion, PD programmes that are voluntary, incentivised, and delivered by effective trainers are more likely to enhance teachers' knowledge and skills and promote student learning gains.

Fourth, research has shown that PD is most effective when teachers participate as a group. Collaborative learning environments enable teachers to challenge each other, justify misunderstandings, and learn from shared experiences (Sims & Fletcher-Wood, 2021). This aligns with Bandura's (1977) social learning theory. Individuals are more likely to inquire and reflect on their practices when engaged in trusting settings that allow them to take risks,

solve problems, share their knowledge and collaborate with their peers (Darling-Hammond et al., 2017). Brown and Danaher (2008) found that effective collaborative learning involves the complex interplay of diverse stakeholders' perspectives and interests, which can lead to empowerment and transformation if managed with effective strategies. For example, the professional learning community (PLC) is a widely recognised approach to promoting teachers' professionalism (e.g., Vescio et al., 2008; Hadar & Brody, 2013). However, research into the application of PLC in early childhood settings is scarce. An exploratory study in New Zealand revealed that structural and relational conditions are crucial for the efficacy of PLC in early childhood settings (Cherrington & Thornton, 2015). However, a thorough review and assessment of the specific conditions required are still lacking. Further research is needed to determine the optimal structural and relational conditions required for successful implementation of PLCs in early childhood settings. This information can then inform the development of evidence-based programmes that facilitate effective collaboration among early childhood educators and ultimately lead to improved outcomes for children.

Fifth, involving outside expertise and providing fresh input can challenge teachers' existing knowledge and skills. Research shows that managed PD programmes with detailed instructions on implementation and follow-up support can significantly improve student test scores, up to 2.5 times (0.052 standard deviations) more than general PD (Popova et al., 2022). Therefore, coaching, a combination of in-service training, individual feedback, and consultation, has been widely employed to serve the professional development of teachers (Johnson et al., 2017). In addition, coaching and expert support can tailor PD content to teachers' individual needs, thus strengthening PD effectiveness (Darling-Hammond et al., 2017). Moreover, the collaborative relationship between coaches and trainees has been recognised as a core element of professionalism from the perspective of early childhood teachers, according to a national survey conducted in New Zealand (Dalli, 2008). Therefore,

coaching and expert support can provide personalised and effective PD, ultimately leading to improved teaching quality and student outcomes.

Sixth, PD is seen to be more effective when it involves not only learning new information but also practising and reflecting on what has been learned (Darling-Hammond et al., 2017; Fontaine, 2018; Sims & Fletcher-Wood, 2021). Mitchell and Cubey's (2003) synthesis of evidence on effective PD in early childhood settings highlights the importance of teachers' evaluation and reflection on their professional practices in realising the PD effects. While one-time workshops have less than a 5% impact on student learning, workshops that involve ongoing practice, coaching, and feedback have been shown to be more effective (Speck & Knipe, 2005). Follow-up visits to review teachers' practice and materials taught in training have also been found to facilitate student learning, as compared to no visit or monitoring-only visits (Popova et al., 2022). The observation, feedback, and practice cycle enable teachers to apply newly-acquired teaching methods and reflect on their performance, which positively correlates with student achievement. Therefore, to maximise the impact of PD, it is essential to provide opportunities for ongoing practice and feedback to help teachers apply and reflect on their newly acquired knowledge and skills.

Seventh, research suggests that PD programmes that are sustained over a significant period are more effective than brief, one-time workshops. This is because teachers need time to assimilate and practice new knowledge, and to see the impact of that knowledge on their teaching practice and student outcomes (Desimone, 2009; Sims & Fletcher-Wood, 2021). PD programmes with significant contact hours (between 45 to 60 hours) have been found to be more effective at improving classroom quality and child learning outcomes than programmes that are either shorter or longer in duration (Egert et al., 2018). Sustained focus over time is a hallmark of effective PD programmes (Bates & Morgan, 2018). Continuous, job-embedded, ongoing professional development allows teachers to identify genuine problems of practice,

develop and implement solutions, and have sufficient time to apply new thinking to their classrooms. This approach supports teachers' growth and development, leading to positive impacts on student learning outcomes.

Finally yet importantly, the location of PD programmes has also been a topic of discussion among researchers, with no clear consensus on the ideal location. Research has shown that teachers participating in PD programmes located within schools or other education-related settings, such as universities or training centres, are more effective than programmes held in hotels or government buildings. Teachers who participated in school-based PD programmes reported higher levels of engagement and satisfaction with the programme than those who participated in off-site programmes (Harris & Jones, 2018). Furthermore, Darling-Hammond and McLaughlin (1995) found that school-based PD programmes that provided opportunities for teachers to observe and receive feedback on their teaching practices were associated with improved student achievement. Teachers participating in school-based programmes tend to raise concrete problems they face in the local environment, which can lead to more relevant and meaningful professional learning experiences.

2.3.3 What Constrains Teachers' Change in or after PD

Despite the demonstrated positive effects of in-service PD on quality ratings and child development (e.g., Egert et al., 2018), some forms of PD have been found to have little impact on teacher learning and the application of instructional strategies (Joyce & Showers, 1982). For example, Copur-Gencturk and Papakonstantinou (2016) found that teachers did not make significant changes in their pedagogical interactions after receiving content-based and sustained PD. Similarly, Loyalka et al. (2019) examined a nationwide PD programme in China that aimed to enhance teachers' subject-specific knowledge, skills, and instructional strategies. However, after one year, the PD programme failed to improve teacher and student

outcomes, despite follow-up support. Therefore, even when informed by the knowledge of PD effectiveness, many PD programmes fail to bring about the intended changes in teacher practice (Loyalka et al., 2019). To ensure the effectiveness of PD, it is important to understand the characteristics of ineffective PD programmes.

Firstly, the effectiveness of PD can be influenced by its perceived level of theoretical complexity and practical applicability (Loyalka et al., 2019). PD programmes that are overly theoretical and disconnected from classroom practice may result in teachers feeling overwhelmed and frustrated, leading to lower levels of engagement and effectiveness. Conversely, PD programmes that are well-designed, prioritising the application of knowledge, and providing practical guidance and support to teachers, have been found to be more effective (Darling-Hammond & McLaughlin, 1995; Harris & Jones, 2018). In addition, PD programmes that cover a broad range of topics without coherence or a clear focus on practical application may also lead to confusion and overload, decreasing the likelihood of teachers applying new strategies in their classrooms. Therefore, designing PD programmes with coherence, focusing on the application of knowledge, and providing practical guidance and support can help maximise their effectiveness (Corcoran et al., 2003).

Secondly, knowledge from PD cannot be well translated into practice if PD is not tailored to teachers' needs. One-size-fits-all approaches are often ineffective as teachers have varying levels of experience, knowledge, and learning styles. The providers cannot expect the same results if they put fledgling teachers and seasoned teacher leaders in the same room and receive the same content. Research has shown that providing differentiated PD to teachers is more effective than offering the same training to all participants (Guskey & Yoon, 2009). Teachers with different levels of experience require different types of training to enhance their skills, knowledge, and classroom practice. New teachers may require more foundational training, while experienced teachers may need more advanced training that builds on their

existing knowledge and skills. They learn best when providers push them slightly beyond their current competence (Tomlinson, 2000). Furthermore, differentiating PD based on the learning interests and styles of teachers can help them engage more effectively with the content and apply it in their classrooms. Therefore, providers should ensure that PD is tailored to the specific needs of teachers to enhance its effectiveness.

Third, teachers are less likely to learn or try new techniques if the delivery of PD content is passive, rote-oriented learning focused on basic skills. These training can be perceived as repetitive, simplistic, and boring by teachers who are busy with lesson planning and grading. Teachers usually bring plenty of work (i.e., lesson plan and homework to grade) or keep playing with their smartphones or computers to ensure the repetitive, simplistic or boring PD does not waste their time (Zdonek, 2016). Research has shown that adult learners direct their learning with independent self-concept (Knowles, 1968), so it is important to incorporate interactive experiences to get teachers actively engaged with the content. A more engaging and interactive experience can increase the likelihood of teachers trying new techniques and implementing what they have learned in their classrooms.

Fourth, PD programmes are less effective when teachers are simply presented with new knowledge without opportunities to apply it to practice. Programmes that fail to connect the content to individual contexts and provide opportunities to practice new skills or strategies can weaken their effectiveness (Bates & Morgan, 2018). Human learning is enhanced through trial and error, with mistakes and feedback helping to internalise what success looks like. Accordingly, teachers need sufficient opportunities to practice new skills and strategies in order to apply them effectively. Moreover, teachers' practice provides insights into their learning progress, which can inform the design of suitable follow-up support. To maximise PD effectiveness, teachers should have adequate time to practice, collaborate, reflect and provide feedback. This allows teachers to analyse their work and

model new strategies in real time, facilitating the development of effective instructional practices that can benefit their students. Meanwhile, some studies have focused on regularly examining teachers' lesson plans, videotapes of teaching practice, and students' learning profiles, in order to link PD to teachers' daily teaching practice. Such efforts can help teachers reflect on and evaluate each other's pedagogical practices, as well as discuss strategies for further improvement.

Fifth, experts' workshops or lectures alone are often insufficient to effect meaningful change in teachers' instructional practices, as teachers cannot receive help when they need it in their classrooms (Rucker, 2018). While PD content is designed to address existing skills gaps and promote new approaches, teachers' habitual behaviours are often deeply ingrained due to years of experience and practice (Loyalka et al., 2019; Sheeran & Webb, 2016). These instructional behaviours are triggered automatically or unconsciously by environmental stimuli and can be resistant to change (Wood & Neal, 2007). As such, ongoing implementation support is critical to help teachers replace old habits with new approaches by repeatedly practising and reinforcing new techniques. Without this support, teachers may struggle to apply the new knowledge and skills gained from PD in their classrooms, leading to ineffective implementation and, ultimately, limited impact on student learning outcomes.

2.3.4 Lessons Learned for Designing Effective PD Programmes

The conceptual framework is further refined based on the critical characteristics that distinguish effective from ineffective PD programmes. **In terms of the "what" component**, the key features of effective PD programmes include being coherent with the context, practice-oriented, and domain-specific knowledge. First, to ensure acceptability, a PD programme should align with national and district educational standards, as well as child developmental standards and assessments. Compliance with federal, district, and kindergarten guidelines establishes a foundation for PD content (Desimone, 2019). Second,

the PD content should be practice-oriented to accommodate adult learners' self-directed learning (SDL) nature. Adult learning programmes should create learning content that addresses the needs, desires, and interests of learners, thereby stimulating their willingness to initiate change in their daily activities (Merriam, 2001). Third, the development of students' comprehension of learning content depends on teachers' content knowledge, pedagogical content knowledge, and pedagogical knowledge. These knowledge areas provide the foundation for teachers to determine what to teach, the critical concepts within different learning domains, how these concepts are established and interconnected, and the anticipated difficulties students may encounter while learning (Luneta, 2012). Consequently, the focus of PD content is on pedagogical content knowledge (PCK), which involves teachers' understanding of children's learning, specific learning content, and how to promote children's learning. Improving teachers' pedagogical practice in supporting child development in diverse domains is the goal of such PD content (Van Driel & Berry, 2012).

In terms of the "how" component, effective PD programmes comprise a combination of concrete, realistic goals, and formative evaluation; active learning experience; collaboration; follow-up expert support on practice, feedback and reflections; and sustained duration (Darling-Hammond et al., 2017; Desimone et al., 2009; Dunst et al., 2015; Loyalka, 2022). Adult learners are more pragmatic, intrinsically motivated to learn and proactive in decision-making than child learners (Housel, 2020). Hence, setting concrete and realistic goals that relate to real-life situations can enhance teachers' learning motivations, and formative evaluation enables them to direct their learning pace. Moreover, as self-direct learners, adults thrive with problem-based, inquiry-based approaches and activities that involve modelling and practice, allowing them to determine what to learn based on their interests and needs and try out and evaluate new strategies. As such, instructors should act as guides and facilitators who provide adult learners with concrete goals and specific models,

encourage learners to analyse, implement, and reflect, and help them become autonomous learners.

In addition, joint development is a promising approach that can effectively support teachers' professional development and overcome barriers that hinder their professional development (Darling-Hammond & Richardson, 2009). According to social-cultural theory (Vygotsky, 1978), learning is considered a social and external process that is internalised at the individual level. By working collaboratively, teachers can engage in meaningful interactions that enable them to clarify concepts, ask questions, and explore different perspectives during PD activities. Additionally, learning should occur within the zone of proximal development, where individuals can benefit from guidance and support from others with similar experiences and knowledge (Vygotsky, 1978). Teachers who work in the same schools, grades and classrooms share a common understanding of contextualised curriculum materials and standards. Their life experience, prior knowledge, and intrinsic incentives can enrich PD training and make instruction deeply embedded and contextualised (Darling-Hammond et al., 2017). Joint participation can also help to overcome the lack of differentiation in standard PD content by enabling teachers to integrate and adapt what they have learned to their school context through collective working and discussions with their peers. In addition, the involvement of grade-level and school-level participants can provide a broader base of support at the school level, fostering a culture of collaboration and continuous improvement.

Follow-up expert support and sustained duration are essential contributors to learning gains. Theories of attitudes-behaviour relations suggest that an individual's behaviours are determined by their intentions (Abraham et al., 1998). After teachers receive the PD content, they may intend to change their behaviour. However, they may struggle to implement it due to their habitual behaviours. Habitual behaviours are governed by different regions of the

human brain, and repeated behaviour becomes a stronger predictor of future behaviour than the intention to change (Seger & Spiering, 2011; Webb & Sheeran, 2006). Therefore, feedback from others can offer a fresh perspective and enable teachers to scrutinise their practices from new perspectives (Sims & Fletcher-Wood, 2021). In addition, follow-up expert support that requires teachers to practice new skills repeatedly can help replace old habits with new ones, thereby promoting habit change (Sims & Fletcher-Wood, 2021).

Additionally, sustained duration is necessary for teachers to practice repeatedly and establish cue-response relationships. As previously mentioned, outside expertise provides fresh perspectives that can challenge teachers' habitual behaviours and transform them into more conscious teaching. After receiving feedback, teachers need reflection, which is the process of making informed and rational decisions regarding educational issues after evaluating the outcomes of teaching choices (Luneta, 2012). Feedback and reflection are two critical components of adult learning theory, as teachers direct their learning by thinking, feeling, receiving feedback from others, and making necessary adjustments (Darling-Hammond et al., 2017). It also should be noted that feedback and reflections take time. Regular feedback and reflections enable teachers to intentionally and systematically analyse and modify their existing behaviours (Van Woerkom, 2004).

Regarding "who" components, research on effective PD has consistently highlighted the importance of external input for successful programmes. Providers of PD require a range of competencies, including specialist content knowledge, in-depth knowledge of effective PD processes, evaluation and monitoring competencies, and transversal skills (Cordingley et al., 2015; European Commission, 2012). Specifically, trainers should possess relevant qualifications in the specific field of training content, and have a thorough understanding of the core content, structures, methods and strategies of training content. In order to support teachers' learning, trainers are expected to possess pedagogical and

assessment competencies, which include content planning, creating a positive learning environment, adjusting teaching approaches based on learners' abilities and needs, and conducting formative assessment and feedback to direct further learning (European Commission, 2012). In addition, social competencies enable trainers to work with heterogeneous groups of learners. Successful facilitators encourage teachers to take on a degree of teaching leadership, treat them as peers and co-learners, and develop close trainer-trainee relationships that enable them to share values, understanding, goals, and beliefs with participants and challenge them effectively. (Cordingley et al., 2015).

Regarding the recipients of PD programmes, the nature of teacher participation in PD programmes is a crucial factor that affects the effectiveness of such programmes. When teachers have concrete learning goals and are motivated to learn, they are more likely to participate actively in PD sessions and reflect on their classroom behaviours (Lipowsky & Rzejak, 2015). This observation aligns with the SDL (Ryan et al., 2000), which suggests that adult learners are more likely to engage in learning when they perceive the anticipated benefits of the PD content. Three motivating factors that influence adult learning behaviour are self-evaluation, adult learning attitudes, and the importance of goals and expectations. Therefore, when selecting participants for PD programmes, it is essential to consider teachers' needs, interests, experiences, and participation goals (Mukhalalati & Taylor, 2019).

Context support is also a vital element of the effectiveness of PD programmes. Research has consistently shown that school leaders are critical in promoting and sustaining teacher learning (Hargreaves & Fullan, 2012). In addition to encouraging PD engagement and creating opportunities for continuous learning, supportive school leaders also provide the necessary resources and infrastructure for teachers to participate in PD programmes. This includes allocating time for teachers to attend workshops or conferences, providing funding for training and development, and offering logistical support for on-site PD sessions.

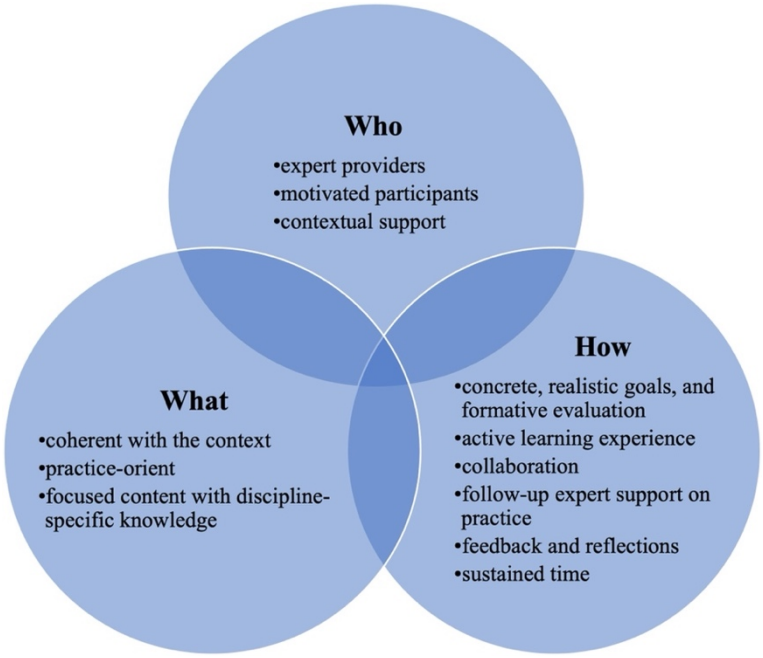
Furthermore, the school environment itself can also affect the effectiveness of PD programmes. A positive and supportive school culture can encourage teachers to engage in learning and experimentation with new instructional strategies, while a negative or unsupportive culture may hinder their willingness to take risks and try new approaches (Darling-Hammond et al., 2017). Therefore, it is crucial for schools to foster a culture of continuous learning and improvement, where teachers feel supported and encouraged to engage in professional growth opportunities. Overall, context support is a crucial factor in the success of PD programmes, and school leaders play a critical role in promoting a supportive and conducive learning environment for teachers. By providing the necessary resources, infrastructure, and culture, schools can help ensure that PD programmes lead to meaningful and sustained improvements in instructional practice.

In summary, the question of what critical elements are necessary for effective professional development has been a longstanding concern for educators. Based on the umbrella review, the previous conceptual framework of the PD programme has been extended to shed light on this question and guide the design of future research. As illustrated in Figure 2.2, the "who" component of effective PD programmes includes expert providers with comprehensive content and pedagogical knowledge, evaluation and monitoring competencies, transversal skills, as well as motivated and receptive receivers who possess positive learning attitudes and expectations, and receive support from the context. The "how" component encompasses concrete and realistic goals, formative evaluation, active learning experience, collaboration, follow-up expert support for practice, feedback and reflections, and sustained time. These elements ensure that professional development programmes are designed to be engaging, interactive, and relevant to the needs of teachers. The "what" component focuses on coherent and context-specific content that is practice-oriented and aligned with discipline-specific knowledge. Effective PD programmes are designed to

provide teachers with the tools and knowledge required to enhance their instructional practice and improve student learning outcomes.

Figure 2.2

The conceptual framework for effective PD programmes.



2.4 Impacts of PD on Teaching and Learning

2.4.1 Influence of PD Participation on Teachers' Professional Growth

Motivation and beliefs. The impacts of PD on teachers are firstly reflected in teachers' motivation and beliefs, as changes in behavioural intentions lead to changes in behaviours. According to a meta-analysis of 47 experimental studies, a medium-to-large change in intention (d = 0.66) resulted in a small-to-medium change in behaviour (d = 0.36) (Webb & Sheeran, 2006). In a study conducted by Barenthien et al. (2020), a sample of 358 preschool teachers in Germany was surveyed. The authors found that learning opportunities provided through pre-service teacher education and in-service PD programmes effectively influenced teachers' science-specific professional knowledge and motivation. In particular, a coaching intervention was found to be particularly effective in arousing teachers' motivation to change and improve their teaching beliefs. This is attributed to the highlighting of

successful teaching moments during the PD program, which provides evidence of mastery (von Suchodoletz et al., 2018). Professional learning for teachers involves updating knowledge, reflecting on their teaching practices, and equipping educators with new pedagogical approaches. This process can be realised by strengthening teachers' motivation and beliefs towards teaching (Durksen et al., 2017).

Instructional knowledge. While PD programmes may also enhance teachers' motivation, the primary goal is to help them acquire new knowledge and skills (Barenthien et al., 2020). Previous research suggests that participation in PD programmes that include focused content, collaboration and reflection, modelling and coaching is associated with increased instructional knowledge among teachers (Fischer et al., 2018). For example, a PD programme for early childhood teachers aimed to increase their ability to teach mathematics. The intervention included two elements: (1) a 13-month-long workshop that provided teachers with knowledge and practice on number sense or algebraic thinking; (2) follow-up sessions focused on curriculum support to explore, modify and implement cognitively-demanding mathematical tasks. Data analyses revealed that the PD programme had a positive impact on teachers' mathematical content knowledge and beliefs about mathematics as a subject area. Similarly, Roth et al. (2011) investigated the impacts of teachers participating in The Science Teachers Learning from Lesson Analysis (STeLLA) programme. They found that the programme improved teachers' science content knowledge, pedagogical knowledge about student thinking, and ability to create a cohesive science content storyline.

In-service teachers' content knowledge is crucial for providing effective domain-specific instruction, particularly since teacher preparation programmes may not always provide the necessary knowledge and skills (Podhajski et al., 2009). Therefore, workshops and mentoring can improve the content knowledge of in-service teachers and enhance their ability to provide effective instruction in the classroom. For example, McIntyre et al. (2019)

evaluated a PD programme aimed at preparing 183 teachers to implement trauma-informed approaches, and the results indicated a significant increase in knowledge about the principles of trauma-informed practices.

General instructional practice. In-service PD programmes significantly contribute to improving instructional quality in various domains, including lesson planning, activity implementation, classroom management, and child assessment. Content-specific coaching programmes have been shown to positively affect teachers' pedagogical practice, including the use of open-ended questions, the development of teacher-student relationships, and effective interactions with students (Kraft et al., 2018). A meta-analysis indicates that in-service PD programmes for early childhood teachers can enhance pedagogical quality with a medium effect size (Egert et al., 2018). For example, Snyder et al. (2018) conducted an RCT with 36 preschool teachers to evaluate the effects of the Tools for Teachers (TfT) PD programme. Teachers who received PD intervention wrote high-quality learning objectives for their students. Additionally, teachers who received follow-up on-site coaching implemented embedded instruction with an evidence-based approach to planning, implementing, and evaluating teaching practices. Sandilos et al. (2018) examined the impact of a 14-week PD course on teacher-child interactions, involving 427 teachers who received training with the CLASS (Pianta et al., 2008). Results showed that teachers who participated in the intervention condition demonstrated improvements in emotional support, classroom organisation, and instructional support. PD programmes designed to improve teacher-child relationships can facilitate changes in how teachers interact with children, particularly when the PD includes opportunities for observations and feedback.

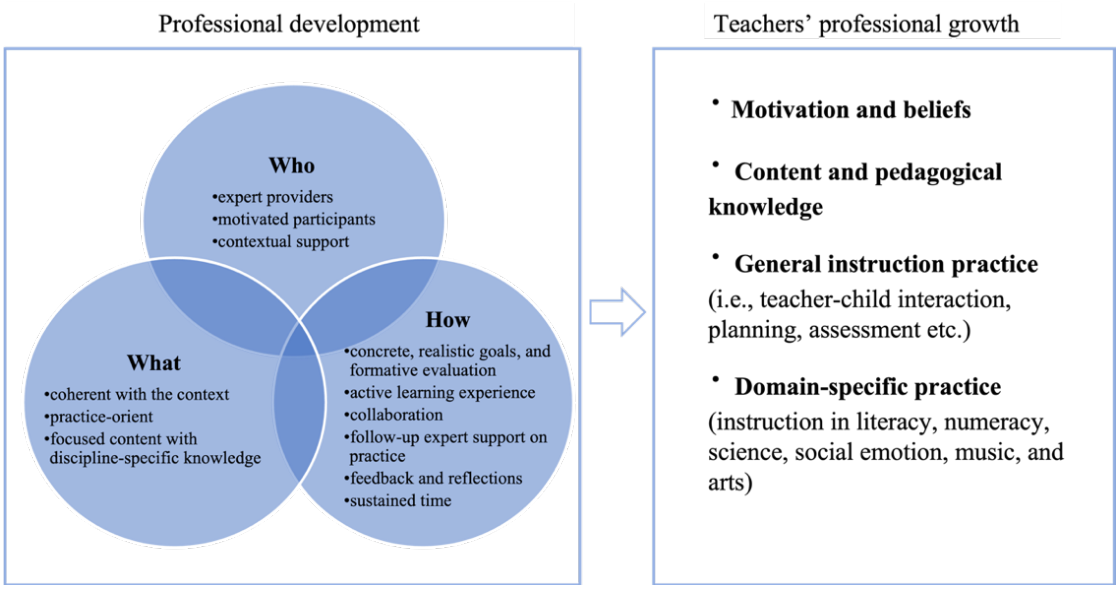
Domain-specific instructional practice. PD programmes with focused content in specific domains have the potential to improve teachers' instructional practice in these areas. For example, due to the lack of adequate knowledge among teachers in teaching English

reading and writing, Brady et al. (2009) developed a PD programme that focused on phonological awareness and code concepts. The study found significant improvements in teachers' understanding of these concepts. In another study, Fischer et al. (2018) conducted a large-scale, quantitative study to explore the influence of an in-service secondary science teachers PD programme. Their findings suggest that PD participation is positively associated with teachers' classroom practices and helps align their instruction with curriculum reforms. Saunder et al. (2019) developed the SHAPES project, an RCT aimed at modifying instructional practices and improving children's physical activities. The SHAPES project, which included six online modules, a guidebook, over 90 activities, self-assessment tools, a video library, and an online community forum, resulted in effective classroom implementation.

In summary, as shown in Figure 2.3, the existing research has identified the impacts of PD programmes on various aspects of teachers' professional growth, such as motivation, beliefs, content and pedagogical knowledge, general instruction practice, and domain-specific practices in diverse learning areas.

Figure 2.3

Professional development and teachers' professional growth.



2.4.2 Influence of PD Participation on Child Outcomes

High-quality PD has been shown to promote instructional quality and improve children's learning outcomes. As illustrated in meta-analyses (Egert et al., 2018; Markussen-Brown et al., 2017), PD has a medium effect on process quality and a small to medium effect on children's outcomes. For example, coaching has been found to result in a 0.18 standard deviation improvement in academic performance on children's standardised tests (Kraft et al., 2018). Meanwhile, existing research mainly focused on exploring the impacts of PD on children's domain-specific abilities, such as language and literacy (i.e., Babinski et al., 2018; Markussen-Brown et al., 2017; Piper et al., 2018), numeracy (i.e., Chen & McCray, 2012; Gasteiger & Benz, 2018; Hilton et al., 2016; Prast et al., 2018), science attitudes (i.e., Murphy et al., 2021), and social-emotional development (i.e., Jagers et al., 2019).

Children's literacy development. A large body of research has consistently demonstrated that children's language skills can be strengthened through teacher-child conversations that involve rich and complex vocabularies. Furthermore, children's literacy skills can be enhanced by engaging in activities such as playing with rhymes, discussing environmental print, and writing for communications (i.e., Piper et al., 2018). For example, shared book reading, where teachers invite children to think about the sound of letters and print in the environment has been widely used to develop young children's language and pre-literacy skills. Wasik & Hindman (2011) implemented the Exceptional Coaching for Early Language and Literacy (ExCELL) PD, which involved summer courses and monthly coaching sessions for 19 teachers. Compared to the control group, ExCELL teachers demonstrated improved instructional practice and significantly facilitated children's receptive vocabulary and phonological awareness. Babinski et al. (2018) conducted an RCT intervention with 45 elementary teachers and found an improvement in students' expressive language.

The effective PD programmes that produced positive impacts on children's literacy and language involved four key elements:

1. the content knowledge of literacy includes phonemic awareness, phonics, fluency, vocabulary, and text comprehension;
2. the pedagogical strategies involve concept development, metacognitive strategies and social/affective strategies;
3. intensive and ongoing support on practice;
4. books, materials, and lesson plans for children's language and literacy (Babinski et al., 2018; Wasik & Hindman, 2011; 2020).

Those PD programmes had two focuses, one on content (what is to be learned) and the other on instructional strategies (how the content is to be learned) with varying impacts. Variance in the effectiveness of PD programmes within subjects may be attributed to differences in domain priorities, as well as varying timelines for achieving improvements in literacy and language skills (Babinski et al., 2018).

Children's numeracy skills. Despite the significance of early mathematics education, many teachers lack the confidence and expertise required to provide high-quality instruction in this area (Chen & McCray, 2012). Especially for teachers in the ECEC sector, they are not required to have specific qualifications in teaching math. Therefore, PD programmes are widely recognised as essential support for strengthening teachers' knowledge and teaching skills. To this end, Chen and McCray (2012) implemented a Whole Teacher Framework PD programme aimed at improving children's mathematics performance by promoting positive attitudes toward math, increasing teachers' pedagogical content knowledge, and enhancing their practice in early mathematics. The year-long PD programme involved learning labs, structured implementation activities, and ongoing classroom support, and resulted in an advanced growth of an average of three months in children's performance

over the intervention year. Similarly, Prast et al. (2018) conducted a large-scale study to improve students' mathematic achievements by training teachers to apply differentiated instruction. The PD programme involved analysing the students' current skill level and grouping them based on their abilities, setting differentiated goals for different developmental groups, and providing differentiating instruction in whole-class teaching, group activities and individual guidance.

However, many studies have reported null results, including RCT of well-designed and scaled-up PD programmes. For example, Argentin et al. (2014) found no impact of a PD programme on students' mathematics performance. The PD programme aimed to encourage teachers to apply and analyse lessons that linked mathematics to real-life situations. Despite these null results, there is still evidence that PD programmes can improve teachers' instruction and children's mathematics development through training in four key aspects:

1. improving teachers' mathematical knowledge for teaching;
2. encouraging mathematical thinking and reasoning during instruction;
3. providing teachers with more concrete advice for practical application with domain-specific guidelines in mathematics;
4. differentiating instruction for students of diverse achievement levels or systematically arranging lessons based on the learning trajectories of developing mathematics concepts.

In summary, the implementation of early mathematics education requires teachers to possess knowledge of mathematical concepts that are relevant for preschoolers, an understanding of children's developmental process, the ability to identify children's stages and learning difficulties, and the capacity to design opportunities or capitalise on spontaneous situations to teach mathematics (Gasteiger & Benz, 2018).

Child social-emotional development. Social-emotional development refers to children's ability to understand and express their own emotions, desires, and intentions, and to recognise the social-emotional status of others (Howe & Mercer, 2007). It is associated with feeling empathy, performing prosocial behaviours, and adjusting to different environments, such as cooperating with peers and comforting others (Kalland & Linnavalli, 2022). Numerous studies indicate that supportive teachers are essential for fostering children's social-emotional skills. For example, what and how teachers talk with children matters, as adults' words related to mental and emotional conditions can influence children's understanding of emotions (Tompkins et al., 2018). Bergman Deitcher et al. (2021) explored a shared storybook reading intervention with children, where the discussion focused on the character's mental and emotional states. Children in the intervention group showed significant improvements in expressing their emotions and solving conflicts after receiving five reading sessions. In addition, close teacher-child relationships and positive emotional experiences in the classroom support children's social skills (Goetz et al., 2021). Macdonald, Gealy and Tinney (2021) implemented an Attachment and Me training intervention to develop the skills of ECEC staff to provide relational-based support for children with behavioural difficulties. The SSTEW results highlighted the potential impact on improving the quality of supporting children's self-regulation and social development and better child outcomes related to emotional, peer problems and prosocial skills (Macdonald et al., 2021).

Although children's social skills are crucial for children's short-term and long-term development, the existing literature has primarily concentrated on exploring the effects of PD programmes on children's cognitive development (Egert et al., 2018). Moreover, most intervention studies on social-emotional development have been geared towards preschoolers with behavioural problems, including ASD, developmental, communication, or social delays (Blewitt et al., 2021; Macdonald et al., 2021; Romano & Woods, 2018). Consequently,

further research is warranted to examine the impacts of PD programmes on the social-emotional development of typically developing children.

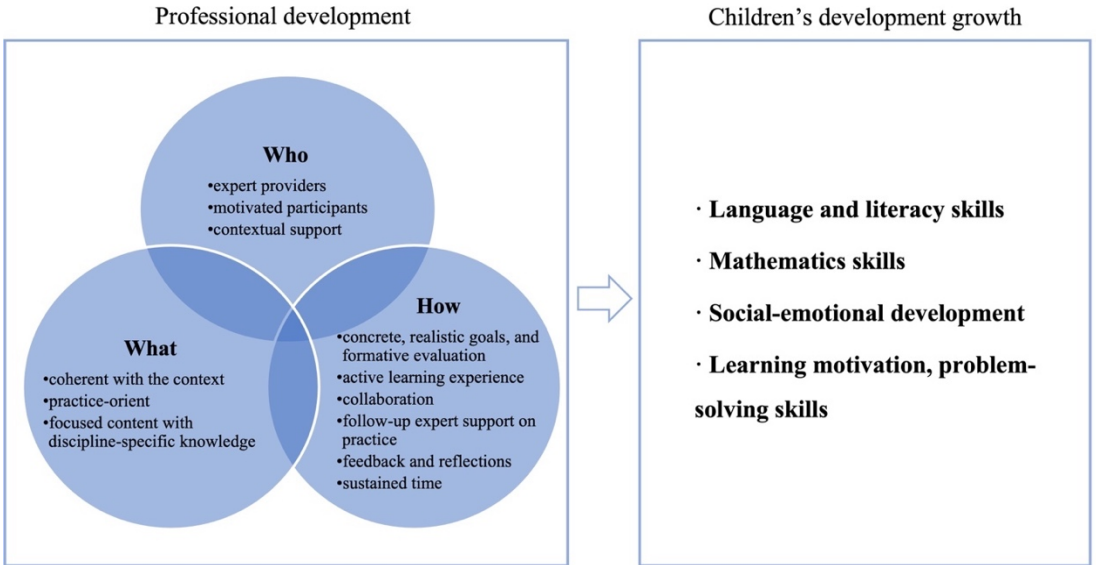
Based on the aforementioned research, teachers received PD on enhancing children's social-emotional skills through three approaches:

1. integration of instructional strategies into their everyday routines, which facilitates regular feedback to help teachers develop naturalistic communication-promoting strategies;
2. direct instruction of social skills through joint instruction by teachers and psychologists;
3. individualised assessment-based interventions that entail a behavioural assessment of child behaviour, followed by the development of personalised interventions that address the targeted behaviour.

In summary, as shown in Figure 2.4, the existing research has identified the effects of PD on children's language and literacy development, mathematics skills, social-emotional development and learning motivation and problem-solving skills.

Figure 2.4

Professional development and children's learning outcomes.



2.4.3 Modelling Teachers and Children's Changes during and after PD

The theory of adult learning provides a framework for understanding teachers' learning in the PD process. Malcolm Knowles (1968) introduced the concept of andragogy to describe adult learning, which is based on five assumptions about adult learners: (1) they have an independent self-concept and can direct their learning (2) adult learners possess a greater accumulation of life experience, which serves as a foundation for their learning and application of new knowledge and skills; (3) their learning needs are linked to changing social roles; (4) they prefer a problem-centred learning approach; (5) motivation primarily comes from internal factors. Therefore, the adult learning environment should promote respect, acceptance, support and teacher-student collaboration. As previously mentioned, adults' SDL is the primary difference between adults and children's learning. To support SDL, adult learning programmes must develop learners' capacity to be self-directed, help them reflect on their needs, interests, and desires, and motivate them to initiate changes in their daily activities (Merriam, 2001).

Several models of supporting SDL have been developed. Tough (1971) introduced the linear model, which involves diagnosing needs, identifying resources and instructional approaches and evaluating outcomes. Over time, additional details have been incorporated to support SDL, such as learning methods, content, environment and learners' characteristics (Danis & Harter, 1996). Grow (1991) proposed the Staged Self-Directed Learning (SSDL) model to explore how to connect SDL with formal classroom learning. In this model, instructors must match the learner's learning process with suitable instructional approaches (e.g. independent projects, students-direct discovery) after adults reflect on their readiness to be self-directed. Lieb and Goodlad (2005) identified four critical elements: motivation, reinforcement, retention, and transference to support instructors in fostering adult learning. Promoting adult learning requires stimulating adults' intrinsic motivation to learn,

transforming their beliefs and practices, and providing support to develop their self-directed learning skills. More specifically, instructors should (1) establish rapport with learners to help them identify their learning needs, (2) promote learners' understanding of the learning content to facilitate information retention, (3) encourage learners to apply what they have learned in new settings, and (4) provide feedback or rewards to learners that allow them to appreciate the benefits of learning and sustain the learning process. This transformative pathway aligns with the evolving models of PD and underscores the importance of fostering meaningful engagement and reflection.

Desimone (2009) proposed a model to illustrate the interdependent relationship between PD programmes and teacher knowledge and beliefs, classroom practice, and student outcomes. Specifically, PD programmes aim to enhance teachers' knowledge and shift their attitudes towards education, which in turn can inform instruction content and pedagogical approaches. However, the effectiveness of PD programmes in transferring knowledge into educational practice remains a challenge. Transfer of learning refers to "the degree to which [learners] apply the knowledge, skills, and attitudes gained in a training context to the job" (Baldwin & Ford, 1988, p. 63). Therefore, Shulman (1978) emphasises comprehension, reasoning, transformation and reflection in the training process. Teacher education is supposed to deal with concepts and knowledge that guide teachers' actions. Therefore, the first stage in changing teachers' behaviours is comprehension or understanding of the content and pedagogical knowledge. Based on comprehension, teachers need to transform what they have learned into practice, which involves preparing the learning environment, identifying the content of pedagogical approaches, and adapting their plan to the characteristics of students and contexts. The transformation process requires conscious training and is a rehearsal of teaching performance. Reflection occurs after instruction when teachers review and critically analyse the instructional process, emotions and results. Evaluation and

reflection lead to a deeper comprehension of the training content and how to apply it in different contexts. As shown in Figure 2.5, PD programmes facilitate teachers' professional growth through the learning transfer process, which involves comprehension, reasoning, transformation and reflection. This cycle continues over the PD programmes and helps transform the training content into practice.

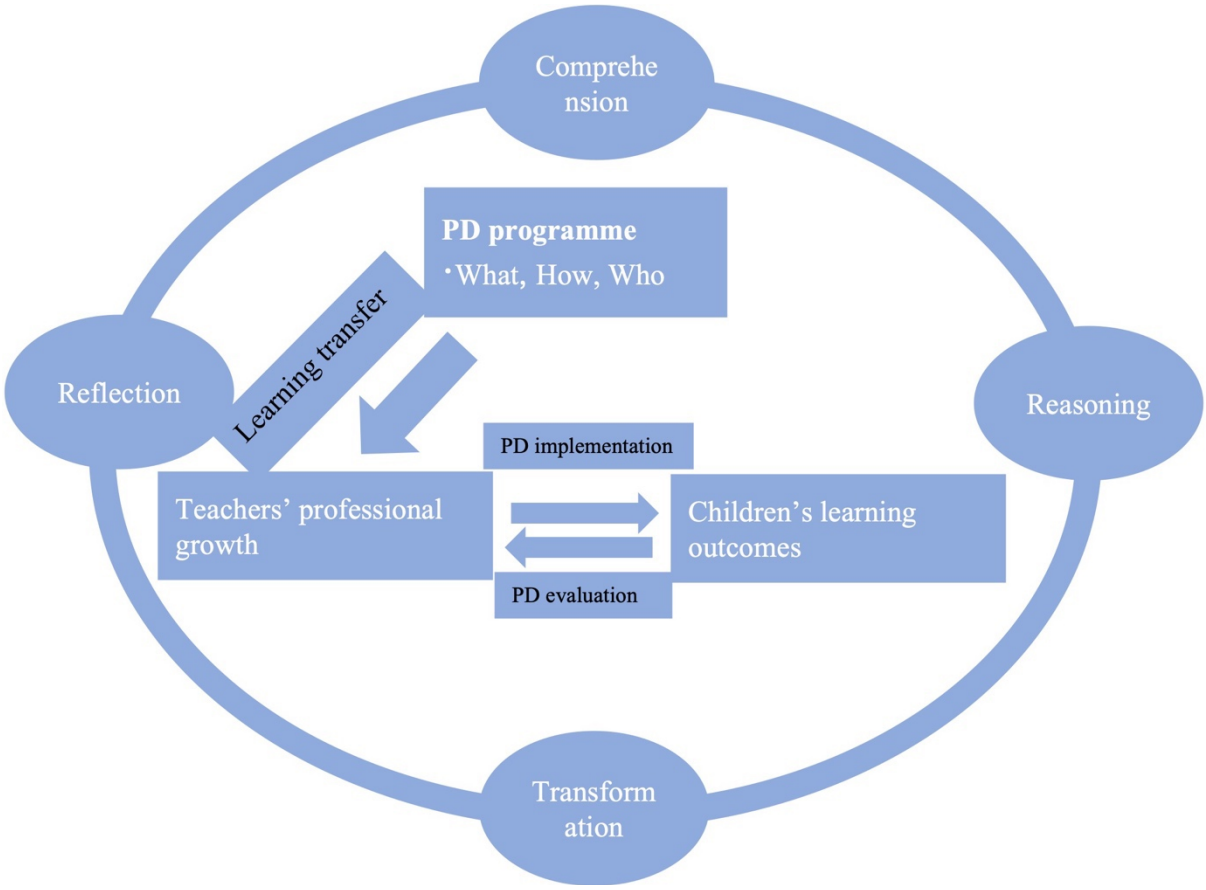
Furthermore, PD can also enhance student learning outcomes by translating theoretical and empirical knowledge into effective classroom practices (Egert et al., 2020). Fullan (1982) posits that improving students' learning outcomes should be the ultimate goal of teacher PD, and PD can achieve this objective by transforming teachers' beliefs and practices. In contrast, Guskey (2002) contends that teachers' beliefs are more likely to change after they witness student improvements resulting from changes in classroom practices. This feedback loop between changes in practice and student outcomes can gradually shape teachers' beliefs and attitudes towards teaching and learning. This is due to that student learning outcomes can serve as a reliable indicator of whether changes in practice are effective or not, leading to greater confidence and a shift in teachers' beliefs towards adopting more effective instructional practices. Especially for teachers with more experience, veteran teachers may become more entrenched in their current instructional approaches, making them less willing to change without compelling evidence that new practices work.

Therefore, facilitating change in teachers is a gradual process, and it requires regular feedback on the effects of teachers' practice and sustained follow-up support to plan effective professional development programmes (Guskey, 2002). To this end, Clarke (1998) transformed Guskey's linear process into a cyclic one that connects changing beliefs and practices. To make the process and aspects of change more transparent, Clarke and Hollingsworth (2002) developed the Interconnected Model, which shows that teachers change through reflection and enactment during professional development. These changes

involve personal changes in beliefs, practice, and disposition, practical changes through professional experimentation, outcomes and external changes from source and information. Additionally, based on social constructivist theory, children's intellectual development is facilitated when they interact with more knowledgeable others. Therefore, teachers have a critical role in stimulating dialogue to support children's understanding through the joint sharing and development of ideas (Pritchard, 2017). As shown in Figure 2.5, teachers' professional growth can affect children's learning outcomes through teacher-child interaction. Meanwhile, children's developmental outcomes can also influence teachers' professional development as they evaluate whether to sustain or quit the change based on child outcomes.

Figure 2.5

Modelling the impacts of PD programmes on teachers and children's change



2.5 The Research Context

2.5.1 Kindergarten Educational Policies in China

Kindergartens (or "you-er-yuan" in Chinese) are the primary institutions providing ECEC for children aged 3-6 years through full-day programmes in China. Since the first Chinese kindergarten was established in 1903, ECEC in China has evolved with a long history of imitation and integration from the Japanese schooling system, the Soviet approach and American education (Li et al., 2016; Yang & Li, 2018). After the establishment of the People's Republic of China in 1949, the Soviet Union approach, which featured subject-based, teacher-directed, unified learning content, became the politically correct teaching approach. Consequently, the only official early childhood pedagogy guideline, the *Teaching Plan for the Colleges of Kindergarten Education* (1956), was issued to standardise the ECEC teaching approach as "Three Disciplines and Six Pedagogical Subjects". The three disciplines encompass education, psychology, and hygiene, while the six subjects are general studies, math, music, arts, physical health, and language (Huang et al., 2019). As a result, Chinese kindergarten teachers were officially required to deliver whole-class, teacher-directed, and academic-oriented instruction (Huang et al., 2019; Zhu & Zhang, 2008). Due to the congruence of the Soviet union's approach with traditional Chinese culture's emphasis on ethical and moral purpose, discipline, adoration of authority, academic achievement, and collectivism, children's active learning and interaction with teachers were previously ignored (Li et al., 2012).

Since the implementation of the opening-up policy in 1978, China has undergone significant economic and social changes that have to connect it with the outside world. As a result, numerous western educational theories and child development pedagogical practices have been introduced, leading to a promising transformation that is aimed at replacing traditional pedagogy with developmentally appropriate practices (DAP). This reform seeks to

reconstruct teachers' pedagogical approach by transforming their educational ideas to respect children, promote active learning, conduct play-based teaching and learning, and teach through daily life routines (Liu & Feng, 2005). In line with this goal, the Ministry of Education in China issued the new *Teaching Guidelines for Kindergarten Education* (MOE, 2001), which encourage Chinese kindergarten teachers to implement play-based, child-centred, and constructive pedagogies (Hu et al ., 2016). To further support teachers' implementation of these official guidelines, the Ministry of Education successively issued the *Guideline for Learning and Development of 3-6 Aged Children* in 2012, which establishes standards for children's developmental outcomes in five learning areas, including health, language, sociability, science, and art. This guideline aims to assist teachers in making their teaching more purposeful and appropriate. However, a considerable policy-practice gap has been observed due to the lack of implementation support or practical instruction for teachers to apply these progressive ideas in practice (Zhang & Zhu, 2016). In Chinese kindergarten classrooms, some unique features continue to dominate, such as teacher-direct instruction, whole-class teaching, large class size, and structured daily routines (Li et al., 2012). As a result, teachers' pedagogical practice in classrooms is often characterised by frequent questions from teachers and collective simple oral responses from children, or by teachers lecturing with children sitting quietly and listening attentively (Li et al., 2012).

2.5.2 The Quality of Kindergarten Education in China

In 2010, the Chinese government announced its commitment to increasing investment in ECEC and achieving national coverage for kindergarten education in the next decade, as stated in the *Outline of the Chinese National Plan for Medium and Long-term Education Reform and Development (2010-2020).* Despite this commitment, concerns about the quality of kindergarten education persist. Pan et al. (2010) evaluated 28 classrooms in Beijing using the Chinese Kindergarten Environment Rating Scale, which measures physical environment,

interaction, daily routine, and curriculum on a 5-point scale. The study found that teacher-child interaction was of moderate quality, with teacher-initiated, large-group interactions occurring frequently (Pan et al., 2010). Li et al. (2016) conducted a study of 178 classrooms with 1,012 children aged 3-6 in Zhejiang province. They found low classroom quality in rural and urban areas using the Chinese Early Childhood Environment Rating Scale (CECERS). Hu et al. (2016) measured the quality of 180 classrooms in Guangdong provinces using the CLASS and found that teachers scored low on instructional support, indicating that they were less intentional in scaffolding children's thinking during educational activities. Li and his colleagues (2019) measured the quality of 428 classrooms with 2,110 children in 193 Chinese kindergartens in eight provinces using CECERS, and found the moderate quality of teaching and interactions strongly associated with Children's language, math, and social-emotional development (Li et al., 2019). Although China's status as one of the largest developing countries and is transforming to be a developed country, providing quality ECEC is still a challenge for cultivating young children (Li et al., 2010).

The aforementioned studies suggest a significant policy-practice gap in implementing DAP in Chinese kindergartens. In particular, the CECERS, adapted from the Early Childhood Environment Rating Scale-Revised Edition (ECERS-R), focuses on DAP, cultural diversity, and individual children's needs (Bredekamp & Copple, 1997). The CLASS also emphasises children's interests, teachers' support in extending children's thinking, and making learning relevant to their daily life. These approaches reflect a child-centred approach, inquiry-based learning, play-based learning, group learning, and process-oriented activities (Li et al., 2012). Despite the Chinese government's promotion of these concepts in educational reform, the observed low-quality pedagogical practices in kindergarten classrooms suggest a lack of effective implementation.

Furthermore, certain recommended educational concepts appear to be at odds with traditional Chinese educational beliefs and practices. Traditional Chinese culture stresses collectivism, obedience, self-constraint, and academic achievement, which are reflected in classrooms are whole-class teaching, teacher-directed activities, direct instruction, subject learning, exercising-based learning, and group activities (Li et al., 2012; Tobin, 2007; Li et al., 2016). However, due to the lack of ongoing PD or implementation support for DAP, many Chinese teachers still rely on whole-class teaching and infrequently engage in one-on-one or small-group pedagogical interactions, particularly in rural areas (Hu et al., 2016). Consequently, the low scores in teaching and learning in Chinese classrooms, which essentially reflect the policy-practice gap, are not surprising. These assessments measure factors such as instructional approaches, the responsiveness of teachers' actions, and children's individual engagement, all of which are weaker aspects of Chinese kindergartens. Therefore, it is necessary to update kindergarten teachers' pre-service education to equip them with advanced educational knowledge and provide ongoing in-service PD to transform their teaching practices. These efforts can narrow the policy-practice gap and enhance the quality of teaching and learning in Chinese kindergartens.

2.5.3 Early Childhood Teachers and their Education in China

The provision of high-quality ECEC in China is hindered by a shortage of qualified and committed early years teachers. In 2018, the gross enrolment in three-year kindergarten education was 81.7%, with 46.56 million children cared for by 2.58 million full-time kindergarten teachers (MOE, 2019). However, the teacher-child ratio remains challenging, with a national average of 1:17, which varies across regions: 1:9.5 in cities, 1:19 in counties, and 1:34 in rural areas (Li et al., 2017). In addition, the large class sizes create a barrier for Chinese kindergarten teachers to provide individualised attention and implement DAP (Hu et al., 2016). This challenge may perpetuate low-quality teaching and learning experiences in

Chinese kindergartens and hinder children's optimal development. Addressing this challenge requires concerted efforts to attract, prepare, and retain qualified and dedicated early years teachers, as well as reducing class sizes to enable teachers to provide individualised attention and implement effective teaching practices.

The education and qualification of kindergarten teachers in China pose another challenge to the provision of high-quality ECEC. In China, teachers' degrees and professional ranks are used as indices of their qualifications. The former reflects teachers' different educational levels, while their work performance determines the latter. Normal universities, normal colleges, and preschool normal schools are three types of ECEC institutions for teachers' training in China. The term 'normal' derives from the French 'école normale' which means 'setting the moral standard or pattern' (Hayhoe & Li, 2010). In the educational context, a normal school or university refers to an institution that aims to train school teachers. In particular, universities offer four-year bachelor's programmes or two to three years of master programmes, normal colleges provide three-year teacher training for middle-school graduates, and normal schools that offer three-year education for primary school graduates (Li et al., 2017). In 2022, only 27.72% of kindergarten teachers held bachelor's degrees, 57.73% with associate degrees, and 14.25% were high school or below graduates (MOE, 2021). Although teacher training institutions have expanded enrollment to meet the increased demand for kindergarten teachers, most enrollments are from normal schools or colleges, which account for 85% of teacher education institutions in China (Li et al., 2017). As a result, kindergarten teachers' academic qualifications tend to be lower, which may affect their understanding of progressive educational ideas.

Furthermore, despite the government issuing official guidelines aimed at transforming kindergarten teachers' practice, there has been a neglect of the transformation of pre-service teacher preparation in higher educational institutions. Since the *Teaching Plan for the*

Colleges of Kindergarten education was introduced in 1956, which established the mode of *Three disciplines and Six Pedagogical Subjects* model, there has been no other official guide for Chinese kindergarten teachers' pre-service education (Huang et al., 2019). Currently, pre-service education for kindergarten teachers emphasises collective learning, teacher-directed lecturing, and subject-based learning, with some progressive ideologies integrated. However, the content and the approach of pre-service education fall short of adequately supporting teachers' implementation of progressive ideologies and bridging the policy-practice gap.

In addition, the Chinese system also categorises kindergarten teachers into six levels based on their in-service experience and performance, including novice teachers, third-grade primary teachers, second-grade primary teachers, first-grade primary teachers, senior primary teachers, and senior secondary teachers (Li et al., 2016). Advancing in rank requires teachers to undergo evaluations after a certain period of service. For example, after five years of work, novice teachers can be evaluated for third-grade or second-grade rankings, with an additional five years of experience and external evaluations required for first-grade ranking. Senior primary teachers are distinguished educators with many years of experience and notable accomplishments, while senior secondary teachers are exceptional educators recognised at the national or provincial level (Li et al., 2016). However, the majority of kindergarten teachers or principals (72.27%) remained unranked, and only a small fraction (10.37%) were considered senior primary or secondary teachers (MOE 2016). Furthermore, Li et al. (2017) have observed that the percentage of teachers identified as senior levels have decreased due to the national expansion of ECEC provision, with a concurrent rise in the number of teachers without entry qualifications.

2.5.4 Professional Development for Early Childhood Teachers in China

To improve the quality of teachers' instruction in China, various in-service training programmes have been implemented (Yang & Rao, 2020). The most widely used approach is

school-based training, which accounts for 42.9% of in-service training for kindergarten teachers (Jiang et al., 2017). However, the effectiveness of school-based training is contingent upon funding, resources, teachers' qualifications, and school leadership, making it difficult to implement in kindergartens with limited resources (Yang & Rao, 2020). To address this issue, in 2010, the Chinese government launched the NTTP teacher training programme. This programme mainly recruited kindergarten principals or experienced teachers in rural China and provided approximately 33 hours of training per teacher. It included collective lectures in normal universities, online discussions, and visiting and teaching in high-quality kindergartens (MOE, 2018). However, the PD effectiveness was limited, as it showed no significant impact on teaching practice or students' learning (Lu et al., 2019). Despite several PD programmes being implemented to improve the quality of teaching and learning in ECEC, teachers' access to in-service training and the effectiveness of these programmes remains a challenge (Jiang et al., 2017).

Previous PD programmes in China have primarily focused on improving teachers' subject knowledge. While possessing good subject knowledge is necessary, it is insufficient. It is important to note that historically, most great teachers were generalists rather than specialists, such as Aristotle and Confucius, who encouraged learners to question, think critically, and break their abilities' limits through wisdom dialogues and interactions (Glazzard et al., 2014). Although ECEC teachers are expected to promote children's thinking and learning through inquiry-based interactions, current PD training for ECEC teachers tends to promote specialisation. Trainers deliver content and skills according to the requirements of production systems, in order to facilitate better training-to-work transitions. However, how teachers teach is influenced by their own learning experience. As a result, classrooms still feature collective teaching, subject-based learning, and teacher-directed pedagogy. Moreover, the instructional style teachers have experienced in PD programmes reflects traditional

Chinese culture, emphasising teachers' authority and obedience, and evokes ideas of direct teaching, such as drill, repetition and rote learning. These factors have hindered PD programmes from changing teachers' existing mind maps of primarily conducting teacher-direct activities. Therefore, there is a need for comprehensive and innovative PD programmes that integrate subject or content knowledge and teacher-child interaction principles for teachers to cultivate learners rather than trainees.

From a historical perspective, schools were established based on an industrial model that implemented a hierarchical structure with principals serving as managers and teachers as labourers (Boles & Troen, 1994). Initially, schools functioned as factories aimed at equipping children with essential knowledge and skills necessary for their roles in society (Pellicer & Anderson, 1995). However, this approach neglected the fact that schools are primarily learning environments that prepare and support children's education. Therefore, some PD programmes aim to promote teachers' basic skills, such as singing, dancing, and playing the piano, to enable them to teach these skills to their students. Other PD programmes focus on developing teachers' pedagogical knowledge, content knowledge, and classroom management strategies (Hu et al., 2014; Yang & Rao, 2020; Zhang & Xie, 2019). Nonetheless, there is still a dearth of PD programmes that enhance teachers' understanding of children, enabling them to identify children's individual needs and scaffold current thinking. To improve classroom quality in Chinese kindergartens, there is a pressing need to foster teachers' leadership for learning. Against this backdrop, this study seeks to explore effective learning for children, the role of teachers in promoting such learning, and the characteristics of effective PD.

Chapter 3 The Pilot Study

3.1 Chapter Introduction

Developing well-designed PD programmes requires careful consideration of several factors, including programme design, field-testing, refining to prepare training tasks and materials, descriptions of teaching and child development measurements (Borko, 2004; Cohen et al., 2013). Tooley and Connally (2016) identified four steps: (1) identifying teachers' needs to make the PD more contextually appropriate; (2) selecting the best-fit approaches to meet these needs; (3) ensuring a high-quality implementation of the PD programme; (4) evaluating the quality and outcomes of PD. Accordingly, this pilot study focused on the first two steps, i.e., identifying teachers' needs and contextualising the PD programmes accordingly. This pilot study aimed to achieve the following three objectives:

1. To validate ECERS-E and SSTEW for measuring classroom quality in the Chinese context;
2. To identify the strengths and weaknesses of teachers' classroom practices as evaluated by ECERS-E and SSTEW scales and reflected in their interviews regarding their PD needs;
3. To explore teachers' previous experiences participating in PD programmes and their training requirements.

3.2 Methods

3.2.1 Participants

The pilot study was conducted in Shenzhen, an experimental place for educational reforms in China. Stratified random sampling was conducted to select ten kindergartens that were located in lower-middle, middle, and upper-middle areas. One K1 (serving 3-4-years old children) or K2 classroom (serving 4-5-years old children) was randomly selected from each kindergarten, resulting in a total of 11 classrooms. Following the identification of

participating kindergartens and classrooms, one teacher was randomly selected from each kindergarten for an interview, resulting in a total of eleven teacher interviews. The details of the kindergarten and classroom characteristics are presented in Table 3.1.

Table 3.1

Demographic information of sampled classrooms

	Classrooms (N=11)
Age group	
3-4 years old	5
4-5 years old	6
Kindergarten type	
Private	4
Public	7
Kindergarten classification	
Province-level	5
City-level	3
District-level	1
Unclassified	2

3.2.2 Ethical Approval

Prior to initiating the pilot study, the Fieldwork Safety and Risk Assessment and CUREC application was completed in accordance with established protocols. Additionally, University of Oxford Central University Research Ethics Committee (CUREC) conducted a thorough review of the project and provided approval, as documented in Appendix A. To ensure compliance with ethical standards, the primary researcher provided a clear and concise explanation of the study's objectives and procedures to potential participants, along with digital consent forms. The consent forms detailed the procedure of the research and the rights and privacy protections afforded to both the researchers and participants. Participating principals, teachers, and parents completed the consent forms through an online survey platform in Oxford.

All personal information in the completed questionnaires and child assessment checklists was removed from the data analysis to protect participants' privacy. Access to the collected information was strictly limited to the researcher and supervisors, and all data was used only for research purposes. In addition, all research assistants who participated in data

collection underwent rigorous training and signed a confidentiality agreement to ensure the research integrity. This agreement details research assistants' obligation to protect participants' confidentiality, maintain data security, and adhere to all ethical guidelines.

3.2.3 Instruments

Early Childhood Environment Rating Scale-Extension (ECERS-E, Sylva et al., 2003). As noted in the literature review, process quality has a direct impact on children's learning experiences, and a teacher's ability to provide high-quality interactions is a key predictor of children's developmental outcomes. Consequently, the present study focused primarily on process quality and teachers' interactional practice. Previous research has demonstrated that the environment rating scale (i.e., ECERS-E), which emphasises process quality, is a more potent predictor of children's learning outcomes than other environment rating scales (ERS) that primarily target structural quality (Howard et al., 2018). Therefore, the Chinese version of ECERS-E was utilised in the present study to assess the quality of curriculum and pedagogy in literacy, numeracy, science, and diversity. The ECERS-E consists of four subscales and a total of 18 indicators, with scores ranging from 1 (indicating inadequate quality) to 7 (indicating excellent quality).

Sustained Shared Thinking and Emotional Well-being Scale (SSTEW, Siraj et al., 2015). SSTEW emphasises educators' ability to extend and scaffold children's thinking, which can enhance the effectiveness of ERS in terms of differentiating the quality of teachers' relational pedagogy and interactions (Howard et al., 2018). To evaluate the quality of pedagogical interaction in classrooms, trained observers used the Chinese version of SSTEW to measure the effectiveness of pedagogical practice. It comprises 14 indicators and produces ratings ranging from 1 (indicating inadequate quality) to 7 (indicating excellent quality). The scale evaluates teachers' ability to build trust, confidence, and independence,

promote social and emotional wellbeing, support and extend language and communication, facilitate learning and critical thinking, and assess learning and language.

In summary, to assess classroom quality, the current study utilised both ECERS-E and SSTEW rating scales, which offer a more nuanced assessment of pedagogical components than traditional quality rating scales. This allowed for a comprehensive evaluation of the quality of classroom processes, including but not limited to environmental factors.

Interview protocol. The interview protocol was developed to elicit participating teachers' reflections on their teaching practice and their PD needs. This protocol comprises three parts and a total of 15 questions. The first part of the interview aims to gather information about the teachers' teaching practices and classroom management strategies, including the types of learning activities they use in their classrooms. The second part of the interview explores the challenges that the teachers face in their daily teaching practice (e.g., what kind of difficulties have you met in daily teaching?). The third part of the interview seeks to understand the teachers' prior PD experiences and their perceived PD needs (e.g., what type of PD programmes have you ever participated in?). Semi-structured interviews were conducted with 11 participating teachers after observing their pedagogical activities. Each interview lasted around 45 minutes and was recorded and transcribed for analysis.

3.2.4 Procedure

Reliability training. As a result of Covid-19 travel restrictions from the UK to China, local research assistants were recruited to conduct classroom ratings in China. This approach allowed the study to proceed while ensuring the safety of all participants involved in the research. Two raters, both of whom were master's students in ECEC or psychology at prestigious universities, were recruited and extensively trained to undertake classroom observations using the ECERS-E and SSTEW. The training process consisted of two rigorous workshops, two weeks of in-depth discussions on the indicators, and four days of rating

practicum. The raters received specialised training workshops provided by one of the authors of ECERS-E and SSTEW to thoroughly understand the rationale of the measurements. Subsequently, the primary researcher organised a two-week-long discussion on the indicators of these two scales, ensuring that the raters were well-versed in the relevant aspects of the instruments.

The raters then conducted four rating practicums in four different classrooms. On the first day, they conducted face-to-face observations and ratings in one classroom, spending 2.5-4 hours on the observation and half an hour interviewing teachers. The other three classrooms were observed and rated in a back-to-back manner. After each observation and rating session, the raters discussed and reconciled any disagreements to strengthen their shared understanding of the instruments. The inter-rater reliability was evaluated using the percentage of items that two raters scored the same and the percentage of items that differed by less than one point. Following the four practicums, the percentages for the ECERS-E were 36% for identical ratings and 85.71% for ratings that differed by less than one point. The percentages for the SSTEW were 50% for identical ratings and 85.71% for ratings that differed by less than one point.

Formal rating. To enhance the reliability of the rating, two raters jointly observed and rated classrooms until they achieved at least 80% consistency in scores at the item level. Their rating consistency was continuously monitored, and any discrepancies were discussed after each observation and quality rating to reach a consensus on all indicators and items. The raters successfully achieved the target consistency in their fourth and fifth classroom ratings. Subsequently, they independently rated six other classrooms. The raters employed a fly-on-the-wall approach to observe teachers' pedagogical practices, thereby avoiding any influence on their typical teaching practices. Prior to the commencement of the rating practicum and formal rating, the raters obtained consent forms from both teachers and parents. Overall, the

two raters rated five classrooms together and six classrooms independently, ensuring that the ratings were comprehensive and reliable.

Follow-up Interview. Following the classroom observation, one teacher from each participating kindergarten was invited to join the follow-up online interviews to reflect on their pedagogical practice and identify their PD needs. Furthermore, two assessors were invited to participate in an online interview to share their reflections on the classroom observation process, the utilisation of rating scales, and recommendations for further improvements in research implementation.

3.2.5 Data Analysis

To conduct a preliminary examination of the quality of teachers' pedagogical practices, IBM SPSS 23.0 was utilised for descriptive analyses. The audiotaped interviews were transcribed and entered into EXCEL, followed by open coding, axial coding, and selective coding (Corbin & Strauss, 2014) to analyse the transcripts and identify emerging themes. The analysis was carried out in two stages: firstly by reading the transcripts and identifying critical information, and secondly by organising the essential information into coherent themes and categories. This approach allowed for a comprehensive and systematic examination of the data, providing valuable insights into the quality of teachers' pedagogical practices.

3.3 Results

3.3.1 The Scores of ECERS-E

The total average and subscale scores. Table 3.2 and Figure 3.1 illustrate the results of the ECERS-E assessments conducted in the sampled classrooms. The total average scores of ECERS-E ranged from 2.43 to 3.57, with a mean score of 3.01 (SD = 0.38), indicating the minimal quality of the observed classrooms. Among the four subscales, classrooms received the highest scores in literacy at 3.62 (SD = 1.64), diversity scored the lowest at 1.27 (SD =

0.45), while mathematics and science scored at 3.39 (SD = 1.62) and 3.36 (SD = 1.37) respectively. Notably, the subscale scores of literacy, math, and science were below five, indicating minimal quality. Furthermore, the diversity subscale indicated inadequate quality, highlighting the need for targeted interventions to enhance this aspect of early childhood education in the sampled classrooms.

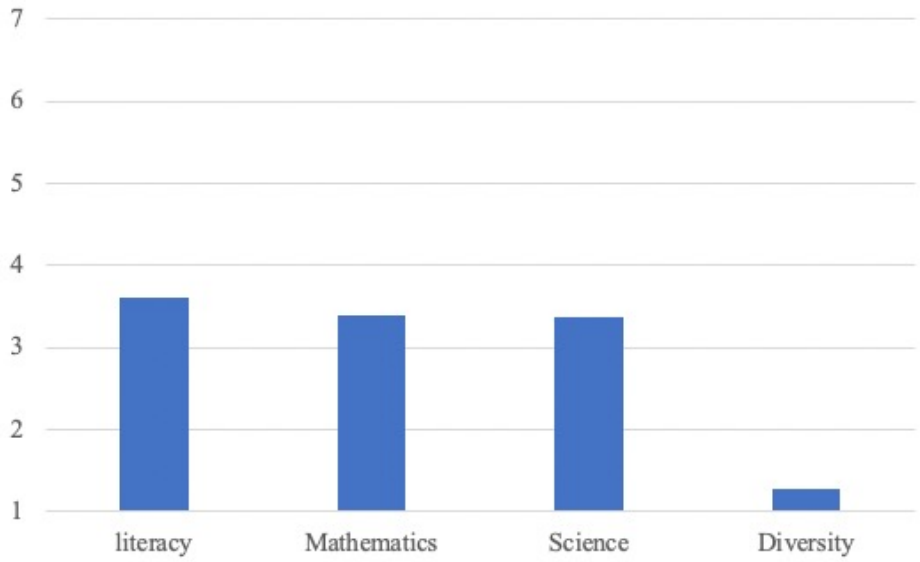
Table 3.2

Descriptive statistics of ECERS-E subscales and total score

Item	Min	Max	Score	SD
Literacy	2.60	4.40	3.62	1.64
Mathematics	2.33	6.00	3.39	1.62
Science and environment	1.67	4.67	3.36	1.37
Diversity	1.00	1.67	1.27	0.45
Total average	2.43	3.57	3.01	0.38

Figure 3.1

The average score of ECERS-E subscales.



The item scores. As shown in Table 3.3, all items in the **literacy** subscale scored below five, indicating minimal or inadequate quality. Within the subscale, the highest average score was obtained for talking and listening (*M* = 4.64, SD = 1.21), while the lowest score was observed for adult reading with the children (*M* = 2.00, SD = 1.00). Similarly, the **mathematic** subscale indicated minimal quality in counting and the application of counting

(*M* = 3.82, SD = 1.17) and shape/sorting (*M* = 3.46, SD = 1.75), and obtained inadequate quality in reading and representing simple numbers (*M* = 2.91, SD = 1.87).

Table 3.3

Descriptive statistics of ECERS-E literacy and mathematics

Item	Min	Max	Score	SD
Literacy	**2.60**	**4.40**	**3.62**	**1.64**
1. Print in the environment	2.00	5.00	3.27	0.79
2. Book and literacy areas	2.00	7.00	4.36	2.25
3. Adult reading with the children	1.00	4.00	2.00	1.00
5. Emergent writing/mark making	2.00	6.00	3.82	1.25
6. Talking and listening	2.00	6.00	4.64	1.21
Mathematics	**2.33**	**6.00**	**3.39**	**1.62**
7. Counting and the application of counting	2.00	6.00	3.82	1.17
8. Reading and representing simple numbers	1.00	7.00	2.91	1.87
9. Shape/sorting	1.00	7.00	3.46	1.75

As shown in Table 3.4, in the **science and environment** subscale, all three items received scores that fell within the minimal quality range, ranging from above three to below five. Sampled classrooms received the highest average score among the sampled classrooms (*M* = 3.55, SD = 1.57), while the lowest was observed in areas featuring science/science materials (*M* = 3.09, SD = 1.64). All sampled classrooms demonstrated inadequate quality in the diversity subscale, with scores ranging from one to two. Among the **diversity** subscale items, race equality and awareness received the highest average scores (*M* = 1.46, SD = 0.52), whereas planning for individual needs received the lowest score (*M* = 1.09, SD = 0.30). The results suggested that the overall quality of teachers' pedagogical practices was minimal or inadequate across all domains of the ECERS-E tool, and that their awareness and practice related to diversity are particularly weak, as indicated by the low scores in the diversity subscale.

Table 3.4

Descriptive statistics of ECERS-E science and diversity

Item	Min	Max	Score	SD
Science and environment	**1.67**	**4.67**	**3.36**	**1.37**
10. Natural materials	2.00	5.00	3.46	0.82
11. Areas featuring science/science materials	1.00	6.00	3.09	1.64
12. Science activities	1.00	6.00	3.55	1.57
Diversity	**1.00**	**1.67**	**1.27**	**0.45**
13. Planning for individual needs	1.00	2.00	1.09	0.30
14. Gender equality and awareness	1.00	2.00	1.27	0.47
15. Race equality and awareness	1.00	2.00	1.46	0.52
Total average	2.43	3.57	3.01	0.376

The characteristics of ECERS-E scores in different types of kindergartens. The scores obtained from classrooms were further analysed to examine potential variations among them. As shown in Figure 3.2, unclassified classrooms ($M_{\text{literacy}} = 4.00$; $M_{\text{diversity}} = 1.50$) obtained higher scores in literacy and diversity than those at the provincial level ($M_{\text{literacy}} = 3.28$; $M_{\text{diversity}} = 1.20$), city level ($M_{\text{literacy}} = 3.87$; $M_{\text{diversity}} = 1.22$), and district-level ($M_{\text{literacy}} = 3.80$; $M_{\text{diversity}} = 1.33$) kindergartens. In terms of mathematics and science subscales, classrooms at the district level ($M_{\text{mathematics}} = 4.33$; $M_{\text{science}} = 4.67$) received higher scores than classrooms at the provincial level ($M_{\text{mathematics}} = 3.40$; $M_{\text{science}} = 3.00$), city level ($M_{\text{mathematics}} = 3.22$; $M_{\text{science}} = 3.44$), and district-level ($M_{\text{mathematics}} = 3.17$; $M_{\text{science}} = 3.50$) kindergartens.

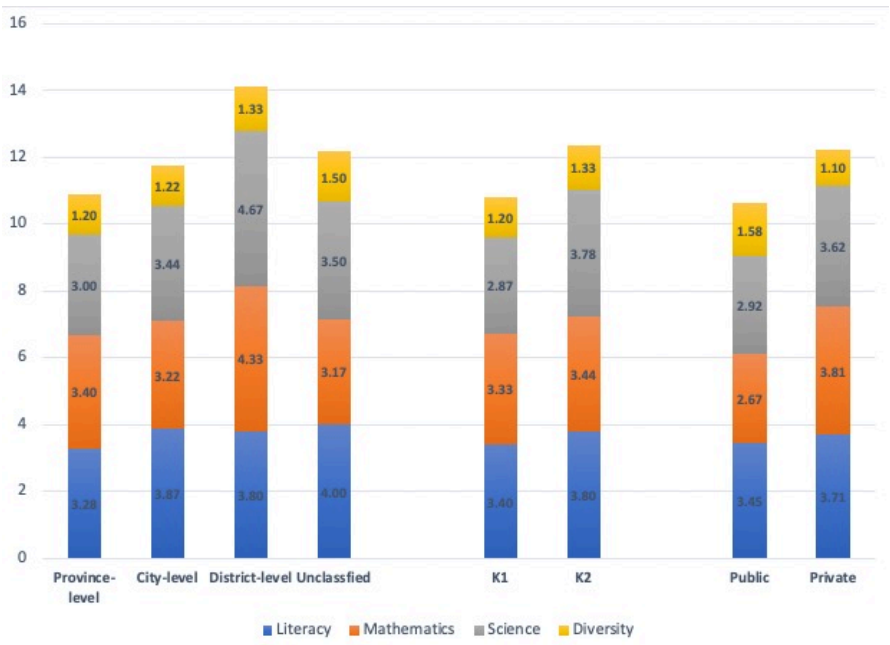
In terms of grade, K2 classrooms demonstrated higher quality than K1 classrooms in literacy ($M_{\text{K2}} = 3.80$; $M_{\text{K1}} = 3.40$), mathematics ($M_{\text{K2}} = 3.44$; $M_{\text{K1}} = 3.33$), science ($M_{\text{K2}} = 3.78$; $M_{\text{K1}} = 2.87$) and diversity ($M_{\text{K2}} = 1.33$; $M_{\text{K1}} = 1.20$). In terms of school types, private kindergartens obtained higher scores in literacy ($M_{\text{private}} = 3.71$; $M_{\text{public}} = 3.45$), mathematics ($M_{\text{private}} = 3.81$; $M_{\text{public}} = 2.67$), science ($M_{\text{private}} = 3.62$; $M_{\text{public}} = 3.92$), but lower scores in diversity ($M_{\text{private}} = 1.11$; $M_{\text{public}} = 1.58$) when compared to public kindergartens.

These findings indicate that school classification, school type, as well as grade, may influence the classroom quality. In terms of the school classification, the findings were

contrary to the previous study (i.e., Li et al., 2014), which suggested that kindergarten classrooms at the provincial level demonstrated superior quality compared to those at other levels. However, it is important to note that there is a limited sample size in this pilot study, which may lead to different findings from prior research. Furthermore, school classification is mainly based on structural quality, which may also contribute to the difference. Future research should employ a larger sample size and a more thorough examination to obtain a more comprehensive understanding of these findings. Therefore, further research is necessary to explore the underlying factors contributing to these results, including classroom practices, teacher qualifications, and curriculum design.

Figure 3.2

The subscale scores of ECERS-E in sampled classrooms.



3.3.2 The Scores of SSTEW

The scores of total average subscales in different types of kindergartens. As shown in Table 3.5, the total average scores of SSTEW ranged from 3.21 to 5.57, with the average score being 4.14 (*SD* = 0.72), suggesting a minimal level of overall quality among the sampled classrooms. Notably, Figure 3.3 shows that the classroom teachers demonstrated

good interactional quality in building trust, confidence and independence (M = 4.97, SD = 0.81), and in supporting and extending language and communication (M = 5.09, SD = 0.96). Conversely, the scores in assessing learning and language were below three (M = 2.27, SD = 0.88), indicating an inadequate level of quality. Furthermore, the average scores of social and emotional wellbeing (M = 3.36, SD = 1.50) and supporting learning and critical thinking (M = 3.70, SD = 0.98) indicated a minimal level of interaction quality.

The scores of items. In terms of the first subscale, participating classrooms received the highest scores in supporting self-regulation (M = 5.55, SD = 1.29) and the lowest scores in encouraging choices (M = 4.45, SD = 0.82). In terms of the third subscale, classrooms scored the highest in listening to children and encouraging children to listen (M = 6.64, SD = 0.67) but scored the lowest in supporting children's language use (M = 3.91, SD = 1.92). In terms of the third subscale, the classrooms achieved the highest scores in supporting curiosity and problem-solving (M = 4.64, SD = 1.80) but scored the lowest in fostering sustained shared thinking in investigating and exploration (M = 1.82, SD = 0.75). Notably, using assessment (M = 2.45, SD = 1.13) and assessing language and development (M = 2.09, SD = 1.14), received scores below three, indicating an inadequate level of quality.

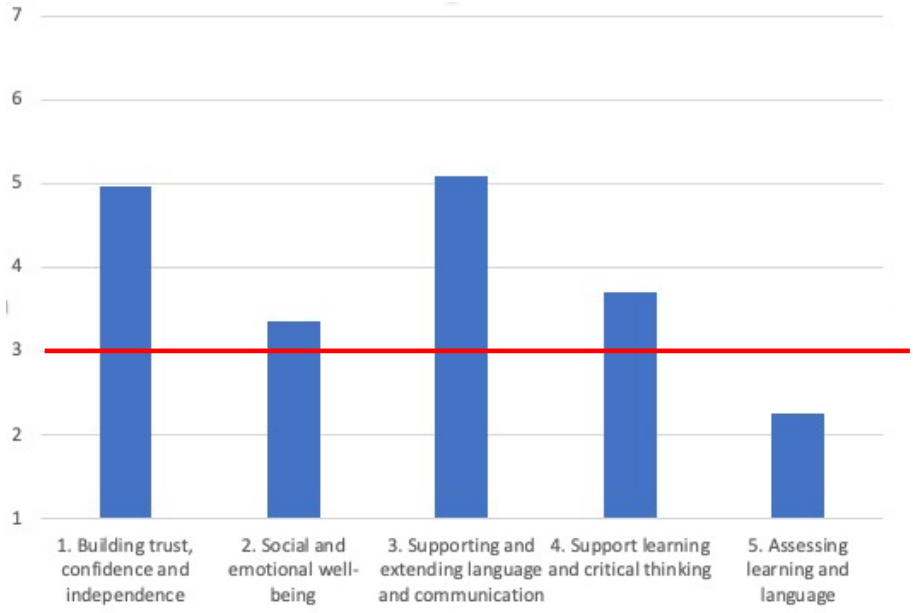
Table 3.5

Descriptive statistics of SSTEW items, subscales and total score

Item	Min	Max	Score	SD
Total average	3.21	5.57	4.14	0.72
Building trust, confidence and independence	**3.33**	**6.00**	**4.97**	**0.81**
1. Self-regulation	4.00	7.00	5.55	1.29
2. Encouraging choices	4.00	6.00	4.45	0.82
3. Planning for small group	2.00	7.00	4.91	1.22
Social and emotional wellbeing	**2.00**	**6.00**	**3.36**	**1.50**
4. Supporting socio-emotional wellbeing	2.00	6.00	3.36	1.50
Supporting and extending language and communication	**3.75**	**6.75**	**5.09**	**0.96**
5. Encourage children to talk with others	3.00	7.00	4.55	1.44
6. Staff actively listen to children and encourage children to listen	5.00	7.00	6.64	0.67
7. Staff support children's language use	1.00	7.00	3.91	1.92
8. Sensitive responsiveness	1.00	7.00	5.27	1.85
Support learning and critical thinking	**2.5**	**5.50**	**3.70**	**0.98**
9. Supporting curiosity and problem-solving	2.00	7.00	4.64	1.80
10. Encouraging sustained shared thinking through storytelling, sharing books, singing, and rhymes	1.00	3.00	1.82	0.75
11. Encouraging sustained shared thinking in investigating and exploration	2.00	7.00	3.82	1.33
12. Supporting children's concept development and higher-order thinking	2.00	7.00	4.55	1.63
Assessing learning and language	**1.00**	**4.00**	**2.27**	**0.88**
13. Using assessment to support and extend learning and critical thinking	1.00	4.00	2.45	1.13
14. Assessing language and development	1.00	4.00	2.09	1.14

Figure 3.3

The scores of the SSTEW subscale



The characteristics of SSTEW scores. The quality scores across classrooms were explored further. As shown in Table 3.6, the total average scores for all classroom types fell above three and below five, signifying a minimal level of quality. Notably, the findings obtained from SSTEW scores differed from those derived from ECERS-E, particularly with respect to the kindergarten classifications. Specifically, classrooms in provincial-level kindergartens (M = 4.34, SD = 0.79) obtained higher SSTEW scores than in city-level (M = 3.60, SD = 0.36) and district-level kindergartens (M = 3.50, SD = 0.00). In terms of the subscales, unclassified classrooms ($M_{\text{subscale 1}}$ = 6.17; $M_{\text{subscale 2}}$ = 5.50; $M_{\text{subscale 3}}$ = 5.50; $M_{\text{subscale 4}}$ = 4.38; $M_{\text{subscale 5}}$ = 2.50) recorded the highest scores across all SSTEW subscales, relative to their counterparts in the provincial - ($M_{\text{subscale 1}}$ = 5.07; $M_{\text{subscale 2}}$ = 3.40; $M_{\text{subscale 3}}$ = 5.40; $M_{\text{subscale 4}}$ = 3.95; $M_{\text{subscale 5}}$ = 2.40), city- ($M_{\text{subscale 1}}$ = 4.56; $M_{\text{subscale 2}}$ = 2.33; $M_{\text{subscale 3}}$ = 5.00; $M_{\text{subscale 4}}$ = 2.67; $M_{\text{subscale 5}}$ = 1.83), district-levels ($M_{\text{subscale 1}}$ = 3.33; $M_{\text{subscale 2}}$ = 2.00; $M_{\text{subscale 3}}$ = 3.75; $M_{\text{subscale 4}}$ = 4.25; $M_{\text{subscale 5}}$ = 2.50). The results also suggest expanding the sample size to explore quality differences among different kindergarten classifications.

In terms of grade, K2 classrooms outperformed K1 classrooms in subscale 1- building trust, confidence and independence (M_{K2} = 5.00; M_{K1} = 4.93), subscale 2 – supporting social and emotional wellbeing (M_{K2} = 3.67; M_{K1} = 3.00), subscale 4 - supporting learning and critical thinking (M_{K2} = 3.75; M_{K1} = 3.65), while K1 classrooms scored higher in subscale 3 - supporting and extending language and communication (M_{K1} = 5.50; M_{K1} = 4.75) and subscale 5 (M_{K1} = 2.50; M_{K1} = 2.08). Regarding the school type, classrooms in private kindergartens scored higher than those in public kindergartens in subscale 1 (M_{private} = 5.25; M_{public} = 4.81), subscale 2 (M_{private} = 3.50; M_{public} = 3.29), subscale 3 (M_{private} = 5.19; M_{public} = 5.04), and subscale 5 (M_{private} = 2.63; M_{public} = 2.07). However, they obtained lower scores in subscale 4 (M_{private} = 3.38; M_{public} = 3.89).

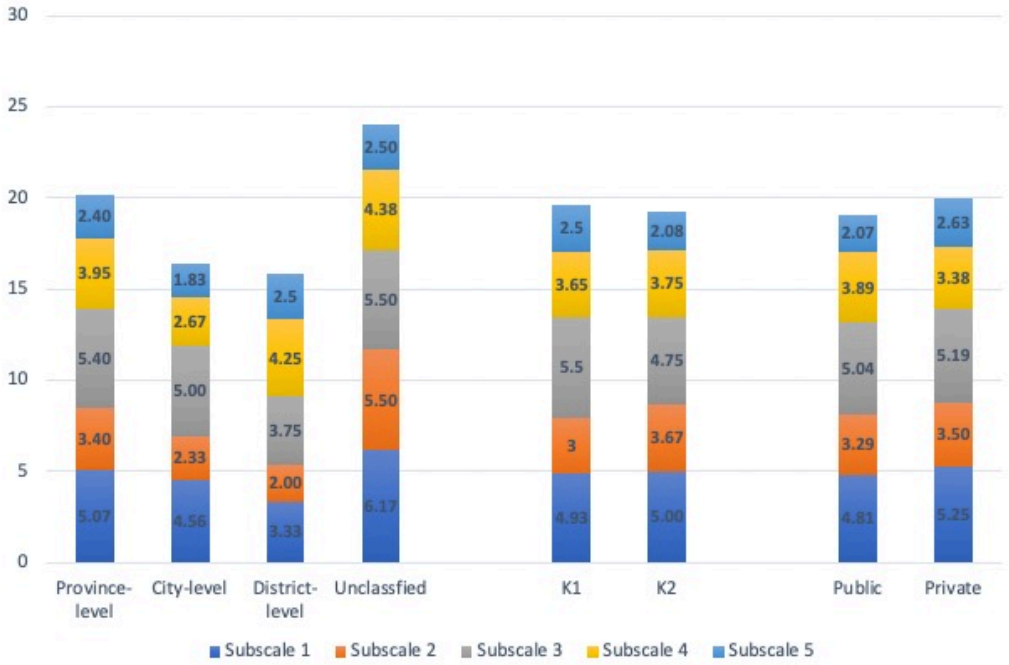
Table 3.6

Descriptive statistics of SSTEW total average scores in different classes

School characteristics	Min	Max	Average score	SD
Age group				
3-4 years old (N=5)	3.43	5.57	4.24	0.70
4-5 years old (N=6)	3.21	5.00	4.06	0.80
Kindergarten type				
Public (N=7)	3.21	5.57	4.11	0.79
Private (N=4)	3.43	5.00	4.20	0.67
Kindergarten classification				
Province-level (N=5)	3.43	5.57	4.34	0.79
City-level (N=3)	3.21	3.93	3.60	0.36
District-level (N=1)	3.50	3.50	3.50	0.00
Unclassified (N=2)	4.57	5.00	4.79	0.30

Figure 3.4

The subscale scores of SSTEW in sampled classrooms.



Notes. Subscale 1 = Building trust, confidence and independence, subscale 2 = Social and emotional wellbeing, subscale 3 = Supporting and extending language and communication, subscale 4 = Supporting learning and critical thinking, subscale 5 = Assessing learning and language.

3.3.3 The Analysis of Teachers' Interviews

Teaching approaches and content. The study investigated teaching practice by asking three questions: 1) How many teachers are in the classroom, and what are the divisions of labour? 2) what learning activities are implemented? 3) what are the daily routines followed in the classroom? The findings, presented in Table 3.7, reveal that the

majority of classrooms are staffed with two teachers - a senior teacher and an assistant teacher – as well as a nurse. However, only two classrooms had an additional teacher assistant. Senior class teachers, who generally had more teaching experience, were responsible for parental communication, classroom management, and dividing the labours of staff in the classroom. Assistant teachers, on the other hand, primarily focused on teaching, supporting senior teachers, and creating an engaging learning environment. Both teachers shared the responsibility of leading the children's learning activities on a rotating basis.

As shown in Table 3.7, the investigated classrooms utilised theme-based learning, domain-specific activities, and specialised lessons. According to the interview, classroom teachers organised learning activities around specific themes, which were selected according to children's needs (e.g., understanding the kindergarten environment for 3-4-year-old children), social events (e.g., COVID-19), or natural phenomena (e.g., summer). Each semester, teachers selected 2-3 themes and designed activities aligned with these themes in five learning areas, including language, mathematics, science, art, and health. In addition to theme-based learning, two of the observed kindergartens employed a project-based approach that followed children's interests and facilitated collaborative group activities. Furthermore, kindergartens had specialised teachers who exclusively taught children in specific areas, such as English, physical education, and music.

Table 3.7

The division of labour and the curriculum in the sampled classroom

The division of labour	
Senior class teacher	Classroom work division; classroom management; communication with parents; planning; teaching.
Associate class teacher	Arranging the learning environment; teaching;
Teacher assistant	Preparing teaching materials; assisting class teachers
Nurse	Classroom cleaning; food preparation.
Curriculum	
Project approach	Based on children's interests;
Theme-based learning	Based on children's needs, social events, or natural phenomena;
Special lessons	English immersion; physical; music; science and technology;

In terms of the learning activities, as shown in Table 3.8, children's daily routines in the observed kindergartens consist of four parts: 1) daily life activities which involve arrival and departure from the kindergartens, snack time, nap time, and using the bathroom; 2) thematic activities in which teachers design collective and group learning experiences across various learning areas; 3) learning-centre activities in which teachers provide individual and group guidance to children engaging in various learning centres; 4) outdoor activities which consist of brief collective physical exercises and outdoor free play for children.

Table 3.8

The daily routines in one sampled classroom

Time	Activity
8:40-8:50	Daily-life activities (arrival at kindergarten and morning exercise)
8:50-9:20	Thematic activity (collective activity; morning talking)
9:20-10:20	Outdoor activities (free play; physical exercise)
10:20-10:30	Daily-life activities (snacks)
10:30-11:30	Learning-Centre activity (individual and group activities)
11:30-12:10	Daily-life activities (using the bathroom; lunch)
12:10-12:30	Daily-life activities (take a walk)
12:30-14:30	Daily-life activities (Nap)
14:30-15:30	Outdoor activities (free play; physical exercise)
15:30-15:50	Daily-life activities (snacks)
15:50-16:20	Thematic activity (group activities)
16:20-16:30	Daily-life activities (leaving kindergartens)

Teaching difficulties. As shown in Table 3.9, according to the interview, teachers identified four types of challenges. Firstly, seven teachers reported difficulties in designing and implementing science activities, which they perceived as more complex than other types of learning activities, such as language, mathematics, and art. The teachers struggled to strike a balance between children's active exploration and their own guidance on the scientific experimental process. They believed that science activities required a logical and scientific approach that necessitated step-by-step guidance from the teacher. However, this guidance could stifle children's creativity during exploration.

Additionally, the teachers found it challenging to remain sensitive to children's interests and needs since they found children's interests changed very quickly. While

principals and governmental guidance encouraged teachers to follow children's interests and cater to individual differences, they struggled to incorporate children's spontaneous interests into educational activities or develop differentiated lesson plans that addressed children's unique needs.

In terms of instructional interaction, teachers in the study reported challenges in questioning and responding to children. Specifically, their questions were restricted to helping children recall what they had previously done or stating what they already knew, rather than scaffolding their thinking or providing more challenging activities. When children were unable to answer teachers' questions, the teachers provided the answers themselves. On the other hand, the teachers found it difficult to respond to children's questions that exceeded their expectations. As a result, they struggled to comprehend children's thought processes and provide appropriate scaffolding or challenges.

Child assessment was identified as another challenge faced by all interviewed teachers. They lacked systematic observation tools or guidance to facilitate intentional observation and were unsure what and how to observe. For example, their lack of knowledge about child development hindered their ability to document children's developmental progress. Additionally, they found it confusing to determine what support should be provided and how to offer it based on their observations. Some teachers also reported difficulties in supporting "children with special needs" who struggled to sustain attention or exhibited externalising behavioural problems. While individual behavioural plans or interventions should be provided for children with special needs, teachers had not received specialised training from the kindergarten, as there were only a small number of children with special needs in their classrooms.

Table 3.9

Teachers' perceived difficulties

Categories	Themes	Descriptions
Learning activities	Science activities	Science activities; the inadequacy of scientific materials due to the large class size; the balance between children's own exploration and teachers' guidance; the balance between the logical steps behind the scientific experiments and children's self-exploration;
	Parental involvement	How to make use of parental resources and encourage parental involvement;
	Planning for individual needs	The differentiation within a learning activity; how to design an activity based on children's interests; children's interests are scattered; unable to respond to all children's thoughts;
Instructional interaction	Questioning	Children cannot understand teachers' instruction; teachers' questioning is limited and keeps repeating; unable to scaffold or extend children's thinking and activity; Some children who do not like to answer questions are easy to be ignored;
	Response	How to respond to children's unpredictable questions; teachers have to answer their questions when children are unable to answer;
Child assessment	Observation	Teachers are unable to assess children's developmental stages; observation is not systematic; they do not have suitable assessment tools; the lack of professional guidance on assessment;
	Corresponding support	Teachers are not clear about children's developmental characteristics; and provide corresponding scaffolding based on observation; how to give parents the assessment feedback.
Children with special needs		How to support children whose emotions are unstable; Some children cannot concentrate; some bully teachers.

Previous PD experience. As presented in Table 3.10, four primary types of PD that kindergarten teachers typically engage in were identified:

1. apprenticeship or coaching, which aims to provide teachers with little to no teaching experience with real teaching experience by working alongside or assisting senior teachers in the same classroom;
2. workshops, where principals invite professionals or experienced teachers to share their educational experience related to a specific topic (e.g., how to use the project approach);
3. problem-based discussions, where principals or year-group leaders prompt kindergarten teachers to discuss their teaching problems and devise solutions;

4. school visits, where teachers visit high-quality kindergartens to learn about environmental decorations and teaching strategies.

Problem-based discussions were found to be the most common PD approach experienced by the teachers, with all reporting engaging in at least one such discussion each week. Teachers identified pedagogical content knowledge, learning environment settings, and communication with parents as areas in which they lacked confidence and desired more PD training. Although they had received some related PD training at the kindergartens, they perceived the training to be fragmented and lacking in follow-up guidance to help them apply what they had learned to practice. Consequently, they stressed the importance of coherent PD content that is relevant to their daily routine and that involves follow-up classroom visits to ensure the effective implementation of new strategies.

Regarding their perceived PD effectiveness, teachers reported that participatory training was more effective than passive listening and that observing the practical implementation of new strategies was critical to their understanding of how to implement them. In contrast, purely lecture-based PD and training that was irrelevant to their teaching practice were deemed to be of little value.

Table 3.10

Kindergarten teachers' previous PD experience

Categories	Themes	Descriptions
PD types	Apprenticeship (coaching)	Assisting and working with experienced teachers in classrooms.
	Workshops	Theoretical lectures from researchers; experience sharing from senior class teachers; Orff activities; project approach;
	Discussion	Problem-based school, year-group meetings; reading a book and sharing their opinions;
	School visiting	Visiting high-quality preschools to learn how to set environment and teach.
PD content	Pedagogical content knowledge	How to implement learning activities in five learning areas (i.e., language, art, health, science, math); theme-based learning; collective learning activities; daily routines;
	Environment setting	Setting learning areas; making learning materials;
	Parental involvement	Communicating skills with parents;
Teachers' feeling	Process	Most PD programmes are fragmented and unsystematic; The lack of follow-up support.

Effectiveness	Participatory PD is more helpful; engaging in activities is more effective than lecturing using PPT; school visiting and seeing what other teachers are doing is more practical; they have no time to internalise the notes from lectures; some lectures are very theoretical and irrelevant to practice.

PD needs. As depicted in Table 3.11, the primary concern of the interviewed teachers was related to understanding child development and scaffolding children's learning. A majority of the teachers expressed their difficulty in assessing children's current developmental stages and providing appropriate scaffolding based on observations. Their lack of knowledge in providing psychological or theoretical explanations for children's behaviours made them feel less confident in teacher-child interactions and unqualified as early childhood teachers. In addition, two teachers highlighted the importance of research skills since their kindergartens require them to conduct research and publish research findings. The ability to conduct research and publish research papers was deemed crucial for their professional development and salary.

According to the results presented in Table 3.11, the surveyed teachers expressed a preference for PD opportunities that are relevant to their daily practice and involve diverse activities, such as integrating lecturing, discussion, observing, and reflection. They indicated a desire for PD programmes that target their actual teaching issues and provide them with new strategies that can be practically applied in the classroom. Teachers emphasised the importance of practice-oriented training over theory-oriented learning, and they appreciated the use of concrete examples of excellent teaching practice.

Table 3.11

Kindergarten teachers' perceived PD needs

Categories	Themes	Descriptions
PD needs	Assessment and scaffolding	Assess child development; Scaffold child development based on observation;
	Educational theory	The gap between educational theory and practice; they need some psychological knowledge to understand children's minds.
	Research skills	Writing skills; how to do educational research.
PD form preferences	Relevant topics	They can discuss and analyse the educational theory based on their own working experience; Observing good examples of teaching.

Diverse forms	Lectures, discussion, visiting, and reflection; Some interacting activities can make the PD more interesting; They hope to watch good practice instead of pure listening; discussing their own thoughts; Engaging in activities

3.4 Conclusions and Implications

3.4.1 Quality of Teachers' Teaching Practices

The result of the assessment indicated that the sampled classrooms received higher scores on SSTEW than on ECERS-E. The average score of ECERS-E in the sampled classrooms was 3.01, which indicates minimal quality. ECERS-E literacy scored the highest at 3.52, while ECERS-E diversity scored the lowest at 1.27. Participating classrooms received 3.39 in ECERS-E mathematics and 3.36 in ECERS-E science and environment. Therefore, the results suggested that teachers are supposed to receive training in all four dimensions to improve their instruction quality. Furthermore, the following five items which were identified as inadequate should obtain particular attention, including (1) adult reading with the children and (2) reading and representing simple numbers; (3) planning for individual needs; (4) gender equality and awareness; (5) race equality and awareness.

In terms of instructional interaction in kindergartens, the total average score of SSTEW was 4.14, indicating minimal quality. Teachers performed relatively higher quality in building trust, confidence and independence, as well as supporting and extending language and communication, with the average scores being 5.09 and 4.97, respectively. However, the quality of assessing learning and language was inadequate, while supporting social and emotional wellbeing and supporting learning and critical thinking were identified as minimal quality. Therefore, teachers need training in teacher-child interaction. Moreover, special attention should be paid to encouraging sustained shared thinking through storytelling, sharing books, singing, and rhymes, using assessment, and assessing language and development, as these were identified as inadequate. These findings highlight the fragility of diversity and the assessment of learning and language in kindergartens.

3.4.2 Teachers' Perceived Teaching Difficulties and PD Needs

Based on the teacher interviews, four types of difficulties were identified. The first challenge pertained to ***planning and implementing learning activities***. Teachers found it challenging to account for children's differences, balance children's active exploration with teachers' guidance during science activities and integrate children's interests into meaningful learning experiences. The second difficulty was ***instructional interaction***, as teachers struggled to extend and scaffold children's thinking through the use of challenging questions and responses. The third concerned ***child observation and assessment***, as teachers expressed uncertainty about how to assess children's learning and provide appropriate support. Finally, some teachers reported difficulties in supporting children with behavioural problems. These perceived difficulties were consistent with the areas of weakness identified by ECERS-E and SSTEW, specifically in planning for individual needs and assessing learning and language. Therefore, future PD programmes should focus on addressing these areas of concern.

When examining teachers' previous PD experience, they reported participating in various forms of PD, including workshops, lectures, problem-based discussions, coaching, and school visits. While seeking to improve their pedagogical content knowledge, environment-setting skills, and communication with parents, they noted that lectures had a limited impact on their teaching practice. Instead, PD programmes that integrated interactive activities, real teaching examples, and opportunities for teacher engagement in discussions were deemed more effective. Additionally, modelling teaching and follow-up support were also highlighted as important aspects of effective PD. As such, teachers expressed interest in participating in PD programmes that focus on real teaching problems, utilise interactive activities and modelling instruction, and provide follow-up feedback. These components should be incorporated into future PD programmes.

3.4.3 Implications for PD Programme Design

Both instruction and interactional quality could be improved. According to the results of ECERS-E, the quality of literacy, mathematics, and science instruction was rated as minimal. Therefore, the forthcoming PD programme should focus on providing teachers with learning materials and strategies to improve their instructional practices in these domains. Moreover, given that all items related to diversity were rated as inadequate, special attention should be devoted to enhancing teachers' ability to incorporate diversity in their instruction.

Results of SSTEW showed that supporting learning and critical thinking and social and emotional wellbeing were identified as areas of minimal quality. As a result, teachers need the training to extend children's thinking and promote children's social-emotional development. Additionally, it is important to encourage sustained shared thinking through various activities such as storytelling, sharing books, singing, and rhymes. Teachers also need to develop appropriate assessment practices to gauge children's learning and development, including reading with children. Therefore, the PD programme should provide training to address these areas of inadequacy in teachers' instruction.

Emphasising the training in diversity and assessing learning and language. According to the results of ECERS-E, it is imperative to enhance teachers' comprehension of race and gender equality, as well as their capacity to plan for individual needs, as all sampled classrooms exhibited inadequate quality in this area. Additionally, the results of SSTEW indicate suboptimal performance among teachers in assessing learning and language. Thus, it is recommended that future PD programmes include training sessions aimed at improving teachers' assessment skills.

The differentiation within the training content. The ECERS-E results indicated varying levels of performance among sampled schools across different items. With regards to diversity-related items, it is recommended that training programmes focus on enhancing

teachers' awareness of individualisation, race and gender equality, as well as their ability to integrate such awareness into learning activities, given the overall inadequacy of the sampled schools in this regard. Furthermore, training programmes should help teachers strike a balance between teacher-led and child-led activities. As for the SSTEW items that were identified as inadequate (i.e., 10, 13 and 14), it is suggested that teachers receive training on fundamental aspects of high-quality assessment, reading and storytelling, and the provision of a positive and respectful learning environment.

Providing practice-oriented content and active learning experiences. According to the findings from interviews, teachers encountered two major difficulties while participating in the PD programme. Firstly, the theory-oriented content presented in lectures proved to be challenging to apply in practice. Secondly, the passive learning experience, which involved teachers solely listening to trainers without the opportunity for discussion or practice, was not conducive to professional growth. As a result, the effectiveness of these PD programmes was limited. To address this issue, it is recommended that PD programmes adopt a more practice-oriented approach, providing teachers with relevant examples and opportunities to practice new skills. Advocating for active participation and practice during PD sessions would help facilitate more effective professional growth among teachers.

Providing follow-up support. Teachers reported difficulties in implementing new strategies learned during professional development due to their demanding schedules and uncertainty about the appropriateness of their practice. To overcome these challenges, teachers may require external perspectives to support the application of new strategies in the classroom. Follow-up school visits, for example, could be an effective approach to help teachers assess their progress. Research has shown that providing mentoring to teachers can enhance their ability to reflect on and adapt their pedagogical practice, leading to pedagogical advancements (Hudson, 2013). Critical dialogues between teachers and external experts, such

as mentors, can help identify and analyse problems in teaching practice (Borko, 2004). Therefore, incorporating mentoring and opportunities for critical reflection can be an effective way to help teachers overcome barriers to professional development and improve their instructional practice.

In addition, PD programmes typically involve two types of learning for teachers: individual learning, including activities such as information acquisition, reflection, and experimentation, and collaborative learning with colleagues, including activities such as collaboration and knowledge sharing (Vangrieken et al., 2017). Peer collaborations and discussions related to real practice are crucial in developing teachers' professional knowledge and pedagogical approaches (Borko, 2004). Additionally, collaborative learning enables teachers from the same classrooms or kindergartens to jointly discuss how to apply PD content, making training content contextually appropriate for their special needs. Therefore, incorporating opportunities for collaborative learning and discussion into PD programmes can enhance teachers' professional growth and improve their ability to apply new knowledge and skills to their classroom practice.

Chapter 4 The Adaptation of the Leadership for Learning PD

4.1 What is the Leadership for Learning PD Programme

Australia's ECEC sector has a well-established national regulatory framework that seeks to enhance the quality of education provided to children. For example, the National Quality Framework (NQF) and National Quality Standard (NQS) outline the requisite qualifications of teachers, approved services and providers, and service quality. The effectiveness of this framework is largely dependent on the ability of teachers to implement it successfully, which requires in-service training. Given the discrepancies between teachers' pre-service education, work requirements, and the unequal distribution of qualified teachers, in-service PD has been identified as an efficient means of addressing these gaps (Siraj & Kingston, 2015). In light of this, Siraj et al. (2018; 2023) developed an evidence-based in-service PD programme entitled Leadership for Learning (LfL) in the Fostering Effective Early Learning (FEEL) project. This programme aims to improve the quality of curricula and interaction, and child outcomes across New South Wales by preparing participants to take leadership roles within their preschools and share their knowledge with colleagues and families. The programme was designed based on evidence-based components of effective PD, the Australian ECEC workforce, and baseline quality ratings, and was delivered to ECEC educators at 38 preschools and long-day care centres. As shown in Figure 4.1, this section describes the "what", "how", and "who" components of the PD programme in detail.

Regarding the "what" component, the PD content for the LfL programme was derived from a careful consideration of teachers' PD needs. This involved an analysis of teaching problems highlighted by baseline measures and previous research on classroom quality and PD effectiveness in both Australian and international contexts. Based on this knowledge, the PD programme covers the principles of child learning and development in self-regulation, language and communication, conceptual development in math, and science

and critical thinking. More specifically, the programme included two full-day sessions focused on high-quality interactions, environmental rating scales, and pedagogical knowledge. Additionally, five half-day sessions were dedicated to curriculum content in literacy, self-regulation and social-emotional development, numeracy, science and critical thinking. In terms of ongoing support, teachers were given access to E-books, links to activities, and online discussion forums in the third phase of the programme. The content was developed to ensure a contextual fit, with teachers' feedback being gathered during the process evaluation to inform the PD content in the next phase. The PD content was also linked to the governmental ECEC framework and standards, and was designed to feature research evidence supporting ECEC quality, focused pedagogical content knowledge and child development knowledge across five domains, thus providing coherence with the broader context.

Regarding the "how" component, the LfL PD programme was designed to provide participants with a comprehensive learning experience, consisting of a range of different components. These components included intensive face-to-face workshops, online support, active discussion, observation, assessment and planning during PD sessions, practice and reflection after each session, and process evaluation (Siraj et al., 2018; 2023). In terms of delivery, the PD programme involved two full-day and five half-day face-to-face content-focused sessions. In addition, a follow-up online discussion platform was made available to participants in the academic year to support the sustainability of changes.

Furthermore, the LfL PD programme placed a strong emphasis on observation, assessment and planning as key components of content delivery during PD sessions. In particular, teachers were initially provided with opportunities to observe high-quality interactions, from either the videotapes or trainers' teaching modelling. Subsequently, they were encouraged to assess their own teaching practice based on the knowledge and skills

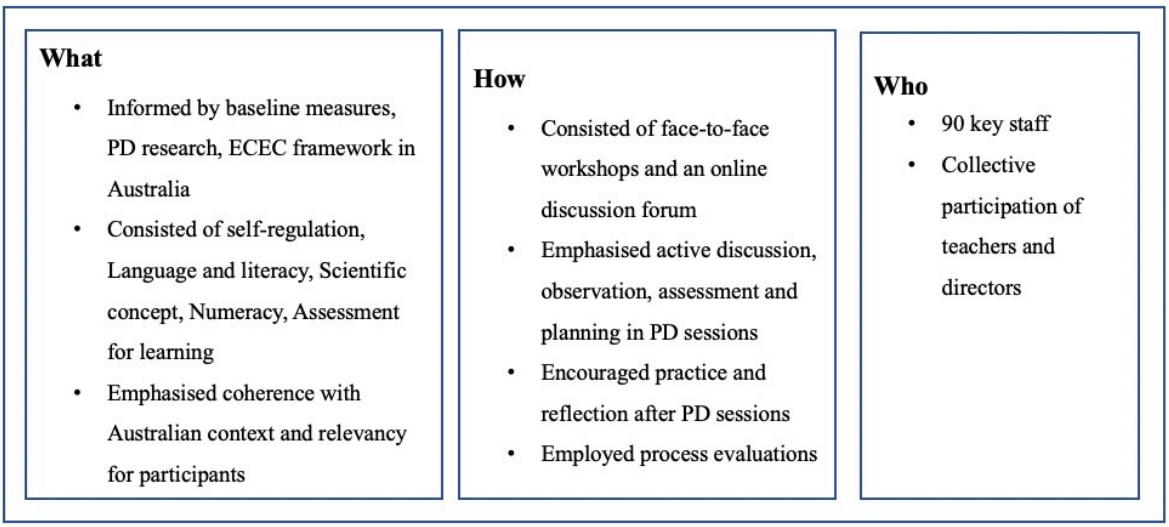
gained from the PD content, and to develop a practical plan for future improvement. Trainers then provided ongoing support, encouraging participants to practice and reflect upon their learning between sessions, apply this learning to their daily practice and feed it back at the next session. This approach was designed to create an improvement cycle that involved observation, assessment, planning, practice, reflection and re-practising after receiving feedback from trainers. By incorporating these various components into the PD programme, the aim was to provide participants with a comprehensive and integrated approach to professional learning that would support ongoing improvements in their teaching practice.

The active learning experience was another feature of the LfL PD programme. The programme included practical examples, participant-led discussions, and critical reflections on underlying theoretical models and concepts during PD sessions. Additionally, the programme provided an online support programme in phase three, which facilitated discussions and provided resources to an online community of educators. Process evaluations were conducted between the PD phase to inform the delivery of subsequent phases. Following the conclusion of each phase, participants were surveyed to gather feedback on their PD experience, challenges, and suggestions.

Regarding the "who" component, the LfL PD involved the participation of 90 key staff from 38 intervention centres. It was designed to facilitate the collective participation of teachers and directors from the same settings to foster a learning culture and professional learning communities within the centres. The joint participation of staff aimed to promote coherence in PD practice and create a professional culture that would ensure the sustainability of changes.

Figure 4.1

Critical components of Leadership for Learning PD programme.



4.2 The Framework of Adapting the Leadership for Learning PD Programme in the Chinese Context

A large body of research has investigated the development of educational resources for cross-national delivery (i.e., Li et al., 2017; Tobin, 2005). Numerous barriers have been identified, such as differences in cultures, teaching methods, educational values and systems, and language and semantics. As a result, cross-national research must take these differences into account and make appropriate adaptations. Researchers typically use three approaches for cross-national delivery of educational resources: (1) adoption, which focuses on linguistic equivalence in translations; (2) adaption, which requires close translation and psychometric activities related to different languages and cultures; and (3) assembly, which involves the creation of new linguistically and culturally appropriate tools (Byrne, 2016). The selection of a cross-national research approach depends on the degree to which the target country varies from the original context. These three approaches provided guidance for translating and adapting the LfL PD programme into the Chinese context for use in the target country and culture of interest.

The selection of an appropriate approach for cross-national research depends on several factors, including the tools, target culture and context of the study. While adoption may be the most straightforward choice for comparing the impacts of PD programmes across different contexts, adaptation or assembly is preferred to ensure maximum contextual- and cultural fit (He & van de Vijver, 2012). In this study, we combined all three approaches to adapt the LfL PD programme to the Chinese context and culture. To determine the extent of contextual and cultural fit, we employed the 3CAP framework (Li, 2007), which was developed based on the analysis of ECEC reforms in China.

Culture pervades and provides the socio-cultural context for learning; educators must consider social and cultural aspects of PD design, delivery, and knowledge structuring to create effective instructional environments for learners from diverse cultural backgrounds. ECEC in China has undergone significant transformations due to the interplay of local cultures and the global force of change. However, China has mainly responded to imported educational ideologies by adopting or adapting them, with few attempts to assemble or develop a unique model to integrate global influences into local contexts and cultural conditions (Zhu & Zhang, 2008; Li & Chen, 2017). This has led to noticeable cultural incompatibility issues, as imported curricula often diverge from teachers' previous professional knowledge and pedagogical practice. This discrepancy creates gaps between policy and practice and between beliefs and practices (Li & Chen, 2017). Tobin's (2005) analysis of ECEC reforms in China revealed that the government had used educational reforms as a strategy to address the challenges of globalisation and economic development. However, developing an ECEC system that respects local culture while welcoming external guidance could provide a way forward.

Against this background, Li (2007) proposed a new theoretical framework called 3CAPs to characterise the ECC reforms. The framework comprises three components:

1. culturally appropriate practice (CAP1), which emphasises sensitivity to Chinese society and culture and advocates against excessive reliance on imported ideas;

2. contextually appropriate practice (CAP2), which prioritises sensitivity to the local context in China and cautions against implementing imported ideologies or approaches without regard to regional differences;

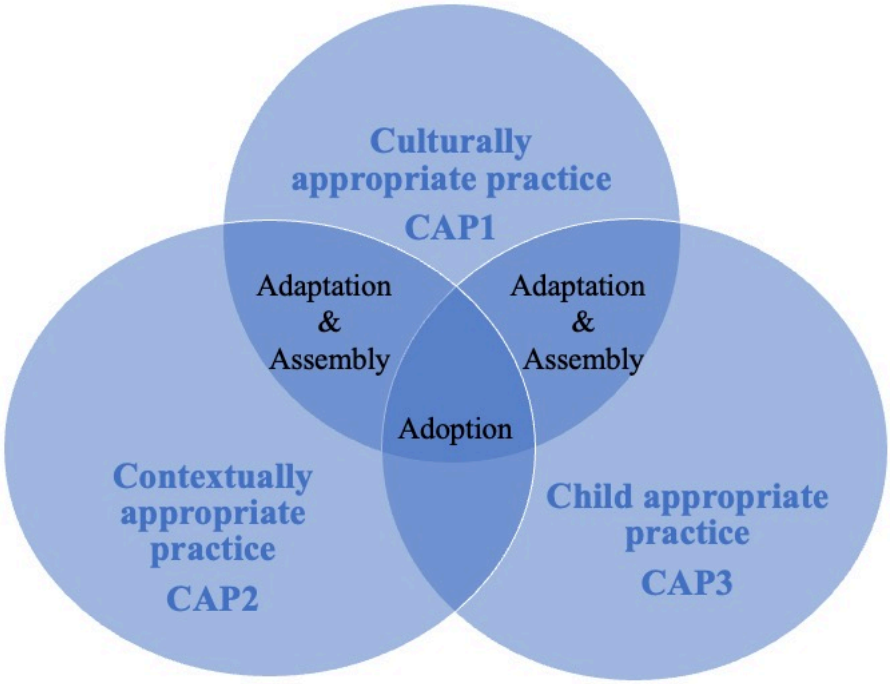
3. child-appropriate practice (CAP3), which recognises that children in different areas have unique developmental trajectories, family backgrounds, schooling histories and community contexts.

These three criteria guided the adaption of LfL PD in China, ensuring that the programme was tailored to meet the needs of local educators and students while remaining faithful to best practices in early childhood education.

Therefore, this study integrates the 3CAPs model criteria with three approaches to cross-national education resources delivery into an adaptation framework, as shown in Figure 4.2. the 3CAPs model serves as a guiding tool to assess the suitability of the "what", "how", and "who" aspects of the LfL PD programme and to determine the appropriate approach for adaptation. For instance, if the LfL programme's domain-focused content meets the 3CAPs model's criteria, it can be directly adopted. However, for those elements that are not culturally, contextually, or child-appropriate, adaptation and assembly techniques are employed to adjust them accordingly.

Figure 4.2

The framework of adapting the Leadership for Learning PD programme.



4.3 Adapting Key Components of the Leadership for Learning PD Programme

The adapted LfL PD programme aims to improve process quality, including curricula and interaction, as well as improve child outcomes. As outlined in chapter 3, a pilot study was conducted before the formal intervention to identify areas of weaknesses in process quality as measured by the ECERS-E and SSTEW to inform the PD content. Drawing on the evidence from the pilot study and the conceptual framework of PD adaptation, the LfL PD programme has been modified in the following aspects.

The "what" component. The "what" component of the LfL PD programme comprises six elements. The original PD programme prioritised high-quality interactions with a focus on sustained shared thinking. This occurs when two or more individuals collaborate intellectually to solve a problem, clarify a concept, evaluate an activity, or extend a narrative, among other interactions that encourage extended thinking (Siraj-Blatchford et al., 2002). In the Chinese cultural context, teacher-child relationships often follow a "master-disciple" style, where children are expected to conform to perfect the knowledge delivered by the

teacher (Tan, 2017, p. 242). To address this, the relational pedagogy of sustained shared thinking, which aims to foster trusting relationships and active learning roles for children, was incorporated into the adapted PD programme. Given that open-ended questions and whole-class instruction dominate Chinese kindergarten classrooms (Huang et al., 2019), the concept of sustained shared thinking was modified to fit teacher-group interaction. The PD emphasises helping teachers to provide sensitive responses and challenging questions to promote this approach.

The second aspect of the study involves the use of quality rating scales to assess teacher-child interactions in literacy, numeracy, science, and emotional wellbeing support. The implementation of rating scales aims to facilitate reflection and discussion. To ensure the relevance and appropriateness of these scales in the Chinese context, the study integrated two government guidelines, namely "Guideline to the Learning and Development of Children Aged 3-6 (MOE, 2012)" and "Kindergarten Education Programme Guidelines (MOE, 2001)" with the environment ratings. This adaptation process aligns the quality rating scales with the ECEC standards specific to China, thereby enhancing the relevance of the PD content to teachers' daily practice.

Third, the LfL PD programme aims to support children's language and literacy development in emergent reading, writing, print awareness, and phonological awareness. Given the significant differences between the English and Chinese language systems, assembly was made to ensure the programme's contextual and developmental fit. Unlike English letters, Chinese characters are classified as "pictographic", "ideographic", or "logographic" and Siok and Fletcher (2001) consider Chinese writing a " logographic system", where characters correspond to meaning. Chinese students learn to read by memorising the shapes of the characters, which is in contrast to English, a phonetic language where letters are composed of alphabets, allowing students to sound out words. Moreover,

although Chinese "Pinyin" provides a phonetic representation of Chinese characters, it was prohibited in preschools due to its rot learning nature (MOE, 2018). To address these challenges, the content of the literacy and language session in the LfL PD programme was modified to align with the pedagogical content knowledge in Chinese literacy with the guidance of a Chinese scholar specialising in child literacy and language development.

Fourth, the original PD session on children's numeracy development covers a range of topics, including understanding numbers, counting, measuring and comparing, sorting, and shapes. Similarly, the PD session on scientific concept development includes living- and non-living science activities, as well as natural and scientific materials. These two PD sessions were adapted to be contextual- and child-appropriate for China, where children's numeracy and science development is more cognitive-oriented and less influenced by social-cultural context than literacy. This involved both adoption and adaptation strategies, such as translating the training materials into Chinese and adding more practice examples of teacher-child interaction and high-quality learning materials from Chinese kindergartens. Furthermore, the pilot study revealed that teachers in China had weak content knowledge of early science due to the lack of pre-service education and in-service training in this area. It was also noted that the concept of "science" was relatively new and imported into China during the "May Fourth Movement" or "New Cultural Movement" of 1919 (Poo, 2019). Consequently, the adaptation of the science session also involved adding the content knowledge of early science to build teachers' foundational knowledge of science activities.

Fifth, the LfL PD includes a self-regulation and social-emotional development session that covers strategies for building trust and independence, as well as supporting social-emotional wellbeing. The cultural appropriateness of this PD session is of particular importance, as social and cultural conditions can significantly influence children's behaviours, emotional expressivity, self-regulation, and interaction styles (Chen, 2010). In

China, for instance, social initiative may be less valued due to the emphasis on group harmony and cohesiveness. As a result, individuals need to restrain personal desires and emotions to address the needs and interests of others (Tamis-LeMonda et al., 2008). Therefore, Chinese children tend to exhibit better self-regulation skills but may be less expressive in terms of emotions and social interaction due to traditional cultural values. To address these characteristics, the self-regulation and social-emotional development session in the LfL PD programmes focuses on promoting children's social-emotional wellbeing. Specifically, it aims to help teachers support children's self-regulation in a child-friendly manner, encouraging children's expression of emotions and needs and being responsive to children's needs.

Sixth, the assessment for learning sessions in the LfL PD programme focuses on child development and assessment knowledge. However, in Chinese kindergartens, direct assessments of children are not commonly used (MOE, 2018). Therefore, this session was adapted to emphasise the importance of child observation and evidence-based recording of children's learning behaviours to assess their development. Additionally, based on the pilot study that identified teachers' weaknesses in planning for individual or small group needs, a new session was developed to help teachers tailor their instruction to accommodate children's diversity, such as their family background, abilities, gender, and race. As shown in Table 4.1, the LfL PD programme was adapted to the Chinese context using the strategies of adoption, adaptation, and assembly.

Table 4.1

Adapting the “what” components of the Leadership for Learning PD programme

What components	CAPs	Approaches	Adapted elements
High-quality interactions	• Culture: Confucian tradition • Context: Large class size • Low cognitive challenges questions and response	Adaptation	• Focus on group interaction • Relational interaction • High-quality questioning • Extending child thinking
Quality rating scales	• Context: Local guidelines and development standards	Adoption & adaptation	• Adapt environment rating scales based on local guidelines
Language and literacy	• Context: No Pinyin • Child: Different learning systems of Chinese and English literacy	Assembly	• Use the pedagogical content knowledge in Chinese literacy • Under the guidance of a Chinese scholar
Numeracy	• Context: different learning environment	Adaptation	• Add examples of pedagogical practice and materials in China
Science	• Culture: New Cultural Movement • Context: Lack of pre-service education and in-service training	Adaptation	• Add content knowledge of science • Add examples of pedagogical practice and materials in China
Self-regulation and social-emotion	• Culture: Group-oriented • Context: cohesiveness in the community • Child: restrain personal desires	Adaptation	• Support children’s self-regulation in a more child-friendly way • Encourage expression • Focus on emotional wellbeing
Assessment for learning	• Context: Direct assessment is not allowed • Lack of pre-service education and in-service training	Adaptation	• Knowledge of child documentation • Focus on child observation and evidence-based recording

The "how" component outlines the delivery of the PD programme to teachers. Table 4.2 shows the adaptations of "how" components. Initially, the LfL PD consisted of two-day intensive face-to-face workshops, followed by five biweekly half-day workshops. However, research has shown that theory-oriented PD content is ineffective in the Chinese context (Loyalka et al., 2019). Instead, domain-specific activities are more popular in kindergartens. Therefore, the two-day intensive sessions on quality ECEC and research on teacher-child interaction were reduced to one session that focused on high-quality teacher-child interaction and environmental rating scales. Additionally, the five workshops were extended into six sessions due to inadequate quality in diversity and assessment observed in the pilot study. Furthermore, the bi-weekly workshops were modified to weekly sessions to accommodate the time limitations of the research project.

The second adaptation in the "how" component involves replacing online support with onsite one-to-one and small-group mentoring. In Chinese culture, classroom communication tends to be listening-centred, with students showing respect to teachers by remaining silent (Cong, 2008). This cultural preference makes it difficult to effectively deliver training content through online platforms, as students rarely initiate questions or interactions in these settings (Yang et al., 2021). Additionally, preschool teachers have busy schedules that often make it challenging for them to access computers and engage actively in online discussions, given their teaching, caring, family communication, and classroom decoration duties. Studies have shown that mentoring is effective in promoting positive teacher practices and improving child development outcomes (e.g., Egert et al., 2018; Neuman & Cunningham, 2009). Therefore, onsite mentoring was employed to help teachers assess their learning progress, apply the new pedagogical approach, and acquire new skills to enhance their existing ones (Rush & Shelden, 2005).

Third, the training programme incorporated process evaluations, which involve observing, assessing, and planning for improvement. These practices have been shown to be effective in enhancing the impact of PD. Additionally, the programme solicited feedback and suggestions from teachers, which were used to tailor the PD content to better suit their needs and the local context. Fourth, the programme emphasised the importance of practice and reflection to support teachers' implementation of new knowledge and skills in their classrooms. To further support teachers' application of the training content in the teaching, they were required to videotape their practice and bring the videos to the training site for assessment and discussion during the training sessions. Each session included a dedicated 40-minute period for teachers to review and reflect on their videotaped practice.

The fifth aspect of the PD programme involves adapting collaboration and discussion strategies to ensure cultural and contextual appropriateness. In Chinese culture, collectivism is highly valued, and individuals tend to be motivated extrinsically, such as by family responsibilities, career development, group success, and social status (Cong, 2008). To ensure contextual appropriateness, teachers from the same kindergarten were grouped together to encourage collective learning and motivation. Moreover, given that the Chinese educational system emphasises memorisation over critical thinking, learners tend to focus on learning from doing rather than questioning or criticising before taking action (Cong, 2008). Thus, the focus of the discussions in the PD programme was on how to apply the high-quality practice in the classroom, based on the training content and reflections on their daily practice.

Table 4.2

Adapting the "how" components of the Leadership for Learning PD programme

How components	CAPs	Approaches	Adapted elements
Two-day intensive face-to-face workshops	• Context: Ineffective theory-oriented PD • Domain-specific curriculum	Adoption & adaptation	• One-day intensive face-to-face workshop
Five biweekly half-day workshops	• Context: Weakness in diversity • Time limit	Adaptation	• Six weekly workshops
Follow-up online support	• Culture: Chinese culture values silence in classrooms • Context: Preschool teachers have busy schedules	Assembly	• Follow-up onsite mentoring
Process evaluations	• Culturally and contextually appropriate	Adoption	• Translations of process evaluation tools
Practice and reflection	• Context: one week for practice	Adaptation	• Videotape their practice for evaluation and reflection
Collaboration and discussion	• Culture: Chinese learners value collectivism • Context: educational system emphasises memorisation rather than critical thinking	Adaptation	• Teachers from the same kindergarten have been grouped together • Discussions focus on how to do and reflect on practice

The "Who" component. Table 4.3 displays the adaptations made to the "who" elements of the LfL PD programme. In the original programme, the intervention was delivered to 90 key staff members from over 30 settings. In Chinese culture, learners hold those with greater knowledge and a higher social hierarchy in high regard (Jiang, 2006). Therefore, in addition to teachers, curriculum coordinators or principals were also invited to attend the PD sessions to motivate teachers' engagement with the PD and encourage them to practice what they have learned.

In terms of the providers, the PD content was contextualised and culturally adapted by inviting five Chinese scholars with expertise in the areas of literacy, numeracy, science, self-regulation, diversity, and assessment. These scholars were responsible for delivering pedagogical content knowledge and providing examples of high-quality practices during the PD sessions, as each discipline has its own unique pedagogical approaches.

Table 4.3

Adapting the "Who" components of the Leadership for Learning PD programme

Who components	CAPs	Approaches	Adapted elements
90 key staff	• Culture: Respect authority	Adaptation	• Curriculum coordinators or principals have been invited
PD designers deliver the training	• Context: Different disciplines have unique pedagogical approaches	Adaptation	• Five Chinese scholars have been invited

Based on the findings of the pilot study and PD adaptation framework, we have made several adaptations to the current LfL PD (See more details in Appendix B):

1. Translating the slides and videotapes from the original PD into Chinese;
2. Inviting Chinese experts in various domains such as literacy, numeracy, science, self-regulation, and assessment to adapt the current Chinese version of slides and provide video recordings of one training session in each domain;
3. Requiring the teachers to bring a video recording of their pedagogical practice to the training sites for discussion and reflection;
4. Removing the online discussion programme and adding follow-up mentoring to provide individual guidance in each classroom;
5. Adding one training session on diversity since the awareness of gender and race equality is inadequate in Chinese kindergartens;
6. Inviting the directors and curriculum coordinators to join the PD sessions with preschool teachers to create a joint learning community.

4.4 The Adapted Leadership for Learning PD Programme

The aim of the adapted LfL PD programme is to enhance teachers' pedagogical content knowledge, teacher-child interaction, intentional and relational pedagogies, and ultimately improve children's learning outcomes. This adaptation of the PD programme was informed by research evidence on PD programmes, ECEC quality standards in China,

pedagogical content knowledge across various learning domains, and teachers' PD need identified in the pilot study. The adapted LfL programme includes the following components:

Collective training workshops. As shown in Table 4.4, the PD intervention utilised in the current study comprised three distinct phases. Phase 1 and Phase 2 are collective training workshops. Phase 1 is a comprehensive one-day, in-person training session designed to introduce the characteristics of quality ECEC, relevant research findings, and best practices. This phase provides an overview of the research on ECEC quality, essential principles of teacher-child interaction, and the application of environment rating scales. Teachers were divided into two groups to participate in the weekend training session held in one kindergarten. Phase 2 encompasses four weekly half-day training sessions and two biweekly half-day training sessions, focusing on literacy, numeracy, science, self-regulation, planning and assessment, diversity and review. These sessions integrate content and child development knowledge with practical application, enabling participants to adapt, practice and evaluate newly acquired pedagogical practice in each domain during and between the sessions. Prior to each session, teachers were required to record a 5-minute video of teacher-child interaction related to the upcoming session's content for evaluation and discussion. Participants were grouped into three cohorts to attend training sessions held in three different kindergartens.

Follow-up mentoring in individual classrooms. Phase 3 of the study involved onsite follow-up mentoring for each kindergarten classroom. Six mentors who resided in the same district as the kindergartens were selected to carry out this task. All the mentors possessed master's degrees in ECEC or relevant areas, and prior teaching experience as classroom teachers for young children. Two mentors were assigned to mentor ten classrooms, two to mentor eight classrooms, and two to mentor six classrooms based on their availability.

The fidelity of PD training. The mentor training process is comprised of three main stages. Firstly, mentors attended the training sessions in Phases 1 and 2 to acquire an understanding of the PD intervention and establish relationships with teachers through face-to-face interactions. Secondly, the primary researcher standardised the mentoring manual and provided mentors with a week-long training that included reading assignments on mentoring, ECERS-E and SSTEW reliability training, as well as role-play modelling of the mentoring process. Thirdly, to ensure a standardised mentoring process, the primary researcher paired with each mentor for a day, practising mentoring in two classrooms. In addition, two mentors were assigned to each kindergarten for bi-weekly mentoring, which allowed for mutual review and suggestions for promoting fidelity. Furthermore, all mentors, including the primary researcher, had weekly meetings to review and reflect on the mentoring process. After each mentoring session, mentors recorded their classroom observations and suggestions for teachers and the primary researcher checked the report to ensure fidelity. This process continued for approximately three months, with each classroom receiving bi-weekly mentoring.

Table 4.4

Overview of the PD programme

	Phase 1: One-day Intensive Training	Phase 2: Six half-day workshops	Phase 3: Follow-up Onsite Mentoring
Specific aims	• Encourage teachers' innovation; • Support teachers' understanding of high-quality classroom environments and interactions.	• Promote teachers' understanding, implementation, and adaptions of high-quality teaching.	• Observe teachers' practice and provide specific suggestions for improvement; • Sustain teachers' implementation of high-quality interactions.
Duration	• Two 3.5 hours of group training.	• Each session lasts three and a half hours.	• The mentoring includes two hours and a half of observation and one-hour discussion;
PD contents	• Fundamental national and international studies about classroom quality; • Current problems of classroom quality in participating kindergartens; • Key elements of ECERS-E and SSTEW;	• Pedagogical content knowledge and teaching strategies in children's different learning domains; • The use of ECERS-E and SSTEW to do self-evaluation and reflection;	• Observe teachers' practice and identify the improvements and weaknesses; • Provide specific feedback for improvements; • Jointly construct an improvement plan for the subsequent mentoring.
PD approach	• Explicit instruction; • Videotapes of best practice; • Coaches' modelling;	• Explicit instruction; • Videotapes of best practice; • Group discussion and reflection on teachers' videotapes;	• Mentors' frequent assessment and feedback to individual teachers; • Jointly planning for further improvement.
Anticipated changes	• Teachers realise their problems and understand the importance and key elements of high-quality interactions.	• Teachers can use ECERS-E and SSTEW for self-appraisal and change their teaching practice accordingly.	• Teachers can continuously implement the key elements of high-quality interactions in classroom practice.

Chapter 5 Methodology

5.1 Research Questions

This research adapted an evidence-based PD programme entitled Leadership for Learning (LfL). It explored the effectiveness of this adapted PD programme on enhancing Chinese kindergarten teachers' pedagogical practice and child outcomes as guided by the following research questions:

5.1.1 The Impacts of PD Intervention

1. What are the effects of the professional development (PD) programme on intervention classroom quality relative to the control group?
2. To what extent do school and classroom characteristics moderate the effects of the PD programme on classroom quality?
3. What are the effects of the PD programme on child development relative to the control group?

5.1.2 The Perceived Influencing Factors of PD Effectiveness

1. How does the PD programme constrain or enhance teachers' pedagogy or child outcomes?
2. What factors do the teachers perceive impact the effectiveness of the PD programme on teaching and learning?

Note: The PD programme is the LfL programme adapted for China.

5.2 The Overview of Study Design

As shown in Table 5.1, this research comprised a pilot study (see more details in chapter 3) and the primary PD intervention study focusing on PD for preschool teachers. The pilot study was primarily concerned with validating measurements and exploring teachers' PD needs, and the findings were used to inform the adaptation of the LfL programme. Meanwhile, based on the established research evidence of the effectiveness of PD

intervention, randomised controlled trials (RCTs) design was employed to ensure rigorous evaluation of the adapted PD programme. This methodological approach provides a robust means of ensuring an equal probability of allocating participants and comparability across groups (Kelly, 2012).

Twenty-four kindergartens from the Shenzhen region participated in the intervention study, with 12 randomly allocated to the intervention group and 12 to the control groups. As shown in Figure 5.1, participating kindergartens received pre-test in October and November 2020 and post-test in July and August 2021 to measure classroom quality and child development. Teachers in the intervention group received the adapted PD workshops from November 2020 to March 2021 and follow-up mentoring from March 2021 to May 2021. After the post-test, teachers in the control group received the PD programme.

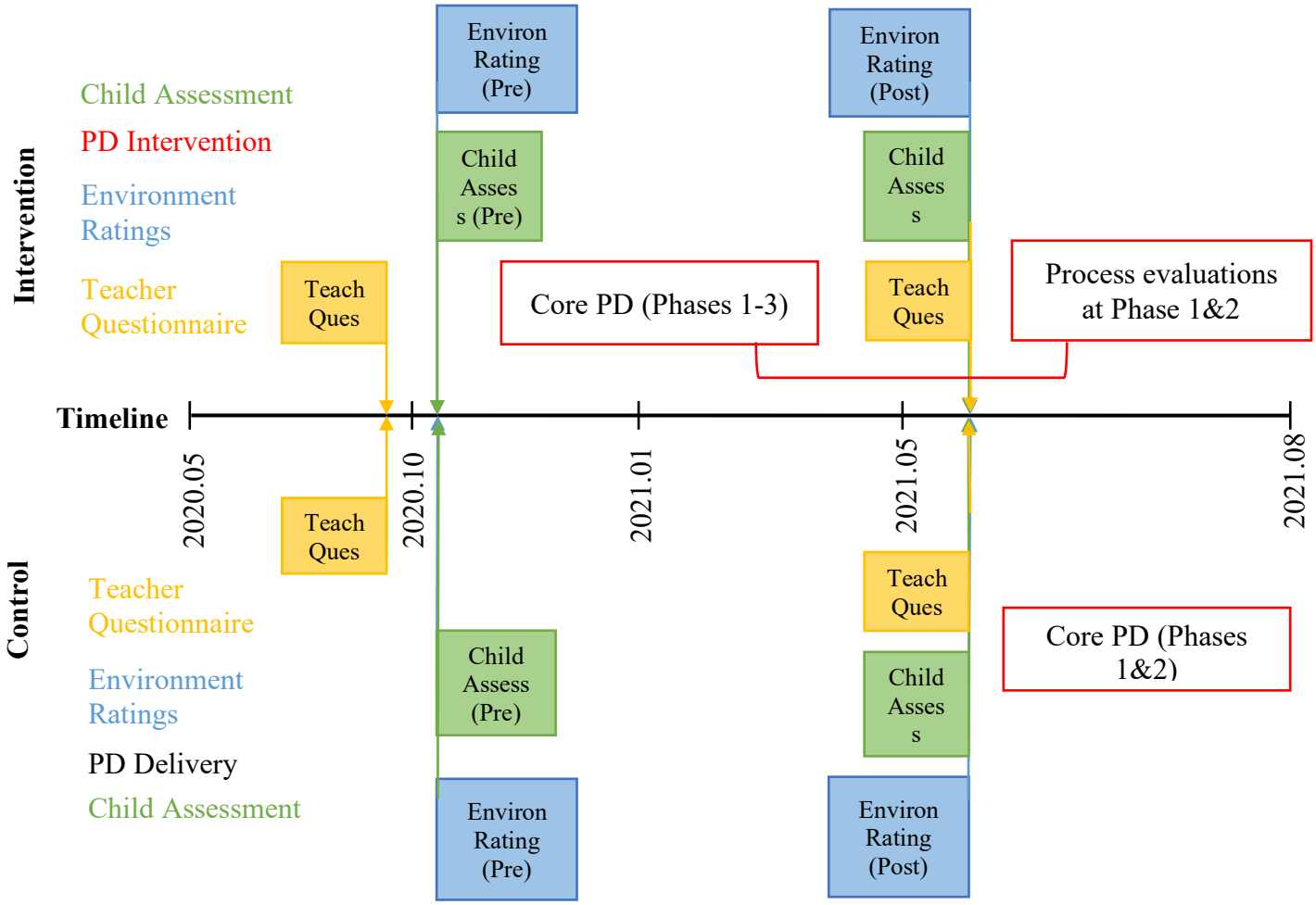
Table 5.1

Overview of the research design

	Phase 1	**Phase 2**
Study	Pilot study	PD intervention
Purposes	To try out the measurements of classroom quality, teacher characteristics, and child development; Identify teachers' PD needs.	To quantitatively evaluate the effects of the PD programme on classroom quality, teachers' characteristics and young children's language, numeracy, and self-regulation competence. Teachers complete the process evaluation survey during PD intervention to reflect on their experience and PD effectiveness.
Participants	Eleven kindergartens (one K1 or one K2 classroom in each kindergarten)	Twenty-four kindergartens: twelve are in the intervention group, twelve are in control groups without any treatment
Data sources	Classroom observations; Teacher interview.	Classroom observation; questionnaire.
Data management	Descriptive analysis	Multiple linear regression; Multilevel modelling; Thematic analysis;

Figure 5.1

Overview of the main study



5.2.1 Calculating the Sample Size

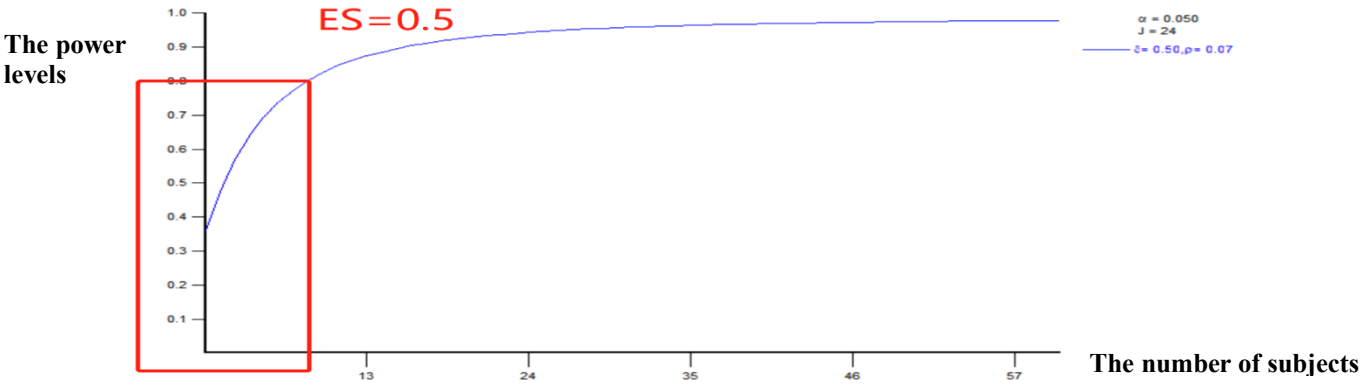
Twenty-four kindergartens and eight teachers in each kindergarten. The present study utilised the Optimal Design Software to conduct a power analysis and determine the required sample size for clustered designs. Specifically, the study drew on the meta-analysis conducted by Egert et al. (2018) on the effects of in-service PD programmes on the pedagogical quality of early childhood teachers. Egert et al. (2018) found that the effect size of in-service PD on process quality was 0.68, while studies on quality rating and child development reported the effect size at the classroom level to be 0.45. Based on these findings, this research anticipated an effect size of 0.5 on classroom quality. To adjust for

clustering, a correction factor of [1+ (m-1) × ICC], where m represents the number of teachers per school, and ICC is the intra-class correlation coefficient, was used (Gore et al., 2017).

As shown in Figure 5.2, assuming a value of ICC as 0.07 and the correction factor as 1.5, the power analysis indicated that selecting eight teachers in each kindergarten cluster and 24 kindergartens were required for an RCT design with 80% power and alpha set at $p < 0.05$. Consequently, a sample of 24 kindergartens, each with eight classroom teachers, and a total of 96 classrooms and 192 teachers, was selected to participate in the intervention research. Given that two teachers typically work in one classroom, selecting four classrooms in each kindergarten was deemed adequate to meet the sample requirement.

Figure 5.2.

The power of choosing different numbers of teachers per kindergarten cluster



Six children in each classroom. Given that children are clustered within classrooms, multilevel analysis is appropriate to analyse children's outcomes. According to Newsom (2019), simple models are unlikely to encounter convergence issues if the analysis includes more than 50 groups, each containing approximately 5-10 cases. Regarding the power issue related to statistical significance, it would be sufficient to involve 50 groups with 5 cases per group (Hox, 2010). As there are 96 classrooms, surpassing the 50-group criterion, six children in each classroom were invited to participate in the research.

5.2.2 Recruiting Participants

Recruitment of kindergartens, classrooms and teachers. Shenzhen, as a special economic zone for national education reforms, is undergoing a promising transformation in early childhood education. Therefore, it was selected as the setting for the study. As shown in Table 5.2, there are 1268 kindergartens in Shenzhen. To ensure the representativeness of the socioeconomic statues (SES), four regions (Nanshan, Longhua, Longgang, Pingshan) were selected as they represent high-, middle-, and lower-middle developed areas. This resulted in a pool of 700 eligible kindergartens for the study.

Table 5.2

Demographic characteristics of different districts in Shenzhen

Indicators Shenzhen	GDP (billion)	Population (Million)	Number of kindergartens
Longgang	4287.86	2.386	167
Nanshan	3714.57	1.291	192
Baoan	3612.18	3.577	244
Futian	3561.44	1.502	151
Longhua	2130.16	1.604	194
Luohu	1974.07	1.004	147
Guangming	920.59	0.625	74
Pingshan	701.66	0.446	69
Yantian	612.76	0.243	30
Dapengxin	341.66	0.153	15

The following criteria were established for the inclusion of kindergartens: (1) willingness of more than eight kindergarten teachers to participate and be allocated to any group; (2) commitment of teachers to complete the 12-month research period; (3) location in areas that are neither highly advantaged nor disadvantaged; (4) not currently involved in other research. An online advertisement was sent to kindergarten principals to solicit participation in the study. Principals, who are willing to participate in this research, complete an online questionnaire to provide basic information about their kindergartens, such as the number of K1 and K2 teachers, location, school type, and classification. Following the pre-test, Prof. Edward Melhuish randomly allocated 24 kindergartens to equalise, as best as

possible, the intervention and control groups based on the criteria of public/private, province/ city/ district, and urban/suburban. The randomisation results are presented in Table 5.3.

Selection of Children. In order to conduct a comprehensive assessment, six children in each classroom were randomly selected, resulting in 576 children. The selection process involved the systematic identification of three boys and three girls according to the alphabetical ordering of their first names by the researcher. Participating teachers provided the name list of children to the researcher, who randomly selected the third, sixth, and tenth children in the boys' and girls' name lists. Adhering to such a rigorous sample selection technique ensured that the assessment accounted for a diverse representation of participants, thus fostering accuracy and generalisability of outcomes.

Table 5.3

The results of kindergartens randomisation

	Total	Treatment group	Control group
Number of kindergartens	24 kindergartens	12 kindergartens	12 kindergartens
Classification	8 province-level 9 city-level 7 district-level	4 province-level 5 city-level 3 district-level	4 province-level 4 city-level 4 district-level
Location	12 urban 12 suburban	6 urban 6 suburban	6 urban 6 suburban
Number of classrooms (four classrooms from each kindergarten)	96 classrooms (48 K1, 48 K2)	48 (24 K1 classrooms serving 3-4 years old children; 24 K2 classrooms serving 4-5 years old children)	48 (24 K1 classrooms serving 3-4 years old children; 24 K2 classrooms serving 4-5 years old children)
Number of teachers (two teachers from each classroom)	192 teachers (96 K1 teachers and 96 K2 teachers)	96 (48 K1 teachers and 48 K2 teachers)	96 (48 K1 teachers and 48 K2 teachers)
Number of children	576 children (3-4 years old)	288 3-4 years old children	288 3-4 years old children

5.3 Measures

5.3.1 Classroom Quality

Early Childhood Environment Rating Scale-Extension (ECERS-E, Sylva et al., 2003). As indicated in the literature review, process aspects of the classroom environment have a direct impact on children's learning experiences, while educators' ability to provide

quality interactions predicts children's developmental outcomes. Consequently, the primary focus of the intervention is on improving the classroom environment and teachers' interactional practice. Additionally, the Chinese version of ECERS-E was employed in this study to assess curriculum and pedagogy quality across different learning areas, including literacy, numeracy, science, and diversity. The ECERS-E consists of 18 items, which are grouped into four subscales and produce ratings ranging from 1 (inadequate) to 7 (excellent). The confirmatory factor analysis (CFA) of ECERS-E (CMIN/DF = 1.102, CFI = 0.939, RMSEA = 0.034, TLI = 0.919) demonstrated good reliability and validity.

Sustained Shared Thinking and Emotional Well-being Scale (SSTEW, Siraj et al., 2015). Trained observers evaluated pedagogical interaction quality in classrooms using the Chinese version of SSTEW scale, which assesses teachers' ability to support children's cognitive and social-emotional development by promoting sustained shared thinking and emotional wellbeing (Howard et al., 2018). The SSTEW consists of 14 items with the score ranging from 1 (inadequate) to 7 (excellent). The first domain is to measure teachers' support in children's social-emotional development and includes two subscales: (1) building trust, confidence, and independence; (2) social and emotional wellbeing. The second domain measures teachers' support in cognitive development through three subscales: (3) supporting and extending language and communication; (4) supporting learning and critical thinking; and (5) assessing learning and language. CFA of SSTEW (CMIN/DF = 1.042, CFI = 0.977, RMSEA = 0.070, TLI = 0.970) also indicated good validity.

Covariates. A structured questionnaire was used to collect background information from the participants about the classroom and school characteristics. In terms of the classroom level, covariates consisted of teachers' age, degree, qualifications (0 = without qualifications, 1 = with qualifications), grade (0 = K1, 1 = K2), and child-to-teacher ratio. Similarly, in terms of the kindergarten level, key variables included school type (0 = private,

1 = public), location (0 = sub-urban area, 1 = urban area), district level (0 = not district level, 1 = district level), and city level (0 = not city level, 1 = city level).

5.3.2 Child Outcomes

The International Development and Early Learning Assessment (IDELA, Save the Children, 2011). This child assessment tool was developed by Save the Children, and designed to evaluate the literacy, numeracy, social-emotional, and motor skills of children between the ages of 3-6 years. Widely implemented in lower and middle-income nations, this assessment tool demonstrates strong reliability and validity, as evidenced by Halpin et al. (2019). Emergent literacy (EL) is comprised of 24 items, which were grouped into six subtasks, including emergent writing, expressive vocabulary, initial word sounds, letter identification, listening comprehension and print awareness. Emergent numeracy (EN) consists of 27 items and six sub-tasks, including classifying and sorting, comparison, counting, number identification, shape identification and simple arithmetic. The social-emotional (SE) part includes friends, emotional awareness, empathy and conflict resolution. Finally, this assessment tool included two subcomponents of the executive function (EF) construct, namely short-term memory and inhibitory control. IDELA was used to measure children's literacy, numeracy, social-emotional development, and executive function in this study. CFA of IDELA (CMIN/DF = 2.88, CFI = 0.915, RMSEA = 0.057, TLI = 0.900) also indicated good reliability and validity.

Covariates. Existing research has demonstrated that children's age and gender influence their academic, social-emotional, and executive function skills (Cohrssen & Niklas, 2019; Fuhs et al., 2014). Therefore, the covariates at the children level included children's age and gender (0 = boys, 1 = girls).

5.3.3 Teachers' Perceived Impacts and Influencing Factors

Teachers' perceptions of PD effectiveness of the PD programme. Teachers from the intervention group were invited to complete a semi-structured questionnaire to elicit their perceptions regarding the PD training and the factors that influenced their PD implementation. The questionnaire consists of two parts. The first part utilised a 5-point likert scale to extract teacher satisfaction levels regarding the PD programme. The second part included open-ended questions intended to explore perceived changes experienced by the teachers, including factors that influenced PD implementation, and difficulties and challenges faced during the training process. Each teacher was allotted around 45 minutes to complete the questionnaires at the end of the PD programme. Of the 109 teachers who participated, 83 provided pertinent feedback.

5.3.4 Research Procedure

Classroom observation. To ensure the reliability and validity of the quality assessment, research assistants were recruited and underwent rigorous training on using assessment tools. Specifically, classroom observation was carried out by four expert assessors, who received rigorous training using ECERS-E and SSTEW. While three of the assessors received two workshops on assessment implementation by Prof. Iram Siraj, and the fourth assessor was trained by the primary researcher. Following these workshops, four assessors engaged in a comprehensive two-week-long discussion, during which they discussed and clarified the various rating indicators in the rating scales. Additionally, raters conducted twelve days of rating practicum to develop a shared understanding of the assessment process.

The assessors devoted a total of six hours to evaluating participating classrooms: five hours for rating them and one hour for interviewing teachers. In order to ensure consistency and standardisation of data collection, two assessors independently rated the same classrooms

and compared their scores, thereby reconciling any discrepancies and promoting mutual understanding. To ensure inter-rater reliability, the primary researcher engaged in a rating practicum with the other three assessors individually until the proportion of the same rating items between the primary researcher and the other assessors reached at least 80%. Following this procedure, the formal rating process commenced. Among the four assessors, the agreement rates for the same score ranged from 78.57% to 92.86% for the ECERS-E instrument and from 71.42% to 85.71% for the SSTEW instrument. Moreover, the rates of scores with a difference of up to 1 point ranged from 85.71% to 100% for both instruments.

Child assessment. A total of 24 research assistants were recruited; 12 for the pre-test and another 12 for the post-test. In preparation for the assessment, these assistants underwent a two-day workshop on the procedures and administrate of child assessment. The training also included individual practice sessions, pairing each research assistant with a senior assessor to go through the assessment process. During these practice sessions, one assessor read the instructions and interacted with one young child, while both of them recorded the scores. The reliability of each research assistant was assessed by comparing rating scores with those of the senior assessor. After each research assistant got 100% exact scores as the senior assessor, they started formal rating. All children participated in the assessment in a classroom located in their kindergartens.

5.4 Data Analysis

To investigate the effects of an adapted professional development (PD) programme and its various influencing factors, we conducted both quantitative and qualitative analyses in five distinct steps:

1. Descriptive analysis of the sample, including sample attrition, school characteristics, teachers, and children's demographic information.

2. Correlational analysis of school characteristics, classroom quality, and child development.
3. Multilevel modelling analysis of the effects of the PD programme on classroom quality as measured by ECERS-E and SSTEW and analysis of kindergarten subgroups as potential moderators.
4. Multilevel modelling analysis of the impact of the PD programme on child development as measured by the IDELA.
5. A qualitative analysis of teachers' perceived impacts and influencing factors of PD effectiveness.

5.4.1 Quantitative Analysis

Descriptive analysis. Analyses of sample and sample attrition were conducted to describe the participating classroom characteristics using demographic information, including school type, grade, teachers' qualifications, age, teaching experience, degree, and children's gender and age. Particularly, there are three categories of school classification which categories are separately dummy coded as district level (0 = not district-level, 1 = district-level), city-level (0 = not city-level, 1 = city-level), province-level (0 = not province-level, 1 = province-level). The descriptive analysis included the mean and standard deviation of pre-test and post-test scores of classroom quality and child development.

Correlational analysis. To analyse the influencing factors of classroom quality, the associations between school characteristics, teacher features, and pre-and post-test scores for classroom quality were examined. The characteristics of senior and assistant teachers (such as qualifications, age, and degrees) were averaged in the analysis, given the presence of at least two teachers per classroom. In terms of analysing the influencing factors of child development, the associations between school characteristics, teacher characteristics, classroom quality and child development were investigated.

Multilevel modelling analysis on classroom quality. To account for the nested structure of the collected data, a multilevel modelling analysis was conducted. A two-level model was constructed to investigate the effects of the PD intervention on classroom quality, with classrooms nested within kindergartens. Classroom variables were entered as Level 1, while school variables were entered as Level 2, to correct for underestimated standard error and variance parameters.

First, to determine the applicability of the multilevel analysis, the *null model* without explanatory variables was constructed to calculate the ICC. The dependent variables were the post-test scale scores of classroom quality, measured by ECERS-E and SSTEW. The ICC values were calculated as the ratio of between-level variance to total variance at both levels (see Equation 1). When the ICC value is above 0.05, it indicates a significant degree of variance between clusters and the need for the multilevel analysis (Heck et al., 2014).

Equation 1 Intraclass correlation

$$\rho = \frac{\tau^2}{\tau^2+\sigma^2}$$

Notes. τ^2 presents the Level 2 (between-level) variance, and σ^2 denotes the Level 1 (within-level) variance.

Therefore, the null models without predictors were constructed. For the ECERS-E null model, approximately 78% of the variance was present at the classroom level, with 22% occurring at the school level. In the case of the SSTEW null model, about 65.3% of the conflict was present at the classroom level, with 34.7% occurring at the school level. These significant variances at each level support the use of two-level models for analysis.

Second, the variables were either *grand-mean* or *group-mean centred* to address the issue of collinearity resulting from potential interactions between variables. The model incorporated a number of classroom-level covariates, including pre-test scores from the ECERS-E and SSTEW, teacher age, teacher qualification, grade, teacher degree, and child-

to-teacher ratio. School-level covariates included: school type, location, district level, city level, and intervention (0 = control, 1 = treatment). The dependent variables were the post-test scale scores on ECERS-E and SSTEW scales. Pre-test scores were included in the model to account for pre-treatment differences, since pre-test scores may have an independent causal effect on the post-test scores (Allison, 1990). To ensure the interpretability of the intercepts at the classroom level, all continuous variables at the classroom level were group-mean-centred. Additionally, all continuous variables at the school level were grand-mean centred to ensure meaningful interpretation of the coefficients.

Third, two separate sets of models were developed in order to examine the main effects of PD on classroom quality, as measured by ECERS-E and SSTEW. Based on the null models, the explanatory variable – intervention - and the covariates were included to determine the extent to which the intervention could predict the post-test classroom quality, while controlling the classroom and school variables. Classroom-level covariates incorporated into the models included pre-test scores of ECERS-E and SSTEW, as well as teacher age, teacher qualification, grade, degree, and child-to-teacher ratio. The school-level covariates, such as school type, location, district level, and city level, were also included. The models were thus specified as follows:

Level 1 Model (classroom)

- $Post\ ECERS\text{-}E_{ij} = \beta 0_j + \beta 1_j$ Pre ECERS-E $+ \beta 2_j$ Teacher Age $+ \beta 3_j$ Teacher Qualification $+ \beta 4_j$ Grade $+ \beta 5_j$ Teacher Degree $+ \beta 6_j$ Child-to-teacher ratio $+ r_{ij}$
- $Post\ SSTEW_{ij} = \beta 0_j + \beta 1_j$ Pre SSTEW$+ \beta 2_j$ Teacher Age $+ \beta 3_j$ Teacher Qualification $+ \beta 4_j$ Grade $+ \beta 5_j$ Teacher Degree $+ \beta 6_j$ Child-to-teacher ratio $+ r_{ij}$

Notes. $Post\ ECERS\text{-}E_{ij}$ is the post-test ECERS-E scores for the i^{th} classroom in school j; and the association between post-test ECERS-E scores and classroom-level covariates is represented by a straight line with intercept β_0 and slope $\beta_{1\text{-}6}$; r_{ij} refers to individual error.

Level 2 Model (kindergarten)

- $\beta 0j = \gamma 00 + \gamma 01$(Intervention j) + $\gamma 02$ (School type j) + $\gamma 03$ (School location j) + $\gamma 04$ (District level j) + $\gamma 05$ (City level j) + u_{oj}
- $\beta 1j = \gamma 10 + \gamma 01$(Intervention j) + $\gamma 02$ (School type j) + $\gamma 03$ (School location j) + $\gamma 04$ (District level j) + $\gamma 05$ (City level j) + u_{1j}
- $\beta 2j = \gamma 20 + \gamma 01$(Intervention j) + $\gamma 02$ (School type j) + $\gamma 03$ (School location j) + $\gamma 04$ (District level j) + $\gamma 05$ (City level j) + u_{2j}
- $\beta 3j = \gamma 30 + \gamma 01$(Intervention j) + $\gamma 02$ (School type j) + $\gamma 03$ (School location j) + $\gamma 04$ (District level j) + $\gamma 05$ (City level j) + u_{3j}
- $\beta 4j = \gamma 40 + \gamma 01$(Intervention j) + $\gamma 02$ (School type j) + $\gamma 03$ (School location j) + $\gamma 04$ (District level j) + $\gamma 05$ (City level j) + u_{4j}
- $\beta 5j = \gamma 50 + \gamma 01$(Intervention j) + $\gamma 02$ (School type j) + $\gamma 03$ (School location j) + $\gamma 04$ (District level j) + $\gamma 05$ (City level j) + u_{5j}
- $\beta 6j = \gamma 60 + \gamma 01$(Intervention j) + $\gamma 02$ (School type j) + $\gamma 03$ (School location j) + $\gamma 04$ (District level j) + $\gamma 05$ (City level j) + u_{6j}

Notes. $\gamma 00$ denotes the grand mean, and u_{oj} refers to a random effect.

Fourth, the *moderation analysis* was conducted to further investigate the potential moderating effects of school-level and classroom variables that were significantly associated with dependent variables in previously mentioned models. Specifically, moderation effects of classroom characteristics were examined by including cross-level interaction terms (e.g., intervention × number of children, intervention × grade, intervention × teacher age) in the full model (Gordon, 2019). Peugh's (2010) method was utilised to examine school-level moderating effects by incorporating terms (i.e., S1 = Post-ECERS-E ON teacher qualification, S2 = Post-ECERS-E ON teacher age). This allows for exploration of whether

the intervention could modify the regression slopes between school-level covariates and dependent variables.

Multilevel analysis on child development. Given that children are nested within classrooms and kindergartens, three-level models were employed at the preliminary stage of analysis, which incorporated children at Level 1, classrooms at Level 2, and school at Level 3. It aimed to investigate the impact of classroom and school factors on post-test scores of child development, with the dependent variables being emergent literacy, emergent numeracy, social emotion, and executive function. The *null model*s showed that school-level variances could be ignored since the ICC were 0.001 for emergent literacy, 0.01 for emergent numeracy, 0.009 for social emotion, and 0.017 for executive function. Cohen (2013) suggested that the multilevel model is appropriate when ICC is greater than 0.059 at each level. Therefore, two-level models were deemed sufficient in accommodating the data, with children at Level 1 and classrooms at Level 2. As such, the "TYPE=TWO LEVEL COMPLEX" command was employed to estimate and adjust the standard errors for the school level.

Four two-level models were then constructed to examine the effects of PD on child development. The emergent literacy null model indicated that approximately 23.2% of the variance was at the classroom level, and 76.8% was at the child level. Regarding the emergent numeracy null model, about 25.4% of the variance was present at the classroom level, and 74.6% occurred at the child level. Regarding the executive function null model, the variance was 9.5% at the classroom level and 90.5% at the child level. However, the ICC of social-emotional null model was found to be quite low (i.e., 5.2%) at the classroom level, suggesting that two-level models were inappropriate. Multiple linear regression analysis was thus constructed to evaluate the effects of PD on children's social-emotional development.

Furthermore, the independent variables were *grand-mean or group-mean* centred to mitigate the potential for collinearity arising from interactions among the variables. Specifically, classroom-level covariates included score change in ECERS-E (i.e., Diff ECERS-E) and SSTEW (i.e., Diff ECERS-E), teacher age, teacher qualification, teacher degree, and child-to-teacher ratio. Child-level covariates included age and gender. The dependent variables were the post-test scores of child literacy, numeracy, and executive function skills measured by IDELA. Pre-test scores of child development were also included in the model to control for the baseline differences between the groups. Specifically, all continuous variables at the classroom level were grand-mean centred, whereas continuous variables at the child level were group-mean centred.

Subsequently, the study employed three distinct sets of models to examine the main effects of PD on child literacy, numeracy, and executive functions as measured by the IDELA. Using the Null models as a reference point, the intervention variable and associated covariates were included to estimate the extent to which the intervention predicted post-test child development while controlling for the classroom- and school-level factors. Accordingly, the models were conceptualised as follows:

Level 1 Model

- $PostEL_{ij} = \beta 0_j + \beta 1_j$ Age $+ \beta 2_j$ Gender $+ \beta 3_j$ PreEL $+ r_{ij}$
- $PostEN_{ij} = \beta 0_j + \beta 1_j$ Age $+ \beta 2_j$ Gender $+ \beta 3_j$ PreEN $+ r_{ij}$
- $PostEF_{ij} = \beta 0_j + \beta 1_j$ Age $+ \beta 2_j$ Gender $+ \beta 3_j$ PreEF $+ r_{ij}$

Notes. *Post*EL = post-test scores of emergent literacy, EN = post-test scores of emergent numeracy, EF = post-test scores of executive function. EL_{ij} is the post-test EL scores for the i^{th} child in classroom j; and the association between post-test scores and child-level covariates is represented by a straight line with intercept β_0 and slope $\beta_{1\text{-}6}$; r_{ij} refers to individual error.

Level 2 Model

- $\beta 0j = \gamma 00 + \gamma 01(Diff\text{-}SSTEW_j) + \gamma 02(Diff\text{-}ECERS\text{-}E_j) + \gamma 03\ (Intervention\ j) + \gamma 03\ (Teacher\ age\ j) + \gamma 03\ (Teacher\ qualification\ j) ++ \gamma 03\ (Teacher\ degree\ j) + \gamma 03\ (Child\text{-}to\text{-}teacher\ ratio\ j) + u_{0j}$
- $\beta 1j = \gamma 10 + \gamma 01(Diff\text{-}SSTEW_j) + \gamma 02(Diff\text{-}ECERS\text{-}E_j) + \gamma 03\ (Intervention\ j) + \gamma 03\ (Teacher\ age\ j) + \gamma 03\ (Teacher\ qualification\ j) ++ \gamma 03\ (Teacher\ degree\ j) + \gamma 03\ (Child\text{-}to\text{-}teacher\ ratio\ j) + u_{1j}$
- $\beta 2j = \gamma 20 + \gamma 01(Diff\text{-}SSTEW_j) + \gamma 02(Diff\text{-}ECERS\text{-}E_j) + \gamma 03\ (Intervention\ j) + \gamma 03\ (Teacher\ age\ j) + \gamma 03\ (Teacher\ qualification\ j) ++ \gamma 03\ (Teacher\ degree\ j) + \gamma 03\ (Child\text{-}to\text{-}teacher\ ratio\ j) + u_{2j}$
- $\beta 3j = \gamma 30 + \gamma 01(Diff\text{-}SSTEW_j) + \gamma 02(Diff\text{-}ECERS\text{-}E_j) + \gamma 03\ (Intervention\ j) + \gamma 03\ (Teacher\ age\ j) + \gamma 03\ (Teacher\ qualification\ j) ++ \gamma 03\ (Teacher\ degree\ j) + \gamma 03\ (Child\text{-}to\text{-}teacher\ ratio\ j) + u_{3j}$

Notes. $\gamma 00$ denotes the grand mean and u_{0j} refers to a random effect. For the level 2 model, three additional predictors were entered. $\gamma 00$ refers to an average or general intercept value that holds across clusters and $U0j$ refers to a group-specific effect on the intercept. $\gamma 00$ can be regarded as a fixed effect as it remains constant across all clusters, and $U0j$ is a random effect because it varies from cluster to cluster. Intervention refers to whether the classroom receives or does not receive the intervention (0=control, 1=treatment).

Based on the analysis of the main effects of PD on classroom quality, a *moderation analysis* was performed to ascertain whether certain child-level or classroom-level variables served as significant moderators, thus strengthening or weakening the relationship between the independent and dependent variables (Hayes, 2013). In particular, moderation effects related to child characteristics were examined by adding cross-level interaction terms (e.g., intervention × child age, intervention × child gender) in the full model (Gordon, 2019). Classroom-level moderating effects were explored using Peugh's (2010) methodology, which involved adding relevant terms to the model (i.e., S1 = PostEN ON teacher qualification, S2

= Post-EL ON teacher age) to determine whether the intervention influenced the regression slopes between classroom level covariates and dependent variables.

5.4.2 Qualitative Analysis

Thematic analysis (Braun & Clarke, 2006) was utilised to analyse the responses of the teachers to the open-ended questions to identify emerging themes and explore the perceived effects and influencing factors associated with the PD intervention. Specifically, to address research question 6.1.2 - 1, the Model of Change (Egert et al., 2018) was adopted as the coding scheme for analysing the impacts of the PD intervention. Egert et al. (2018) conceptualised the influence of teacher training as comprising three distinct components: (1) teacher outcomes, encompassing teachers' awareness, knowledge, competencies and performances; (2) classroom outcomes which consist of learning activities, interactions, emotional support and domain-specific quality; and (3) child outcomes which involve language, literacy, cognition, social-emotional development and other related domains.

Furthermore, to examine how the adapted PD programme influenced or failed to influence teaching and learning (research question 6.1.2 - 2), the Model of Change (Egert et al., 2018) was also employed to investigate the mechanisms underlying the PD's effectiveness. The Model of Change framework dissects the "how", "what", and "who" components of PD to provide a comprehensive understanding of the programme's influence. The "how" component includes factors such as training intensity, format and delivery method; The "what" component encompasses the specific knowledge and skills embodied in the PD content. Finally, the "who" component addresses the role of both learners and PD providers in addition to the contextual factors that may shape the programme's efficacy.

In line with established coding procedures (Corbin & Strauss, 2014), the present study employed open coding, axial coding, and selective coding to analyse the data. Initially, the researcher became acquainted with the data by reading and re-reading the response. Next,

interesting patterns and features were systematically identified and coded into potential themes. A comprehensive topic map was then generated that aggregated relevant themes. Finally, an ongoing analysis was undertaken to refine each theme, develop clear definitions, and ensure an accurate representation of the data (Braun & Clarke, 2006).

5.5 Ethical Consideration

The Fieldwork Safety and Risk Assessment and CUREC application were completed before the study. University of Oxford Central University Research Ethics Committee (CUREC) has reviewed and approved this project (see the approval evidence in Appendix A). In accordance with the guidelines set forth by the CUREC, participant confidentiality was strictly maintained throughout the study. Participation was entirely voluntary, and all participants were informed of their rights and privacy protection regulations. Prior to initiating data collection, the primary researcher made arrangements to brief principals at participating kindergartens on the research's aim, data collection procedures, and participant rights. Subsequently, principals, teachers, and parents received detailed consent forms that outlined the research information, researchers' responsibility and participants' rights. All participants acknowledged their right to withdraw from the study at any time, and were informed that all data would be destroyed promptly and according to research ethics standards. After collecting all participants' consent forms, the data collection process began.

In this study, a team of 15 research assistants were recruited and trained to conduct the pre-test, while 16 other qualified assistants were recruited to conduct the post-test. All research assistants were trained appropriately and received a confidential agreement before they were designated to their respective kindergartens for data collection purposes. The questionnaires were collected using the Oxford Jisc online survey platform. Only the primary researchers' student ID has access to the questionnaire data. On the other hand, observation and child assessment data were gathered using traditional, paper-based methods by the

primary researcher and research assistants. Upon completing the data collection process each day, the primary researcher would collect completed paper forms and input the respective assessment results into an EXCEL file for analysis. All gathered research materials, including audio recordings, videotapes, completed questionnaires, and child assessment checklists, were exclusively utilised for research purposes before being securely stored on the researcher's PC or in a locked cabinet utilising secure password protection. Access to these data was limited to the researcher and the supervisors. Furthermore, to safeguard participants' identities and privacy, personal information was excluded from the data analysis process, and participants' research information was anonymised.

5.6 Methodology Limitations

The limited sample size of children. The current research selected six children in each classroom to analyse the impact of in-service PD on child development through multilevel modelling. Although choosing six children is adequate for multilevel modelling analysis, the power is not high. According to Egert et al. (2018), the effect size of in-service PD on child development was 0.14. Assuming the value of ICC as 0.07 and the correction factor as 1.5, the result of power analysis indicated that selecting six children in each classroom cluster and 96 classrooms are qualified for RCT design. The sample size was qualified for 65% power and alpha set at $p < .05$. Furthermore, selecting 16 children in each classroom would achieve 80% power. However, due to the limited time and resources, only six children in each classroom were selected for this research to meet the basic data analysis requirement. Larger-scale studies are warranted in the future to explore the impact of PD on child development with greater power.

Two times assessment. The current research utilised pre-test and post-test in exploring the PD effects without knowing its long-term sustainability. Future studies may consider incorporating two additional assessments to support individual-level analyses and

capture intra-individual changes over time (Gee, 2014). This approach offers valuable insights into how individual changes over time. Moreover, extending the post-intervention assessment period could enable teachers to internalise and implement newly acquired knowledge and skills, particularly in promoting children's social-emotional development. Further pedagogical practice tailored to this specific area could enhance the effectiveness of interventions aimed at boosting child development.

The lack of in-depth qualitative analysis to explore how PD works. The current study quantitatively analysed the PD impacts on classroom quality, teachers' characteristics and child development. However, a questionnaire was also administered to collect teachers' feedback on the effectiveness of the PD programme. Variation in attendance rates and outcomes among teachers offers an opportunity for further investigation. Specifically, future studies could employ interviews with teachers who witnessed significant changes in their pedagogy or child outcomes, as well as those who did not experience notable improvements. This approach would enable a deeper analysis of the factors that contribute to the effectiveness of the PD programme. Such insights would support PD adaptation to better strengthen classroom quality, teachers' pedagogical practice and child development.

Chapter 6 Quantitative Results: The Effects of PD on Classroom Quality and Child Development

This chapter comprises four sections. The first section outlines the characteristics of the teachers and classrooms that participated in the study. The second section provides descriptive and analyses of classroom quality, as measured by ECERS-E and SSTEW, as well as multilevel modelling of the main and moderation effects of PD intervention on ECERS-E and SSTEW. The third section evaluates the main effects of PD intervention on the subscales of ECERS-E and SSTEW and whether these effects vary based on school and classroom characteristics. The fourth section focuses on the effects of PD interventions on child development.

6.1 Describing the Characteristics of Participating Teachers and Classrooms

Participating classrooms. Table 6.1 displays the participation of 96 classrooms from 24 kindergartens in the pre-test. The sample comprised 48 K1 classrooms catering to 3-4 years old children and 48 K2 classrooms serving 4-5 years old children. Overall, 44 classrooms belonged to private kindergartens, 52 to public kindergartens, 32 to province-level kindergartens, 36 to city-level kindergartens, and 28 to district-level kindergartens. Meanwhile, there were 95 classrooms remaining for the post-test as the teachers from one classroom withdrew from the study due to job-hopping, yielding 98.96% retention overall. The missing data from this classroom was consequently excluded from the analysis.

There were 24 classrooms serving K1 children, and 24 classrooms serving K2 classrooms in both intervention and control groups. With respect to the school type, the intervention group comprised 20 private and 28 public kindergartens. Conversely, the control group included 24 classrooms each from private and public kindergartens. Regarding the school classification, there were 16 classrooms in the province-level kindergartens, 20 in the city-level kindergartens, and 12 in the district-level kindergartens. The control group had 16

classrooms each from province-level, city-level, and district-level kindergartens. Furthermore, both groups had 24 classrooms, each from urban or sub-urban kindergartens.

Table 6.1

Characteristics of participating classrooms

Classroom characteristics	Intervention group N=48	Control Group N=48	Total N=96	Missing data N=1
Grade, n (%)				
K1	24 (50)	24 (50)	48 (50)	0 (0)
K2	24 (50)	24 (50)	48 (50)	1 (100)
School type, n (%)				
Private	20 (41.67)	24 (50)	44 (45.83)	1 (100)
Public	28 (58.33)	24 (50)	52 (54.17)	0 (0)
School classification				
Province level	16 (33.33)	16 (33.33)	32 (33.33)	0 (0)
City level	20 (41.67)	16 (33.33)	36 (37.50)	1 (100)
District level	12 (25)	16 (33.33)	28 (29.17)	0 (0)
School location				
Urban	24 (50)	24 (50)	48 (50)	0 (0)
Sub-urban	24 (50)	24 (50)	48 (50)	1 (100)

Description of participating teachers. In this study, a typical classroom was staffed with one senior teacher and one assistant teacher; however, 12 classrooms were equipped with two assistant teachers, yielding a total of 95 senior and 107 assistant teachers. Table 6.2 depicts the demographic distribution of senior and assistant teachers. Around half number of the senior teachers (40%) were above 30 years old, possessed bachelor's degrees or higher (65.36%), with over seven years of teaching experience (41.67%). In terms of the assistant teachers, most assistant teachers (46.67%) were aged below 25 years, possessed bachelor's degrees or above (53.33%), and with less than three years of teaching experience (53.33%). The associations between senior teachers' characteristics and classroom quality were analysed in this research since senior teachers take the main responsibility in overseeing the daily routines.

Table 6.2

Characteristics of participating teachers

Teachers' characteristics	Intervention group *N* senior = 48 *N* assistant = 60	Control Group *N* senior = 47 *N* assistant = 47	Total *N* senior = 95 *N* assistant = 107	Missing data
Senior teacher				
Age				
≤ 25 years	14 (29.17)	11 (23.40)	25 (26.32)	1 (100)
25-30 years	17 (35.42)	15 (31.91)	32 (33.68)	0 (0)
≥ 30 years	17 (35.42)	21 (44.68)	38 (40)	0 (0)
Degree				
Associate degree or below	20 (41.67)	13 (27.66)	33 (34.74)	0 (0)
Bachelor's degree or above	28 (58.33)	34 (72.34)	62 (65.26)	1 (100)
Working experience				
≤3 year	13 (27.08)	5 (10.64)	18 (18.95)	1 (100)
4-6 years	15 (31.25)	18 (38.30)	33 (34.74)	0 (0)
≥7 years	20 (41.67)	24 (51.06)	44 (46.32)	0 (0)
Qualification				
Without professional	44 (91.67)	39 (82.98)	84 (87.50)	1 (100)
With professional qualification	4 (8.33)	8 (17.02)	12 (12.50)	0 (0)
Assistant teacher				
Age				
≤ 25 years	28 (46.67)	22 (46.81)	50 (46.73)	1 (100)
25-30 years	19 (31.67)	15 (31.91)	34 (31.78)	0 (0)
≥ 30 years	13 (21.67)	10 (21.28)	23 (21.50)	0 (0)
Degree				
Associate degree or below	28 (46.67)	19 (40.43)	47 (43.93)	0 (0)
Bachelor's degree or above	32 (53.33)	28 (59.57)	60 (56.07)	1 (100)
Working experience				
≤3 year	32 (53.33)	28 (59.57)	60 (56.07)	1 (100)
4-6 years	18 (30.00)	11 (23.40)	29 (27.10)	0 (0)
≥7 years	10 (16.67)	8 (17.02)	18 (16.82)	0 (0)
Qualification				
Without professional	59 (98.33)	47 (100)	106 (99.07)	1 (100)
With professional qualification	1 (1.67)	0 (0.00)	1 (0.93)	0 (0)

6.2 The Effects of PD on Instruction Quality Measured by ECERS-E

6.2.1 Descriptive Analysis

Table 6.3 presents the pre-test and post-test scores of ECERS-E in participating classrooms. The mean scores of ECERS-E increased significantly in the intervention group from $M_{\text{pre-test}} = 3.03$ to $M_{\text{post-test}} = 4.02$ ($p < .001$), whereas the control group showed non-significant changes, with the mean scores changing from $M_{\text{pre-test}} = 2.84$ to $M_{\text{post-test}} = 2.85$ ($p > .05$).

In terms of the ECERS-E subscales, participating classrooms received the highest scores in literacy than other subscales in the intervention and control groups and both in the pre-test (M intervention = 3.74, SD intervention = 0.57; M control = 3.54, SD control = 0.56) and the post-test (M intervention = 4.91, SD intervention = 0.69; M control = 3.28, SD control = 0.70), while they received the lowest scores in diversity both in the pre-test (M intervention = 1.69, SD intervention = 0.43; M control = 1.80, SD control = 0.40) and post-test (M intervention = 2.32, SD intervention = 0.36; M control = 1.87, SD control = 0.38).

In the intervention group, all subscales of ECECRS-E displayed significant score improvement. In particular, ECERS-E math showed the most significant improvement, rising from M pre-test = 3.23 to M post-test = 4.60 ($p < .001$). The paired t-test demonstrated significant improvements in the average ECERS-E scores and all its subscales in the intervention group. On the contrary, the ECERS-E diversity subscale showed the smallest improvement ($D = 0.63$, $p < .001$). Conversely, the control group showed no significant changes in any of the ECERS-E subscales. Moreover, the literacy subscale scores in the control group showed a decrease (M pre-test = 3.54, SD pre-test = 0.56; M post-test = 3.39, SD post-test = 0.52).

Table 6.3

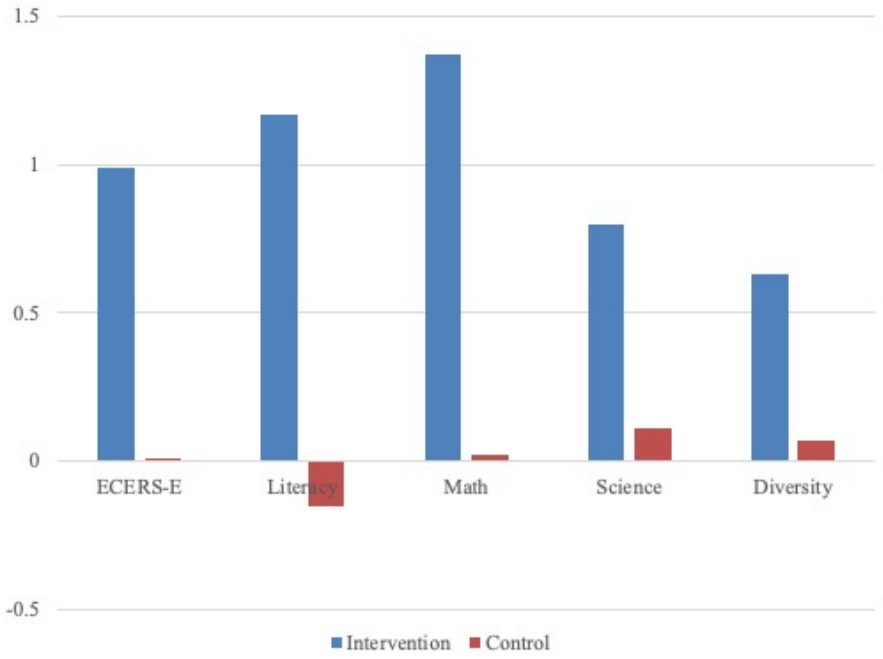
The intervention and control groups' mean, standard deviation and scores change in the pre-test and post-test total average scores of ECERS-E and its subscale scores

Outcome variables-classroom	Intervention group Pre-test M	Pre-test SD	Post-test M	Post-test SD	D	Control group Pre-test M	Pre-test SD	Post-test M	Post-test SD	D
Class (n)	48		48			48		47		
ECERS-E	**3.03**	**0.50**	**4.02**	**0.84**	**0.99*** **	**2.84**	**0.45**	**2.85**	**0.37**	**0.01**
Literacy	3.74	0.57	4.91	0.69	1.17***	3.54	0.56	3.39	0.52	- 0.15
Math	3.23	0.78	4.60	0.87	1.37***	3.26	0.96	3.28	0.70	0.02
Science	3.46	1.07	4.26	0.82	0.80***	2.76	0.97	2.87	0.70	0.11
Diversity	1.69	0.43	2.32	0.36	0.63***	1.80	0.40	1.87	0.38	0.07

Notes. * $p < .05$, ** $p < .01$, *** $p < .001$. D = post-test – pre-test;

Figure 6.1

Comparison of scores change of ECERS-E for intervention and control groups



6.2.2 Correlational Analysis

The correlational analysis explored the influence of variables at classroom and kindergarten levels on the post-test scores of ECERS-E and its subscales. As shown in Table 6.4, the intervention (0 = control, 1 = intervention), district-level (0 = not district-level, 1 = district-level), city-level (0 = not city level, 1 = city level), school type (0 = private, 1 = public) were significantly associated with the post-test scores of ECERS-E or its four subscales. More specifically, the intervention was significantly associated with the post-test scores of ECERS-E and its four subscales (*r*s = .545 to .796, $p < .01$). The district level was significantly associated with literacy score ($r = - 0.256$, $p < .05$). School type was significantly associated with the post-test scores of ECERS-E and its four subscales (*r*s = 0.220 to 0.316, $p < .01$). These findings were further validated using multilevel modelling to investigate their correlations with classroom quality.

Table 6.4

Pearson correlations between kindergarten and classroom variables and the total average scores of post-test ECERS-E

	ECERS-E	Literacy	Math	Science	Diversity
Kindergarten variables					
Intervention	**0.796****	**0.783****	**0.619****	**0.656****	**0.545****
District level	-0.181	**-0.256***	-0.060	-0.131	-0.192
City level	0.015	0.039	0.023	0.041	-0.149
School type	**0.316****	**0.230***	**0.297****	**0.283****	**0.220***
Location	-0.113	-0.151	0.027	-0.195	-0.020
Classroom variables					
Grade	0.048	0.070	-0.059	0.124	0.015
Child-to-teacher ratio	0.133	0.103	0.120	0.119	0.086
Teacher degree	-0.029	-0.063	0.086	-0.114	0.013
Teacher age	-0.015	0.093	-0.072	-0.077	0.056
Teacher qualification	0.020	-0.006	0.007	0.009	0.113

Notes. * p < .05, ** p < .01, *** p < .001.

6.2.3 Main and Moderation Effects of PD Intervention on Total Scores of ECERS-E

Exploring the main effects. Multilevel modelling was employed to examine the impact of PD on classroom quality since classrooms are nested within kindergartens. Firstly, the null model without predictors was used to confirm whether there was sufficient variances. The results from the ECERS-E null model revealed sufficient variances at each level (See more details in chapter 5). Subsequently, reduced models were evaluated, which included only within-level (i.e., classroom-level) or between level (i.e., kindergarten-level) predictors, alongside a full model with both classroom-level and kindergarten-level predictors.

Two Models 2 were specified to examine the main effects of variables at the classroom and kindergarten level on the post-test scores of ECERS-E. The first model included classroom variables, such as pre-test ECERS-E, grade, child-to-teacher ratio, teachers' degrees, age and qualifications. As shown in Table 6.5, the pre-ECERS-E scores (b = 0.349, p < .01, SE = 0.116), teacher's age (b = - 0.081, p < .05, SE = 0.040) and qualification (b = 0.180, p < .001, SE = 0.048) had significant effects on post-test scores of ECERS-E, while the other variables at the classroom-level did not exhibit a significant

impact. The second model included variables specific to kindergartens, such as intervention, district level, city level, location and school type. The results indicated that intervention (b = 1.042, p < .001, SE = 0.103), school type (b = 0.514, p < .001, SE = 0.095), and district level (b = -0.429, p < .01, SE = 0.127) significantly influenced post-test scores of ECERS-E. In Model 3, both classroom- and kindergarten-level variables were included, and the results indicated that after controlling for these variables, the PD intervention (b = 1.060, p < .001, SE = 0.103) remained a significant predictor of the post-test scores of ECERS-E.

In summary, the intervention, pre-test ECERS-E scores, teacher age and qualifications, school type and classification significantly impacted the total average scores of ECERS-E. Specifically, classrooms in the intervention group or led by younger and higher-qualification teachers received higher post-test scores on ECERS-E. Conversely, classrooms in private and district-level kindergartens tended to perform lower scores on ECERS-E. For a detailed analysis output, please refer to Appendix C.

Table 6.5

Model results of multilevel modelling analysis of total average scores of post-test ECERS-E

	Model 2-ANCOVA model		Model 2-Intercept Model		Model 3-Full Model	
Coefficient	*b*	SE	*b*	SE	*b*	SE
Fixed effect						
Intercept	**3.688*** **	0.349	**2.838*** **	.111	**2.799*** **	0.397
Level 1-Classroom						
Pre-ECERS-E	**0.349** **	0.116	------	------	**0.349** **	0.121
Teacher age	**-0.081***	0.040	------	------	**-0.085***	0.041
Teacher qualification	**0.180*** **	0.048	------	------	**0.175** **	0.048
Grade	-0.096	0.085	------	------	-0.010	0.086
Child-to-Teacher	-0.015	0.020	------	------	0.002	0.016
Teacher degree	-0.033	0.083	------	------	0.042	0.076
Level 2-Kindergarten						
Intervention	------	------	**1.042*** **	0.103	**1.066*** **	0.098
School type	------	------	**0.514*** **	0.095	**0.469*** **	0.093
District level	------	------	**-0.429** **	0.127	**-0.425*** **	0.118
City level	------	------	0.153	0.075	0.149	0.116
Location	------	------	**-0.205**	0.110	**-0.212**	0.110
Variance components						
Level 1-classroom	**0.088*** **	0.013	**0.108*** **	0.017	**0.854*** **	0.083
Level 2- school	**0.435*** **	0.091	**0.031***	0.012	**0.077***	0.032
Model summary						
Within level R^2	**0.148**	0.076	------	------	**0.146**	0.083
Between level R^2	------	------	**0.928*** **	0.032	**0.923** **	0.032
AIC	129.521		92.518		90.361	

Exploring the moderation effects. To investigate the potential moderation effects of school type and district level on the relationship between intervention and ECERS-E score, two sets of multilevel models (Models 4 and 5) were specified. Model 4 focused on kindergarten-level moderation effects and included two between-level interaction terms (TI = Type * Intervention, DI = District level * Intervention) as predictors, in addition to the variables that remained significant in Model 3. Table 6.6 indicated that neither school type (b = 0.120, p > .05, SE = 0.208) nor district level (b = 0.133, p > .05, SE = 0.249) significantly moderated the effects of the intervention on post-test scores of ECERS-E. Therefore, the association between intervention and ECERS-E score was not moderated by these two kindergarten-level variables.

Model 5 was designed to examine the potential cross-level moderation effects of teacher age and qualification on the association between intervention and ECERS-E scores. As with Model 4, all variables significantly associated with post-test ECERS-E scores in Model 3 were retained in Model 5. As teacher age and qualification were found to significantly predict ECERS-E scores in model 3, this analysis sought to explore whether these variables had a moderation effect on the relationship between intervention and ECERS-E scores. Two terms (i.e., S1 = Post-ECERS-E ON teacher qualification, S2 = Post-ECERS-E ON teacher age) were added to explore whether the intervention could influence the regression slopes between teacher age and ECERS-E scores and between teacher qualification and ECERS-E scores. However, the results indicated that neither teacher qualification (b = 0.165, p > .05, SE = .321) nor teacher age (b = - 0.090, p > .05, SE = 0.112) moderated the association between intervention and ECERS-E scores. Further details of the analysis output can be found in Appendix.

Table 6.6

Moderation effects on the association between intervention and total average scores of post-test ECERS-E

	Model 4		Model 5	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**2.835*** **	0.108	**2.818*** **	0.105
Classroom level main effects				
Pre-ECERS-E	**0.267***	0.105	**0.280*** **	0.093
Teacher age	**-0.089***	0.040	------	------
Teacher qualification	**0.168****	0.052	------	------
Kindergarten level main effects				
Intervention	**0.967*** **	0.149	**1.038*** **	0.140
School type	**0.376****	0.117	**0.460****	0.150
District level	**-0.466*** **	0.127	**-0.413***	0.168
Kindergarten level moderation effects				
Intervention × School type	0.120	0.208	------	------
Intervention × District level	0.133	0.249	------	------
Cross level moderation effects				
Intervention × Teacher age	------	------	-0.090	0.112
Intervention × Teacher qualification	------	------	0.165	0.321
Variance components				
Level 1-classroom	**0.091*** **	0.013	**0.091*** **	0.012
Level 2- school	**0.044****	0.014	**0.048****	0.018

6.2.4 Main and Moderation Effects of PD Intervention on ECERS-E Subscales

The ICC values for literacy, math, science and diversity in the null models were identified. The results showed that for the literacy null model, 76.1% of the variance was accounted for at the kindergarten level, while 23.9% was at the classroom level. In the **math null model**, 51.6% of the variance was at the kindergarten level and 48.4% at the classroom level. In the **science null model,** 67.3% of the variance was at the kindergarten level, while 33.7% was at the classroom level. The **null diversity model** indicated that about 41.9% of the variance was at the kindergarten level, and 58.1% was at the classroom level. These models exceeded the recommended threshold of at least 5.9% of the variance at each level (Kreft & De Leeuw, 1998), suggesting that multilevel modelling was an appropriate analytic approach.

As shown in Table 6.7, to examine the main effects of variables on ECERS-E scores, four sets of Models 6 were specified for literacy, math, science, and diversity. These models included both classroom-level demographic factors such as pre-test scores, grades, child-to-teacher ratio, teachers' qualifications, degrees, and age, as well as kindergarten-level variables such as intervention, school type, school location, district level, and city level.

In terms of **ECERS-E literacy**, the intervention (b = 1.386, p < .001, SE = 0.122) had significant effects on post-test ECERS-E literacy scores after controlling classroom- and kindergarten-level variables. Classrooms in the intervention group had higher scores in ECERS-E literacy. Meanwhile, school type (b = 0.479, p < .001, SE = 0.135), district level (b = - 0.725, p < .001, SE = 0.163), and school location (b = - 0.412, p < .01, SE = 0.125) were significantly associated with post-test ECERS-E literacy. These results indicated that ECERS-E literacy scores were lower in private kindergartens and kindergartens located in urban areas or classified as district-level, compared to public kindergartens, sub-urban areas, and city or province-level kindergartens.

In terms of **ECERS-E math**, the intervention (b = 1.268, p < .001, SE = 0.194) significantly contributed to the scores of ECERS-E math. Regarding the classroom-level variables, pre-test ECERS-E math scores (b = 0.222, p < .05, SE = 0.094) and teachers' degrees (b = 0.290, p < 0.05, SE = 0.131) were related to the post-test scores of math. School type (b = 0.539, p < 0.01, SE = 0.137) and district level (b = - 0.167, p < .001, SE = .232) at the kindergarten level were also associated with post-test scores of ECERS-E math.

In terms of **ECERS-E science**, intervention (b = 1.150, p < .001, SE = 0.212) was significantly associated with the post-test scores of ECERS-E science. Child-to-teacher ratio (b = - 0.085, p < .05, SE = 0.35) and teachers' degrees (b = - .354, p < .05, SE = .127) were also related to the post-test scores of science. Classrooms with lower child-to-teacher ratios and lower teachers' degrees showed a higher quality of science. Meanwhile, private

kindergartens (b = 0.829, p < .001, SE = 0.209), kindergartens in the district level (b = -0.528, p < .05, SE = -.233) demonstrated lower quality of ECERS-E science.

In terms of **ECERS-E diversity**, classrooms receiving the intervention (b = 0.424, p < .001, SE = 0.069) performed higher quality. Teachers with higher qualifications (b = .259, p < .01, SE = 0.088) performed higher quality in ECERS-E diversity. In addition, kindergartens in the district level (b = - 0.293, p < .001, SE = 0.070) and city level (b = -0.194, p < .05, SE = 0.095) demonstrated lower quality than kindergartens in the province level.

Table 6.7

Model results of main effects on the subscale scores of post-test ECERS-E

	Model 6 literacy		Model 6 Math		Model 6 Science		Model 6 Diversity	
Coefficient	*b*	SE	*b*	SE	*b*	SE	*b*	SE
Fixed effect								
Intercept	**3.270*** **	0.477	**2.225*** **	0.486	**3.879*** **	0.546	**1.997*** **	0.303
Level 1-Classroom								
Pre-test	**0.176**	0.090	**0.222***	0.094	0.122	0.108	0.155	0.129
Teacher age	0.040	0.058	**-0.211**	0.113	-0.089	0.064	-0.050	0.032
Teacher qualification	0.013	0.137	0.219	0.251	0.099	0.204	**0.259****	0.088
Grade	0.030	0.106	-0.239	0.187	0.166	0.152	-0.060	0.084
Children-to-teacher ratio	0.025	0.023	0.041	0.056	**-0.085***	0.035	0.016	0.020
Teacher degree	0.077	0.109	**0.290***	0.131	**-0.354****	0.127	0.019	0.083
Level 2-Kindergarten								
Intervention	**1.386*** **	0.122	**1.268*** **	0.194	**1.150*** **	0.212	**0.424*** **	0.069
School type	**0.479*** **	0.135	**0.539****	0.137	**0.829*** **	0.209	0.095	0.077
District level	**-0.725*** **	0.163	**-0.167*** **	0.232	**-0.528***	0.233	**-0.293*** **	0.070
Location	**-0.412****	0.125	0.041	0.185	**-0.417**	0.214	0.034	0.080
City level	0.121	0.139	**0.352**	0.196	0.282	0.234	**-0.194***	0.095
Variance components								
Within level	**0.211*** **	0.032	**0.481*** **	0.061	**0.285*** **	0.046	0.088	0.013
Between level	**0.029***	0.015	**0.077**	0.065	**0.179****	0.068	0.005	0.009
Model summary								
Within level R^2	**0.061**	0.033	0.124	0.073	**0.177****	0.057	0.083	0.052
Between level R^2	**0.959*** **	0.024	**0.961*** **	0.025	**0.769*** **	0.095	**0.927*** **	0.107
AIC	160.179		239.882		208.468		72.285	

Exploring the moderation effects. Model 7 was specified to examine kindergarten-level moderation effects in the association between intervention and **ECERS-E literacy** scores. It examined the kindergarten-level moderation effects of school type, district level and location since they were significantly associated with post-test scores of ECERS-E

literacy. As shown in Table 6.8, three kindergarten-level interaction terms (i.e., TI = Type * Intervention, DI = District level * Intervention, LI = Location * Intervention) were added as kindergarten-level predictors. The results indicated that school type (b = 0.519, p < .05, SE = 0.213) and district level (b = - 0.818, p < .01, SE = 0.235) moderated the effects of the intervention on post-test scores of ECERS-E literacy. More details of the output can be found in Appendix D.

Table 6.8

Moderation effects on associations between intervention and post-test ECERS-E literacy scores

	Model 7: within-level interaction	
Coefficient	*b*	SE
Fixed effect		
Intercept	**3.244*** **	0.465
Classroom level main effects		
Pre-test	**0.176**	0.090
Teacher age	0.044	0.057
Teacher qualification	-0.046	0.127
Grade	0.027	0.107
Children-to-teacher ratio	0.027	0.024
Teacher degree	0.103	0.102
Kindergarten level main effects		
Intervention	**1.340*** **	0.239
School type	0.220	0.148
District level	**-0.373** **	0.131
Location	**-0.553*** **	0.140
City level	0.130	0.117
Kindergarten level moderation effects		
Intervention × School type	**0.519***	0.213
Intervention × District level	**-0.818** **	0.235
Intervention × Location	0.044	0.229
Variance components		
Level 1-classroom	**0.211*** **	0.031
Level 2- school	0.004	0.011
Model summary		
Within level R^2	**0.064**	0.033
Between level R^2	**0.995*** **	0.015
AIC	157.507	

ECERS-E Math. To explore the potential moderation effects of intervention on post-test ECERS-E math scores, two distinct sets of multilevel models (Models 8 and 9) were employed to examine the classroom-level and kindergarten-level moderation effects. As shown in Table 6.9, model 8 examined the kindergarten-level moderation effects of school

type. All of the variables in Model 6 remained in Model 8, and one interaction term (i.e., TI = Type * Intervention) was added as a between-level predictor. The results indicated that school type (b = - 0.025, p > .05, SE = 0.412) and district level (b = 0.775, p > .05, SE = 0.449) did not moderate the effects of the intervention on post-test scores of ECERS-E math.

Model 9 aimed to investigate the potential cross-level moderation effects of pre-test ECERS-E math scores and teachers' degrees on the relationship between intervention and post-test ECERS-E math scores. Two terms (i.e., S4 = Post-math ON teacher leadership and S5 = Post-math ON Pre-math) were added to explore whether intervention predicted the regression slopes. However, pre-test ECERS-E math (b = - 0.111, p > .05, SE = 0.268) and teachers' degrees (b = - 0.196, p > .05, SE = 0.329) did not moderate the association between intervention and post-test ECEES-E math scores.

Table 6.9

Moderation effects on associations between intervention and post-test ECERS-E math scores

	Model 8		Model 9	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**2.232*** **	0.533	**3.104*** **	0.152
Classroom level main effects				
Pre-test	**0.232***	0.094	------	------
Teacher age	**-0.222***	0.112	**-0.202***	0.097
Teacher qualification	0.331	0.257	0.171	0.303
Grade	-0.246	0.189	-0.190	0.176
Children-to-teacher ratio	0.041	0.056	**0.038**	0.056
Teacher degree	**0.308***	0.139	------	------
Kindergarten level main effects				
Intervention	**1.075*** **	0.243	**1.931***	1.228
School type	**0.507***	0.226	**0.548**	0.377
District level	**-0.490***	0.200	-0.173	0.364
Location	0.153	0.173	0.043	0.289
City level	0.317	0.195	0.356	0.362
Kindergarten level moderation effects				
Intervention × School type	-0.025	0.412	------	------
Intervention × District level	0.775	0.449	------	------
Cross level moderation effects				
Intervention × Pre-test	------	------	-0.111	0.268
Intervention × teacher degree	------	------	-0.196	0.329
Variance components				
Level 1-classroom	**0.483*** **	0.056	**0.494*** **	0.079
Level 2- school	0.049	0.052	**0.119***	0.056
Model fit				
Within level R^2	**0.137**	0.076	0.156***	0.050
Between level R^2	**0.918*** **	0.083	0.840***	0.194
AIC/DIC	240.597		239.016	

ECERS-E Science. Two sets of multilevel models (Models 10 and 11) were employed to examine classroom-level and kindergarten-level moderation effects in the association between intervention and post-test ECERS-E science scores. As presented in Table 6.10, model 10 investigated the potential moderation effects of school type and district level at the kindergarten level on the relationship between intervention and science scores. Three kindergarten level interaction terms (i.e., TI = Type * Intervention, DI = District level * Intervention, LI = Location * Intervention) were added as kindergarten level predictors. The results indicated that school location (b = -1.217, p < .01, SE = 0.450) moderated the effects of the intervention on post-test scores of science.

Model 11 investigated the cross-level moderation effects of teacher degrees on the association between intervention and post-test ECERS-E science scores. Two terms (i.e., S6 = Post-science ON teacher degree, S7 = Post-science ON children-to-teacher ratio) were added to explore whether intervention predicted the regression slopes. Results suggested that teacher degree (b = - 0.512, p < .05, SE = 0.214) moderated the association between intervention and post-test ECERS-E science scores.

Table 6.10

Moderation effects on associations between intervention and post-test ECERS-E science scores

	Model 10		Model 11	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**3.931*** **	0.588	**3.558*** **	0.667
Classroom level main effects				
Pre-test	0.122	0.108	0.118*	0.088
Teacher age	-0.091	0.063	-0.079	0.073
Teacher qualification	0.134	0.207	0.120	0.227
Grade	0.165	0.152	0.224	0.136
Children-to-teacher ratio	**-0.085***	0.035	------	------
Teacher degree	**-0.354****	0.126	------	------
Kindergarten level main effects				
Intervention	**0.965****	0.321	**3.062*** **	0.789
School type	0.430	0.321	**0.777***	0.389
District level	0.193	0.323	-0.464	0.419
Location	-0.198	0.225	**-0.431**	0.276
City level	0.177	0.243	0.320	0.407
Kindergarten level moderation effects				
Intervention × School type	0.451	0.446	------	------
Intervention × District level	-0.612	0.410	------	------
Intervention × Location	**-1.217****	0.450	------	------
Cross level moderation effects				
Intervention × Teacher degree	------	------	**-0.512***	0.214
Intervention × Children-to-teacher	------	------	-0.015	0.131
Variance components				
Level 1-classroom	**0.285*** **	0.046	**0.290*** **	0.060
Level 2- school	**0.133****	0.052	**0.182*** **	0.155
Model fit				
Within level R^2	**0.178****	0.056	**0.215*** **	0.055
Between level R^2	**0.829*** **	0.079	**0.886*** **	0.106
AIC/DIC	209.544		190.341	

ECERS-E Diversity. Two different sets of multilevel models (i.e., Models 12 and 13) were specified to examine classroom-level and kindergarten-level moderation effects in the association between intervention and post-test ECERS-E diversity scores. Model 12 examined the kindergarten-level moderation effects of district level and city level on the association between intervention and post-test ECERS-E diversity scores, as shown in Table 6.11. Two kindergarten-level interaction terms (i.e., DI = District level * Intervention, CI = City level * Intervention) were added as kindergarten-level predictors. The results indicated that district level ($b = 0.022$, $p > .05$, SE = 0.149) and city level ($b = 0.281$, $p > .05$, SE = 0.158) cannot moderate the effects of the intervention on post-test scores of diversity.

Model 13 aimed to investigate the cross-level moderation effects of teacher qualification in the association between intervention and post-test ECERS-E diversity scores. One term (i.e., S6 = Post-diversity ON teacher qualification) was added to explore whether intervention predicted the regression slopes between teacher qualification and post-test ECERS-E diversity scores. However, teacher qualification (b = - 0.162, p > .05, SE = 0.294) could not moderate the association between intervention and post-test ECERS-E diversity scores.

Table 6.11

Moderation effects on the association between intervention and post-test ECERS-E diversity scores

	Model 12		Model 13	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**2.038*** **	.308	**1.847*** **	.088
Classroom level main effects				
Pre-test	.158	.130	.134	.124
Teacher age	-.048	.032	**-.068***	.040
Teacher qualification	**.238****	.085	------	------
Grade	-.064	.083	-.048	.083
Children-to-teacher ratio	.017	.020	**.015**	.025
Teacher degree	.029	.085	.048	.074
Kindergarten level main effects				
Intervention	**.326*** **	.076	**.446*** **	.096
School type	.085	.062	.093	.124
District level	**-.318*** **	.086	**-.313***	.119
Location	**-.057**	.072	**-.032**	.102
City level	**-.342***	.145	**-.199***	.120
Kindergarten-level moderation effects				
Intervention × city level	**.281**	.158	------	------
Intervention × District level	.022	.149	------	------
Cross level moderation effects				
Intervention × Teacher qualification	------	------	-.162	.294
Variance components				
Level 1-classroom	**.092*** **	.013	**.100*** **	.017
Level 2- school	.010	.012	**.019*** **	.022
Model fit				
Within level R^2	.076	.049	**.125*** **	.040
Between level R^2	**.989*** **	.096	**.711*** **	.178
AIC/DIC	72.645		68.811	

In summary, the results indicated that the impacts of the intervention on ECERS-E literacy were moderated by school type and district level. Private and district-level kindergartens tended to show fewer PD effects compared to public kindergartens and those at

the province and city levels. In terms of ECERS-E science, location and teachers' degrees were found to moderate the effects of the intervention. Specifically, the intervention showed stronger effects on classrooms in suburban areas and with relatively lower-degree teachers. However, neither kindergarten-level nor classroom-level variables showed moderating effects on ECERS-E math or diversity.

6.3 The Effects of PD on Interactional Quality as Measured by SSTEW

6.3.1 Descriptive Analysis

Table 6.12 reports the group means and SDs of SSTEW in the pre- and post-test. The mean scores of SSTEW significantly improved from 3.97 (SD = 0.52) to 4.51 (SD = 0.60) in the intervention group ($D = 0.54$, $p < .001$), while the mean scores in the control group dropped from 3.84 (SD = 0.67) to 3.39 (SD = 0.55) (D = - 0.48, $p > .05$).

In terms of the subscales of SSTEW, it was found that SSTEW supporting and extending language and communication received the highest scores among all subscales in both the pre-test (M intervention = 4.72, SD intervention = 0.87; M control = 4.61, SD control = 0.93) and post-test (M intervention = 5.60, SD intervention = 0.79; M control = 4.42, SD control = 0.78). On the contrary, SSTEW assessing children's learning received the lowest scores both in the pre-test (M intervention = 2.22, SD intervention = 0.80; M control = 2.11, SD control = 0.89) and the post-test (M intervention = 2.81, SD intervention = 0.73; M control = 1.60, SD control = 0.44). Notably, the scores of SSTEW supporting and extending language and communication in the intervention group showed the most significant improvement ($D = 0.88$, $p < .001$). With the exception of the SSTEW assessing learning subscales, all other subscales of SSTEW showed significant improvements in the intervention group, while there was no significant difference between the pre-test and post-test in the control group.

Table 6.12

Mean and standard deviation of pre- and post-test scores for classroom quality measured by SSTEW in the intervention and control groups

Outcome variables-classroom	Intervention group					Control group				
	Pre-test		Post-test		D	Pre-test		Post-test		D
	M	SD	M	SD		M	SD	M	SD	
Class (n)	48		48			48		47		
SSTEW	**3.97**	**0.52**	**4.51**	**0.60**	**0.54*** **	**3.84**	**0.67**	**3.39**	**0.55**	**-0.48**
Build TCI	4.72	1.01	5.51	0.76	0.79***	4.56	1.09	4.24	0.71	-0.32
SE Well-bg	4.31	0.88	4.73	1.07	0.42*	4.11	1.45	3.38	1.09	-0.73
Lang-Comm	4.72	0.87	5.60	0.79	0.88***	4.61	0.93	4.42	0.78	-0.19
Learn-Crit	3.90	0.70	4.54	0.78	0.64***	3.82	0.72	3.32	0.71	-0.50
Assessing	2.22	0.80	2.18	0.73	-0.04	2.11	0.89	1.60	0.44	-0.51

Note: Build TCI = Building trust, confidence and independence; SE Well-bg = Social and emotional well-being; Lang-Comm = Supporting and extending language and communication; Learn-Crit = Supporting learning and critical thinking; Assessing = Assessing learning and language; *p < .05; **p < .01; ***p< .001.

6.3.2 Correlation Analysis

Through correlational analysis, the present study examined the potential impact of variables at both the classroom and kindergarten levels on the post-test scores of the SSTEW and its respective subscales. As shown in Table 6.13, the intervention (rs = 0.447 to 0.679, $p < .01$) and school type (rs = 0.183 to 0.326, $p < .01$) were significantly associated with the post-test scores of SSTEW and its five subscales. Additionally, the district level was significantly associated with SSTEW (r = - 0.115, $p < .01$), social and emotional well-being (r = - 0.183, p < 0.01), support learning and critical thinking (r = -0.092, $p < .05$), and assessing learning and development (r = - 0.107, $p < .05$). The city level was significantly associated with assessing learning and development (r = - 0.123, $p < .01$).

In terms of the classroom level variables, teacher qualification was significantly related to the post-test scores of SSTEW (r = 0.123, $p < .01$) and its subscales, including building trust confidence and independence (r = 0.162, $p < .01$), extending language and communication (r = 0.151, $p < .01$), and supporting learning and critical thinking (r = 0.211, $p < .01$). Teacher age was significantly associated with the average scores of SSTEW (r =

0.088, $p < 0.05$), extending language and communication ($r = 0.132$, $p < .01$), supporting learning and critical thinking ($r = 0.102$, $p < .05$), and assessing learning and development ($r = 0.092$, $p < .05$). The child-to-teacher ratio was significantly related to supporting learning and critical thinking ($r = 0.180$, $p < .01$) and assessing learning and development ($r = 0.092$, $p < .05$). Teacher degree was significantly associated with supporting social-emotional wellbeing ($r = 0.093$, $p < .05$) and assessing learning and development ($r = 0.107$, $p < .05$).

Table 6.13

Pearson correlations between kindergarten and classroom variables and post-test total average scores of SSTEW

	SSTEW	Build TCI	SE Well-bg	Lang-Comm	Learn-Crit	Assessing
Kindergarten variables						
Intervention	**0.679****	**0.643****	**0.510****	**0.576****	**0.613****	**0.447****
District level	**-0.115****	-0.030	**-0.183****	-0.042	**-0.092***	**-0.107***
City level	-0.019	-0.019	-0.057	-0.043	-0.009	**-0.123****
School type	**0.307****	**0.189****	**0.183****	**0.331****	**0.326****	**0.264****
Location	-0.040	-0.052	-0.001	-0.063	-0.075	0.041
Classroom variables						
Teacher qualification	**0.123****	**0.162****	0.014	**0.151****	**0.211****	-0.050
Teacher age	**0.088***	0.006	0.044	**0.132****	**0.102***	**0.092***
Grade	0.030	0.008	-0.049	0.017	**0.181****	-0.026
Child-to-teacher ratio	0.074	-0.030	0.062	0.012	**0.180****	**0.092***
Teacher degree	0.035	0.042	**0.093***	-0.077	-0.007	**0.107***

Note: Build TCI = Building trust, confidence, and independence; SE Well-bg = Social and emotional well-being; Lang-Comm = Supporting and extending language and communication; Learn-Crit = Supporting learning and critical thinking; Assessing = Assessing learning and language.

6.3.3 Main and Moderation Effects of PD Intervention on Average Scores of SSTEW

Main effects. The present study employed multilevel modelling to investigate the effects of PD on classroom quality, given the nested structure of classrooms within kindergartens. To begin, a null model was fitted without predictors to assess the variance at each level, as indicated by the ICC, to justify the use of a multilevel analytic approach (see more details in chapter 5). Following the confirmation of the significant variability at the between-level, two subsequent models were examined: the reduced model that only included

classroom-level or kindergarten-level predictors and the full model that encompassed both within-level and between-level predictors.

Two models were specified to separately examine the main effects of variables at the classroom- and kindergarten levels on the scores of SSTEW. The first model consisted of classroom variables, including pre-test SSTEW, grade, child-to-teacher ratio, teachers' degrees, qualifications, and age. As shown in Table 6.14, the teacher qualification (b = 0.361, p < .01, SE = 0.138) had significant associations with post-test score of SSTEW, while other variables in the classroom-level did not. The second model consisted of variables specific to kindergartens, involving intervention, district level, city level, province level, location and school type. The results indicated that intervention (b = 0.959, p < .001, SE = .141), school type (b = 0.734, p < .001, SE = .183), and district level (b = - 0.431, p < .01, SE = 0.151) showed significant effects on post-test score of SSTEW.

Next, a Full Model was constructed to investigate the contributions of classroom-level and kindergarten-level variables to classroom quality as measured by SSTEW. Results in Table 6.14 indicated that the PD intervention (b = 0.990, p < .001, SE = 0.146) significantly contributed to the post-test scores of SSTEW after controlling the variables at classroom and kindergarten levels. Additionally, teacher qualification, school type, and district level exhibited significant associations with the post-test scores of SSTEW.

Table 6.14

Model results of intervention effects on post-test total average scores of SSTEW

	Model 14-Ancova model		Model 14-Intercept Model		Model 14-Full Model	
Coefficient	*b*	SE	*b*	SE	*b*	SE
Fixed effect						
Intercept	**4.297*** **	0.585	**3.196*** **	0.249	**3.357*** **	0.590
Level 1-Classroom						
Pre-test	0.088	0.084	------	------	0.094	0.084
Teacher qualification	**0.361** **	0.138	------	------	**0.303***	0.131
Teacher age	-0.041	0.053	------	------	-0.022	0.052
Grade	-0.010	0.096	------	------	-0.018	0.094
Children-to-teacher ratio	0.031	0.026	------	------	0.033	0.028
Teacher degree	-0.064	0.122	------	------	-0.018	-0.094
Level 2-Kindergarten						
Intervention	------	------	**0.959*** **	0.141	**0.969*** **	0.137
School type	------	------	**0.734*** **	0.183	**0.706*** **	0.188
District level	------	------	**-0.431** **	0.151	**-0.448** **	0.166
City level	------	------	0.187	0.199	0.153	0.211
Location	------		-0.056	0.132	-0.056	0.133
Variance components						
Level 1-classroom	**0.206*** **	0.050	**0.225*** **	0.053	**0.207*** **	0.050
Level 2- school	**0.453*** **	0.086	**0.037**	0.031	0.045	0.116
Model summary						
Within level R^2	0.073	0.045	------	------	0.055	0.040
Between level R^2	------	------	**0.916*** **	0.075	**0.898*** **	0.072
AIC	191.999		155.965		163.063	

Moderation effects. To explore potential moderation effects at the classroom and kindergarten levels on the association between intervention and SSTEW score, two distinct sets of multilevel models (i.e., Models 15 and 16) were specified. Table 6.15 indicated that school type (b = 0.137, p > .05, SE = 0.240) and district level (b = - 0.003, p > .05, SE = 0.318) could not moderate the effects of the intervention on post-test scores of SSTEW. Model 16 examined the cross-level moderation effects of teacher qualification in the association between intervention and SSTEW score. However, teacher qualification (b = - 0.136, p > .05, SE = 0.682) did not have the moderation effects.

Table 6.15

Moderation effects on the association between intervention and post-test total average scores of SSTEW

	Model 15		Model 16	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**3.092*** **	.651	**3.261*** **	.364
Classroom level main effects				
Pre-test	.085	.081	.085	.119
Teacher qualification	**.339***	.139		
Teacher age	-.053	.051	-.053	.061
Grade	.005	.089	-.052	.096
Children-to-teacher ratio	.013	.021	.014	.023
Teacher degree	-.025	.108	-.027	.102
Kindergarten level main effects				
Intervention	**.909*** **	.223	**1.016*** **	.199
School type	**.606** **	.216	**.639*** **	.225
District level	**-.415***	.168	**-.412***	.239
City level	.162	.207	.183	.231
Location	-.064	.138	-.103	.171
Kindergarten level moderation effects				
Intervention × School type	.137	.240	------	------
Intervention × District level	-.003	.318	------	------
Cross level moderation effects				
Intervention × Teacher qualification	------	------	-.136	.682
Variance components				
Level 1-classroom	**.207*** **	.051	**.225*** **	.041
Level 2- school	.045	.028	.046	.033
Model fit				
Within level R^2	.059	.039	.111***	.037
Between level R^2	.899	.073	.666***	.116
AIC	166.817		150.090	

6.3.4 Main and Moderation Effects of PD Intervention on SSTEW Subscales

Main effects. After confirming the ICC values for the subscales of SSTEW in the null model, the **Build TCI null model** indicated that approximately 47.9% of the variance was present at the kindergarten level, and 52.1% of the variance occurred at the classroom level. The **SE Wellbg null model** revealed that 42.4% of the variance was at the kindergarten level, and 57.6% of the variance was at the classroom level. In the **Lang-Comm null model**, approximately 51.1% of the variance was present at the kindergarten level, and 48.9% of the variance occurred at the classroom level. The **Learn-Crit null model** indicated that approximately 53.5% of the variance was present at the kindergarten level, and 46.5% of the variance occurred at the classroom level. The **Assessing null model** indicated that

approximately 28.5% of the variance was present at the kindergarten level, and 71.5% of the variance occurred at the classroom level. As shown in Table 6.16, five sets of Models 17 were specified to examine the main effects of variables at the classroom- and kindergarten levels on the post-test scores of SSTEW subscales.

In terms of ***Build TCI***, as shown in Table 6.16, intervention (b = 1.254, p < .001, SE = 0.173) had significant effects on the post-test score of *Build TCI* after controlling classroom- and kindergarten-level variables. The intervention group received significantly higher scores on Build TCI than the control group. Meanwhile, teacher qualification (b = 0.652, p < 0.01, SE = 0.201) was significantly associated with post-test scores of Build TCI, indicating that teachers with higher qualifications tended to show higher quality.

In terms of ***SE Wellbg***, as shown in Table 6.16, the intervention (b = 1.195, p < .001, SE = 0.257) had significant impacts on post-test score of SE Wellbg after controlling classroom- and kindergarten-level covariates. The intervention group received higher scores on SE Wellbg than the control group. Meanwhile, pre-test scores (b = 0.258, p < .01, SE = .089) and district level (b = - 0.725, p < .05, SE = .0299) were significantly associated with post-test scores on SE Wellbg, indicating that classrooms with lower pre-test scores and classified as district levels tended to show lower scores on post-test SE Wellbg.

In terms of ***Lang-Comm***, as shown in Table 6.16, the intervention (b = 0.961, p < .001, SE = 0.175) had significant impacts on post-test score on Lang-Comm after controlling the covariates. Those classrooms in the intervention group received higher scores than control group. Meanwhile, classrooms in the public kindergartens (b = 0.948, p < .001, SE = 0.250) showed higher scores than private kindergartens.

In terms of ***Learn-Crit***, as shown in Table 6.16, the intervention (b = 1.014, p < .001, SE = 0.134) had significant impacts on post-test score of Learn-Crit after controlling the covariates. Those classrooms in the intervention group received higher scores on Learn-Crit.

Meanwhile, classrooms tended to perform higher scores on Learn-Crit if their teachers had higher qualifications (b = 0.610, p < .001, SE = 0.163) and higher child-to-teacher ratio (b = 0.055, p < .05, SE = 0.026). Regarding the classroom-level variables, public kindergartens (b = 0.913, p < .001, SE = 0.147) received higher scores than private kindergartens. Kindergartens in city level (b = 0.331, p < .05, SE = 0.156) also received higher scores than district level (b = 0.331, p < .05, SE = 0.156).

In terms of ***Assessing***, as shown in Table 6.16, the intervention (b = 0.466, p < .001, SE = 0.111) had significant impacts on post-test score of Assessing after controlling the covariates. Those classrooms in the intervention group received higher scores on Assessing. Meanwhile, private kindergartens (b = 0.512, p < .01, SE = 0.153) and district-level kindergartens (b = -0.387, p < .01, SE = 0.145) received significantly lower scores than public kindergartens and kindergartens classified as city or province level.

Table 6.16

Model results of multilevel modelling analysis of intervention effects on the post-test scores of SSTEW subscales

	Model 17-Build TCI		Model 17-SE Well-bg		Model 17-Lang-Comm		Model 17-Learn-Crit		Model 17-Assessing	
Coefficient	*b*	SE	*b*	SE	*b*	SE	*b*	SE	*b*	SE
Fixed effect										
Intercept	**3.591*****	0.853	**2.130**	1.169	**5.726*****	1.028	**3.048****	0.983	**1.493***	0.750
Level 1-Classroom										
Pre-test	0.101	0.066	**0.258****	0.089	-0.041	0.093	0.136	0.114	0.047	0.062
Teacher qualification	**0.652****	0.201	0.081	0.369	**0.380**	0.200	**0.610*****	0.163	-0.214	0.135
Teacher age	-0.123	0.075	-0.086	0.113	-0.004	0.054	-0.086	0.069	0.047	0.081
Grade	-0.014	0.144	-0.039	0.178	-0.011	0.123	0.187	0.135	-0.047	0.158
Children-to-teacher	-0.011	0.025	0.028	0.043	-0.013	0.032	**0.055***	0.026	-0.003	0.027
Teacher degree	0.179	0.161	0.209	0.188	**-0.389**	0.203	-0.081	0.161	0.041	0.170
Level 2-Kindergarten										
Intervention	**1.254*****	0.173	**1.195*****	0.257	**0.961*****	0.175	**1.014*****	0.134	**0.466*****	0.111
School type	**0.334**	0.182	**0.680**	0.380	**0.948*****	0.250	**0.913*****	0.147	**0.512****	0.153
District level	-0.153	0.222	**-0.725***	0.299	**-0.371**	0.194	**-0.452****	0.163	**-0.387****	0.145
City level	0.144	0.190	0.287	0.429	0.152	0.306	**0.331***	0.156	-0.067	0.138
Location	-0.093	0.151	-0.093	0.253	-0.023	0.179	-0.178	0.145	0.063	0.106
Variance components										
Level 1-classroom	**0.437*****	0.074	**0.888*****	0.156	**0.439*****	0.077	**0.349*****	0.058	0.020	0.027
Level 2- school	0.034	0.054	0.123	0.107	0.046	0.059	0.001	0.030	**0.992*****	0.198
Model summary										
Within level R^2	**0.118**	0.062	**0.075**	0.039	**0.464*****	0.093	**0.162***	0.065	**0.302*****	0.055
Between level R^2	**0.931*****	0.112	**0.827*****	0.151	0.066	0.052	0.998***	0.060	0.001	0.029
AIC	225.380		295.844		235.279		197.925		184.181	

In summary, the results demonstrated significant effects of the intervention on all subscales of SSTEW after controlling for covariates. Furthermore, pre-test scores of Build TCI were found to positively predict post-test scores, while teacher qualifications positively predicted post-test scores of Build TCI, Lang-Comm, and Learn-Crit. Additionally, child-to-teacher ratio was identified as a predictor of post-test scores of Learn-Crit. With regard to kindergarten-level variables, school type was found to predict scores of SE Well-bg, Lang-Comm, Learn-Crit, and Assessing, with higher quality observed in public kindergartens. Conversely, the district level was negatively associated with scores of SE Well-bg, Learn-Crit, and Assessing, indicating lower quality in district-level kindergartens.

Moderation effects. ***Build TCI.*** To examine the moderation effects of school type and teacher qualifications in the association between intervention and Build TCI scores, two different sets of multilevel models (Models 18 and 19) were specified. Model 18 examined the kindergarten-level moderation effects and included one interaction term (TI = Type * Intervention) as the kindergarten-level predictor. Model 19, on the other hand, examined the classroom-level moderation effects and included one term (S9 = Build TCI ON teacher qualification) to explore whether the intervention can influence the regression slope. Table 6.17 indicated that neither school type (b = .016, p > .05, SE = .310) nor teacher qualification (b = -.005, p > .05, SE = .595) could moderate the effects of the intervention on post-test scores of Build TCI.

Table 6.17

Moderation effects on the association between intervention and the post-test scores SSTEW Build TCI

	Model 18		Model 19	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**3.596*** **	.843	**3.495*** **	.653
Classroom level main effects				
Pre-test	.101	.066	.110	.089
Teacher qualification	**.654** **	.197	------	------
Teacher age	-.123	.075	-.132	.088
Grade	-.014	.144	-.023	.141
Children-to-teacher ratio	-.011	.026	-.008	.035
Teacher degree	.179	.162	.163	.151
Kindergarten level main effects				
Intervention	**1.246*** **	.223	**1.284*** **	.211
School type	.325	.238	.327	.293
District level	.153	.219	-.169	.283
City level	.143	.186	.100	.288
Location	-.093	.151	-.062	.243
Kindergarten level moderation effects				
Intervention × School type	.016	.310	------	------
Cross level moderation effects				
Intervention × Teacher qualification	------	------	-.005	.595
Variance components				
Level 1-classroom	**.437*** **	.074	**.497*** **	.084
Level 2- school	.034	.054	**.134*** **	.112
Model fit				
Within level R^2	**.119**	.061	.133***	.043
Between level R^2	**.931**	.112	.657***	.145
AIC	227.378		214.189	

SE Wellbg. To examine the moderation effects of district-level and pre-test scores in the association between intervention and SE Well-bg scores, two different sets of multilevel models (Models 20 and 21) were specified. Model 20 examined the kindergarten-level moderation effects and included one interaction term (TI = District level * Intervention) as the kindergarten-level predictor. Model 21, on the other hand, examined the classroom-level moderation effects and included one term (S10 = SE Well-bg ON pre-test) to explore whether the intervention can influence the regression slope. Table 6.18 indicated that neither district level ($b = 0.192$, $p > .05$, SE = 0.588) nor pre-test scores ($b = 0.279$, $p > .05$, SE = 0.261) could moderate the effects of the intervention on post-test scores of SE Wellbg.

Table 6.18

Moderation effects on the association between intervention and post-test scores of SSTEW SE Wellbg

	Model 20		Model 21	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**2.187**	1.154	**2.087*** **	0.965
Classroom level main effects				
Pre-test	**0.257****	0.089	------	------
Teacher qualification	0.105	0.396	0.041	0.405
Teacher age	-0.088	0.113	-0.072	0.125
Grade	-0.014	0.144	0.046	0.208
Children-to-teacher ratio	0.025	0.047	0.023	0.051
Teacher degree	0.210	0.190	0.159	0.223
Kindergarten level main effects				
Intervention	**1.143****	0.349	**1.221*****	0.323
School type	**0.672**	0.370	0.701	0.454
District level	**-0.809***	0.364	-0.729	0.423
City level	0.276	0.419	0.238	0.435
Location	-0.064	0.277	-0.069	0.365
Kindergarten level moderation effects				
Intervention × District level	0.192	0.588	------	------
Cross level moderation effects				
Intervention × Pre-test	------	------	-0.279	0.261
Variance components				
Level 1-classroom	**0.889*****	0.156	**0.979*****	0.177
Level 2- school	0.121	0.103	**0.342*****	0.280
Model fit				
Within level R^2	**0.074**	0.039	**0.134*****	0.043
Between level R^2	**0.830*****	0.144	0.532*****	0.158
AIC	298.735		278.812	

Lang-Comm. To examine the kindergarten level moderation effects in the association between intervention and Lang-Comm scores, Model 22 was specified. This model included one interaction term (TI = Type * Intervention) as the kindergarten-level predictor to examine the moderation effects of school type. Table 6.19 indicated that school type (b = 0.192, p > .05, SE = 0.588) could not moderate the effects of the intervention on post-test scores of Lang-Comm.

Table 6.19

Moderation effects on the association between intervention and post-test scores of SSTEW Lang-Comm

	Model 22	
Coefficient	*b*	SE
Fixed effect		
Intercept	**5.769*** **	1.002
Classroom level main effects		
Pre-test	-0.041	0.095
Teacher qualification	**0.391**	0.200
Teacher age	-0.088	0.113
Grade	-0.010	0.123
Children-to-teacher ratio	-0.014	0.033
Teacher degree	**-0.387**	0.206
Kindergarten level main effects		
Intervention	**0.898****	0.307
School type	**0.878****	0.286
District level	**-0.373**	0.192
City level	0.145	0.300
Location	-0.023	0.177
Kindergarten level moderation effects		
Intervention × School type	0.192	0.588
Variance components		
Level 1-classroom	**0.464*****	0.094
Level 2- school	0.121	0.103
Model fit		
Within level R^2	**0.074**	0.039
Between level R^2	0.064	0.049
AIC	237.149	

Learn-Crit. To examine the kindergarten- and classroom-level moderation effects in the association between intervention and Learn-Crit scores, Models 23 and 24 were specified. These models included multiple interaction terms as the kindergarten-level predictors to examine the moderation effects of school type, city level, district level, and teacher qualifications. Specifically, three interaction terms were added (TI = Type * Intervention, CI = City level * Intervention, DI = District level * Intervention) to examine the moderation effects of school type, city level, and district level, respectively. Additionally, one term (S11 = Learn-Crit ON teacher qualification) was added to explore whether intervention influenced the regression slope. Table 6.20 indicated that school type ($b = 0.029$, $p > .05$, SE = 0.252), district level ($b = 0.159$, $p > .05$, SE = 0.304), city level ($b = 0.414$, $p > .05$, SE = 0.350),

teacher qualification (b = 0.179, p > .05, SE = 0.712) and child-to-teacher ratio (b = 0.060, p > .05, SE = 0.076) can not moderate the effects of the intervention on post-test scores of Learn-Crit.

Table 6.20

Moderation effects on the association between intervention and post-test scores of SSTEW Learn-Crit

	Model 23		Model 24	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**2.764*** **	.604	**2.289***	1.555
Classroom level main effects				
Pre-test	0.135	0.119	0.122	0.122
Teacher qualification	**0.604*** **	0.162	------	------
Teacher age	-0.076	0.068	-0.063	0.081
Grade	0.147	0.137	0.155	0.138
Children-to-teacher ratio	0.052	0.030	------	------
Teacher degree	-0.185	0.160	-0.212	0.188
Kindergarten level main effects				
Intervention	**0.798** **	0.258	1.921	1.235
School type	**0.932*** **	0.233	0.908	0.309
District level	**-0.552** **	0.183	-0.471	0.314
City level	0.091	0.309	0.284	0.287
Location	-0.173	0.134	0.166	0.229
Kindergarten level moderation effects				
Intervention × School type	0.029	0.252	------	------
Intervention × District level	0.159	0.304	------	------
Intervention × City level	0.414	0.350	------	------
Cross level moderation effects				
Intervention × Teacher qualification	------	------	0.179	0.712
Intervention × Children-to-teacher			-0.060	0.076
Variance components				
Level 1-classroom	**0.344*** **	0.056	**0.497*** **	0.084
Level 2- school	0.002	0.029	**0.134*** **	0.112
Model fit				
Within level R^2	**0.162***	0.072	**0.171*** **	0.049
Between level R^2	**0.997*** **	0.055	**0.924*** **	0.119
AIC	202.585		201.459	

Assessing. To explore the potential moderation effects of school type and district level on the relationship between the intervention and Assessing scores, Model 25 was specified at the kindergarten level. This model included two interaction terms (i.e., TI = Type * Intervention, DI = District level * Intervention) as predictors. Table 6.21 indicated that

district level (b = - 0.299, p < .001, SE = 0.120) could moderate the effects of the intervention on post-test scores of Assessing.

In summary, the results suggested that kindergarten and classroom variables could not moderate the impacts of the intervention on Build TCI, Se-Well-bg, Lang-Comm, and Learn-Crit. However, school type demonstrated a moderating effect on the association between intervention and the outcome of Assessing, with public kindergartens exhibiting a more pronounced impact of the intervention on Assessing compared to private kindergartens.

Table 6.21

Moderation effects on associations between intervention and post-test scores of SSTEW Assessing

	Model 25	
Coefficient	*b*	SE
Fixed effect		
Intercept	**1.641***	0.796
Classroom level main effects		
Pre-test	0.046	0.061
Teacher qualification	-0.175	0.123
Teacher age	0.044	0.081
Grade	-0.049	0.158
Children-to-teacher ratio	-0.007	0.031
Teacher degree	0.055	0.174
Kindergarten level main effects		
Intervention	0.196	0.144
School type	0.152	0.122
District level	**-0.299***	0.120
City level	-0.090	0.122
Location	0.029	0.083
Kindergarten level moderation effects		
Intervention × School type	**.676*****	0.147
Intervention × District level	-0.221	0.245
Variance components		
Level 1-classroom	**0.281*****	0.047
Level 2- school	0.000	0.072
Model fit		
Within level R^2	0.019	0.029
Between level R^2	**0.997***	0.440
AIC	181.088	

6.4 The Effects of PD Programme on Child Development

As shown in Table 6.22, 577 children participated in the pre-test, while 549 children participated in the post-test due to 28 children transferring to other schools, resulting in a retention rate of 95.15%. The data of the missing children were excluded from the analysis. In terms of the participants, there were 290 boys (50.26%) and 287 (49.74%) girls, with 289

children aged 3-4 years old and 288 aged 4-5 years old. 313 (54.25%) children were from public kindergartens and 264 (45.75%) were from private ones. 388 (49.91%) children were from kindergartens in urban areas, and 289 (50.09%) were from sub-urban areas. Regarding school classification, 192 (33.28%) children were from province-level kindergartens, 216 (37.44%) from city-level, and 169 (29.29%) were from district-level kindergartens.

Table 6.22

Characteristics of participating children

Children characteristics	Intervention group N=289	Control Group N=288	Total N=577	Missing data N=28
Gender, n (%)				
Boy	146 (50.52)	144 (50)	290 (50.26)	17 (60.07)
Girl	143 (49.48)	144 (50)	287 (49.74)	11 (37.93)
Grade, n (%)				
K1	145 (50.17)	144 (50)	289 (50.09)	17 (60.07)
K2	144 (49.83)	144 (50)	288 (49.91)	11 (37.93)
School type, n (%)				
Public	169 (58.48)	144 (50)	313 (54.25)	12(42.86)
Private	120 (41.52)	144 (50)	264 (45.75)	16 (57.14)
Location, n (%)				
Urban	144 (49.83)	144 (50)	288 (49.91)	17 (60.07)
Sub-urban	145 (50.17)	144 (50)	289 (50.09)	11 (37.93)
School classification, n (%)				
Province level	96 (33.22)	96 (33.33)	192 (33.28)	12 (42.86)
City level	120 (41.52)	96 (33.33)	216 (37.44)	9 (32.14)
District level	73 (25.26)	96 (33.33)	169 (29.29)	7 (25.00)

6.4.1 Descriptive Analysis of Child Development

Table 6.23 reported the mean and standard deviation scores of children's emergent literacy, numeracy, executive function and social-emotional development in the pre-test and the post-test. In the intervention group, the total average scores of IDELA significantly (D = 15.79, $p < .001$) increased from 52.36 (SD = 17.51) in the pre-test to 68.34 (SD = 14.60) in the post-test. In terms of the subscales, children's numeracy skills demonstrated the biggest improvement (D = 19.87, $p < .001$), which improved from 53.03 (SD = 24.24) in the pre-test to 72.90 (SD = 23.02) in the post-test. The literacy scores significantly increased from 43.86

(SD = 21.52) in the pre-test to 61.46 (SD = 21.94) in the post-test; the executive function significantly (D = 14.53, p < .001) improved from 49.38 (SD = 22.81) in the pre-test to 63.91 (SD = 16.51) in the post-test. Meanwhile, the social-emotional skills demonstrated the smallest by significant (D = 10.26, p < .001) improvement from 49.37 (SD = 22.81) in the pre-test to 63.91 (SD = 16.51) in the post-test.

Child in the control group also demonstrated significant improvements. The total average scores of IDELA significantly (D = 13.46, p < .001) increased from 52.43 (SD = 16.47) in the pre-test to 65.89 (SD = 14.99) in the post-test. Children's numeracy skills demonstrated the biggest improvement (D = 19.27, p < .001). The literacy scores also significantly (D = 14.29, p < .001) increased from 44.94 (SD = 20.39) in the pre-test to 59.23 (SD = 21.29) in the post-test. Meanwhile, the executive function (D = 8.38, p < .001) and the social-emotional skills (D = 7.53, p < .001) demonstrated relatively smaller change than numeracy and literacy.

Table 6.23

The intervention and control groups' mean and standard deviation of pre- and post test scores of child development in the intervention and control groups

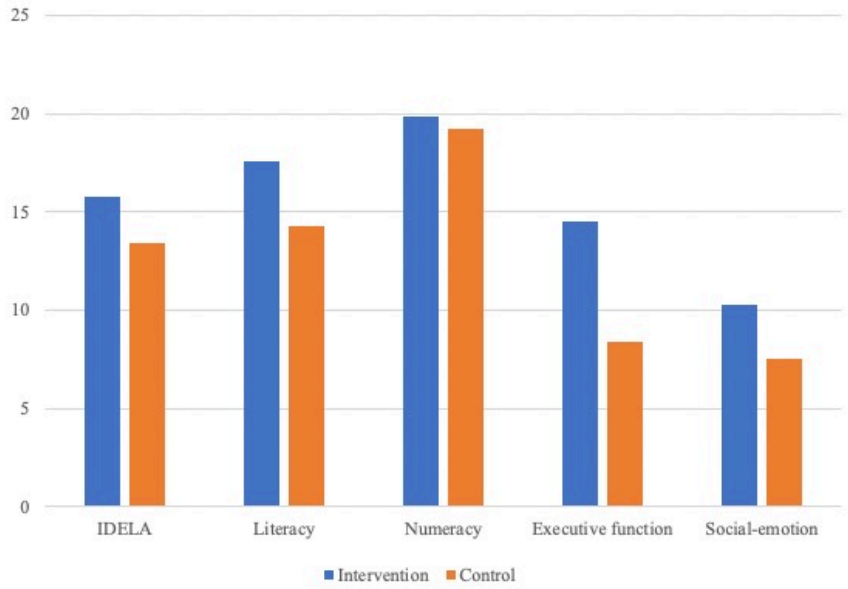
Outcome variables-child	Intervention group					Control group				
	Pre-test		Post-test		D	Pre-test		Post-test		D
	M	SD	M	SD		M	SD	M	SD	
Class (n)	272		272			275		275		
IDELA	**52.36**	**17.51**	**68.34**	**14.60**	**15.79*** **	**52.43**	**16.47**	**65.89**	**14.99**	**13.46*** **
Literacy	43.86	21.52	61.46	21.94	17.59***	44.94	20.39	59.23	21.29	14.29***
Numeracy	53.03	24.24	72.90	23.02	19.87***	50.04	23.94	69.31	22.50	19.27***
Executive function	49.38	22.81	63.91	16.51	14.53***	50.49	22.13	58.87	17.24	8.38***
Social-emotion	49.37	15.90	59.63	15.26	10.26***	51.87	17.86	59.40	17.33	7.53***

Figure 6.2 presents a comparison of the score change in child development between the intervention and control groups. The results indicated that children in the intervention group outperformed their counterparts in the control group in terms of literacy, numeracy,

executive function, and social-emotional development. Meanwhile, both intervention and control groups demonstrated the biggest change scores in numeracy, whereas the lowest change scores were observed in social-emotional skills.

Figure 6.2

The score change of child development in the intervention and control groups



6.4.2 Main Effects of PD Intervention on Child Outcomes

To account for the hierarchical structure of students nested within classrooms, four two-level models were employed to analyse the impacts of PD on children's literacy, emergent numeracy, executive function and social-emotional development separately. The ICCs of the four models suggested that multilevel modelling was an appropriate analytic approach for emergent literacy, numeracy and executive function but not for social-emotional development (see more details in chapter 5). Therefore, three sets of child development Model 25 were constructed to explore the main effects on children literacy, numeracy, and executive function and RMANOVA analysis was conducted to explore the impacts of PD on children's social-emotional development. The child level variables consisted of pre-test scores, children age and gender. The classroom-level variables included change scores of

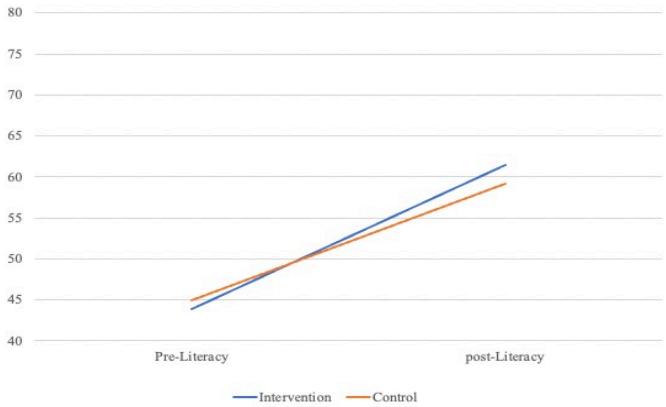
ECERS-E (i.e., Diff-ECERS-E) and SSTEW (i.e., Diff-SSTEW), and intervention, teacher qualification, teacher age and degree, and child-to-teacher ratio.

Emergent Literacy. Table 6.24 presents the results of the main effects model, which examined the impacts of the intervention on children's emergent literacy while controlling for classroom and kindergarten-level variables. The intervention showed a significant positive effect (b = 11.057, p < .001, SE = 3.535), indicating that children in the intervention group had approximately 11.057 more scale points in emergent literacy compared to the control group. Additionally, pre-test literacy (b = 0.662, p < .001, SE = .034), children's age (b = 0.514, p < .01, SE = 0.198), the score change of ECERS-E (b = - 10.762, p < .001, SE = 2.730), teachers' qualifications (b = 9.433, p < .05, SE = 3.954), and child-to-teacher ratio (b = 1.030, p < 0.05, SE = 0.504) were significant predictors of children's emergent literacy skills. Specifically, children with higher pre-test scores and older age showed higher literacy scores, while less score change of ECERS-E and higher child-to-teacher ratio in classrooms were positively associated with children's emergent literacy.

Furthermore, as shown in Figure 6.3 and Table 6.24, the literacy mean scores for the intervention and control groups were M intervention = 43.86 and M control = 44.94 in the pre-test. In the post-test, the mean score for the intervention group was M intervention = 61.64, while the mean score for the control group was M control = 59.32. The paired t-tests showed a significant difference with a large effect size in the intervention group (t (271) = 17.619, p < .001, d = 1.07) and in the control group (t (274) = 16.849, p < .001, d = 1.02). Therefore, the between-group Cohen's d was 0.05.

Figure 6.3

Comparison of mean scores for intervention and control groups in emergent literacy.

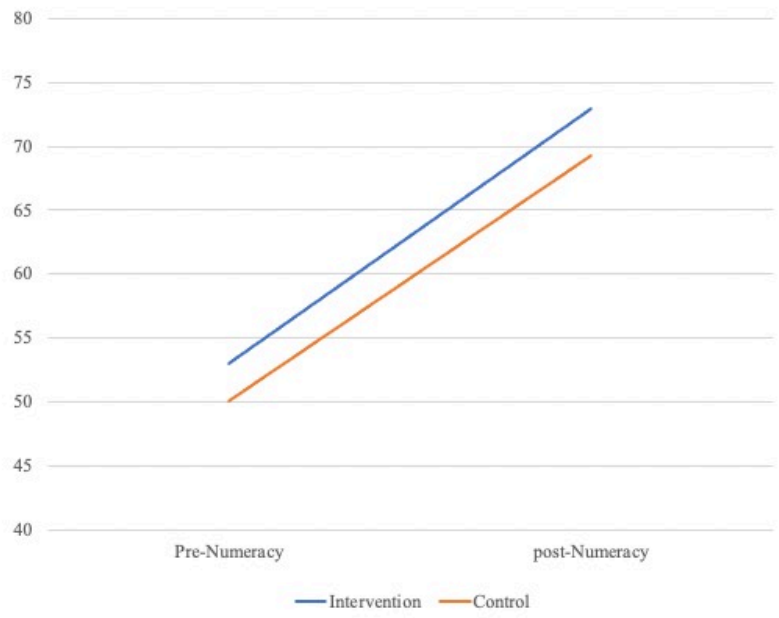


Emergent Numeracy. As shown in Table 6.24, the intervention (b = 14.072, p < .01, SE = 4.632) showed significant positive effects of approximately 14.072 scale points for those children within classrooms in the intervention group. Children with higher pre-test scores (b = 0.636, p < .001, SE = 0.036), older age (b = 0.642, p < .01, SE = 0.211) and boys (b = 2.643, p < .05, SE = 1.205) had higher scores in emergent numeracy. Meanwhile, children in classrooms with less score change of ECERS-E (b = - 9.996, p < .01, SE = 3.181) tended to receive higher scores of emergent numeracy.

As shown in Figure 6.4, the mean numeracy scores for the intervention and control groups were M intervention = 53.3 and M control = 50.04 in the pre-test. In the post-test, the mean score for the intervention group was M intervention = 72.9, while the mean score for the control group was M control = 69.31. The paired t-tests showed a significant difference with a large effect size in the intervention group (t (271) = 17.619, p < .001, d = 1.07) and in the control group (t (274) = 20.006, p < .001, d = 1.21). Therefore, the between-group Cohen's d was 0.14.

Figure 6.4

Comparison of mean scores for intervention and control group regarding emergent numeracy.



Executive Function. As shown in Table 6.24, The intervention (b = 6.775, p < .05, SE = 2.645) showed significant positive effects of approximately 6.775 scale points for those children within classrooms in the intervention group. Meanwhile, children with higher pre-test scores (b = 0.284, p < .001, SE = 0.033) and older age (b = 0.686, p < .01, SE = 0.205) performed significantly better in executive function skills. Meanwhile, children in the classrooms with more changes of ECERS-E (b = - 4.328, p < .05, SE = 1.820) and fewer changes of SSTEW (b = 2.701, p < .05, SE = 1.075) showed higher scores of executive function.

As shown in Figure 6.5, the mean scores of executive function for the intervention and control groups were M intervention = 49.38 and M control =50.49 in the pre-test. In the post-test, the mean score for the intervention group was M intervention = 63.91, while the mean score for the control group was M control = 58.87. The paired t-tests showed a significant difference with a large effect size in the intervention group (t (271) = 11.369, p < .001, d = 0.689) and in the control group (t (274) = 6.451, p < .001, d = 0.389). Therefore, the between-group Cohen's d was 0.3.

Figure 6.5

Comparison of mean scores for intervention and control group regarding executive function.

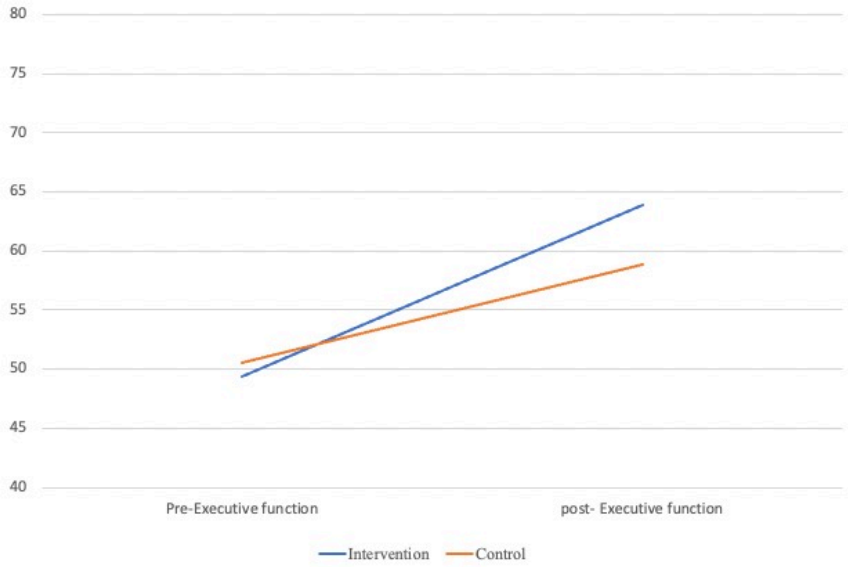


Table 6.24

The results of multilevel modelling analysis of the main effects of PD on the post-test scores of child development

	Emergent literacy		Emergent numeracy		Executive function	
Coefficient	*b*	SE	*b*	SE	*b*	SE
Fixed effect						
Intercept	**54.671*** **	4.407	**58.169*** **	4.875	**56.451*** **	3.259
Level 1-Individual						
Pre-test	**0.662*** **	0.034	**0.636*** **	0.036	**.284*** **	0.033
Age	**0.514** **	0.198	**0.642** **	0.211	**.686** **	0.205
Gender	0.096	1.302	**2.643***	1.205	-1.127	1.180
Level 2-Classroom						
Intervention	**11.057** **	3.535	**14.072** **	4.632	**6.775***	2.645
Diff-ECERS-E	**-10.762*** **	2.730	**-9.996** **	3.181	**-4.328***	1.820
Diff-SSTEW	1.932	1.708	0.221	1.926	**2.701***	1.075
Teacher qualification	**9.433***	3.954	**7.912**	4.642	2.658	2.454
Teacher degree	0.322	2.563	4.493	3.062	.058	1.632
Children-to-teacher	**1.030***	0.504	0.722	0.657	.272	0.316
Teacher Age	-0.317	1.287	0.266	1.418	.543	0.975
Variance components						
Level 1-individual	**202.505*** **	15.457	**189.750*** **	11.405	**218.365*** **	15.467
Level 2- classroom	**54.671*** **	4.407	**124.987*** **	20.437	**19.175***	7.516
Model summary						
Within-level R^2	**0.390*** **	0.032	**0.462*** **	0.031	**.148 *** **	0.025
Between-level R^2	**0.321** **	0.094	**0.249** **	0.089	**.446 ** **	0.154
AIC	4604.697		4595.562		4563.044	

Socio-emotional skills. Given the ICC value of social-emotional development is too low for multilevel modelling, As shown in Table 6.25 and Figure 6.6, RMANOVA analysis was conducted to explore group differences by time interaction. However, RMANOVA

analysis did not identify significant differences in social-emotional development (SE) (F (1, 555) = 3.285, p > .05) by time and group interaction.

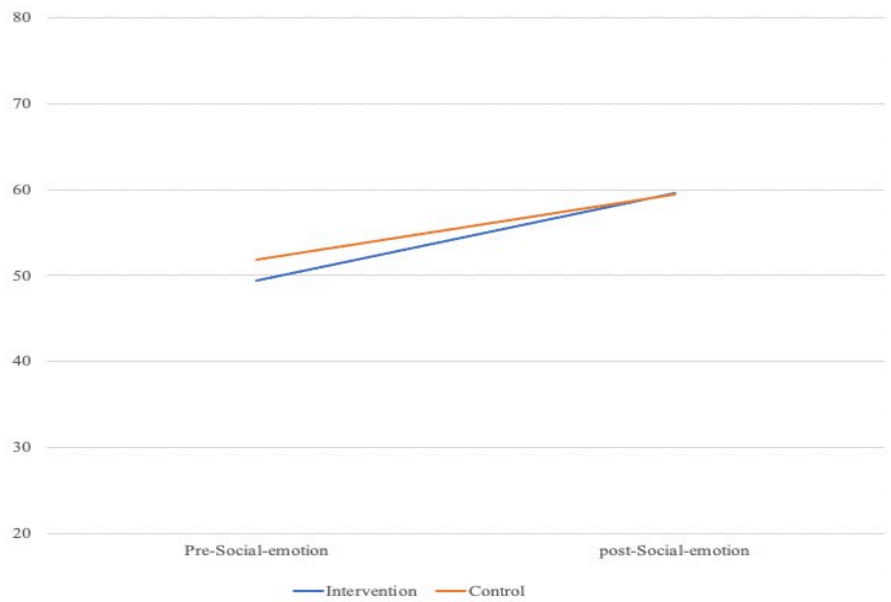
Table 6.25

The results of RMANOVA analysis regarding the post-test scores of social-emotion development

Outcomes variables-children	Intervention group				Control group				Between-group	
	Pre-test		Post-test		Pre-test		Post-test			
	M	SD	M	SD	M	SD	M	SD	Cohen's d	F
Children (n)	272		272		275		275			
IDELA	**52.36**	**17.51**	**52.43**	**16.47**	**52.43**	**16.47**	**0.66**	**0.15**	0.09	**9.857****
Social emotion	0.50	0.16	0.60	0.15	0.52	0.18	0.59	0.17	0.16	3.285

Figure 6.6

Comparison of mean scores for intervention and control group regarding social-emotional development



6.4.3 Moderation Effects of PD Intervention on Child Outcomes

Emergent Literacy. To examine whether the effects of the PD intervention varied according to classroom- and child-level variables, interaction terms between intervention and these variables were included in the analysis. Child-level variables included pre-test scores, age, and gender, while the classroom variables included the score changes of ECERS-E and

SSTEW, teachers' qualifications, age, degree, and child-to-teacher ratio. The results of the moderation analysis for emergent literacy is presented in Table 6.26. Models 26 and 27 included the interaction terms (intervention * diff-ECERS-E, intervention * qualification, intervention * child-to-teacher ratio) to the effects models. As shown in Table 6.26, the score change of ECERS-E (b = -1.477, p > .05, SE = 4.900), teachers' qualifications (b = 4.890, p > .05, SE = 6.358), child-to-teacher ratio (b = -1.467, p > .05, SE = 1.043), and children's age (b = 0.124, p > .05, SE = 0.405) did not moderate the effects of PD intervention on children's literacy skills.

Table 6.26

Moderation effects on associations between intervention and post-test scores of child literacy

	Model 26 - Classroom level moderation		Model 27 - Child level moderation	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**54.630*** **	4.679	**54.674*** **	4.402
Level 1-Individual				
Pre-test	**0.662*** **	0.034	**0.663*** **	.033
Age	**0.514** **	0.198	------	------
Gender	0.081	1.304	**0.097**	1.311
Level 2-Classroom				
Intervention	**14.489***	16.444	**11.057** **	3.535
Diff-ECERS-E	**-10.121***	3.924	**-10.762*** **	2.729
Diff-SSTEW	2.029	1.702	1.932	1.708
Teacher qualification	7.427	4.709	**9.433***	3.954
Teacher degree	0.441	2.527	0.321	2.563
Children-to-teacher	**1.765***	0.812	**1.030***	0.504
Teacher Age	-0.122	1.240	-0.317	1.287
Classroom level moderators				
Intervention × Diff-ECERS-E	-1.477	4.900	------	------
Intervention × Qualification	4.890	6.358	------	------
Intervention × Child-to-teacher ratio	-1.467	1.043	------	------
Child level moderator				
Intervention × Age	------	------	0.124	.405
Variance components				
Level 1-individual	**202.489*** **	15.455	**194.735*** **	16.327
Level 2- classroom	**88.905*** **	16.960	**93.196*** **	16.860
Model summary				
Within-level R^2	**0.390*** **	0.032	------	------
Between-level R^2	**0.345*** **	0.088	------	------
AIC	4608.203		4606.969	

Emergent Numeracy. Models 28-29 was specified to examine the potential moderation effects of child- and classroom-level variables on the association between

intervention and emergent numeracy. One interaction term, namely Diff-ECERS-E * Intervention, was included as the classroom-level predictor to investigate whether the score change of ECERS-E moderates the association between intervention and emergent numeracy. Additionally, two terms, numeracy ON gender and numeracy ON age, were added to explore whether children's age and gender have moderation effects. Table 6.27 indicated that there were no moderation effects of Diff-ECERS-E (b = 5.682, p > .05, SE = 4.604), child age (b = 0.124, p > .05, SE = 0.405), and gender (b = - 0.730, p > .05, SE = 2.425) on the association between intervention and post-test scores of emergent numeracy.

Table 6.27

Moderation effects on associations between intervention and post-test scores of child numeracy

	Model 28 - Classroom level moderation		Model 29 - Child level moderation	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**56.921*** **	5.021	**58.084*** **	4.868
Level 1-Individual				
Pre-test	**0.636*** **	0.036	**0.637*** **	0.037
Age	**0.642** **	0.211	------	------
Gender	**2.646***	1.205	------	------
Level 2-Classroom				
Intervention	**11.781***	4.726	**14.073** **	4.631
Diff-ECERS-E	**-13.459** **	4.192	**-9.996** **	3.181
Diff-SSTEW	0.217	1.873	0.219	1.926
Teacher qualification	7.812	4.723	**7.912**	4.642
Teacher degree	4.527	2.996	4.494	3.062
Children-to-teacher	**0.710**	0.652	0.722	0.657
Teacher Age	0.135	1.368	0.265	1.419
Classroom level moderators				
Intervention × Diff-ECERS-E	5.682	4.604	------	------
Child level moderator				
Intervention × Age	------	------	0.124	0.405
Intervention × Gender	------	------	-0.730	2.425
Variance components				
Level 1-individual	**189.734*** **	11.404	**182.135*** **	13.205
Level 2- classroom	**123.219*** **	19.983	**93.196*** **	16.860
Model summary				
Within-level R^2	**0.462*** **	0.031	------	------
Between-level R^2	**0.260** **	0.088	------	------
AIC	4596.463		4606.969	

Executive Function. Models 30 and 31 were specified to investigate whether children- and classroom-level variables moderate the association between the intervention

and executive function. Two interaction terms (i.e., Diff-ECERS-E * Intervention; Diff-SSTEW * Intervention) were added as the classroom-level predictors to explore whether score change of ECERS-E and SSTEW could moderate the effects of intervention on executive function. One term (i.e., executive function ON age) was included to explore whether children's age has a moderation effect. Table 6.28 indicated that there were no moderation effects of Diff-ECERS-E (b = 0.677, p > .05, SE = 3.414), Diff-SSTEW (b = 2.260, p > .05, SE = 2.183) or age (b = - 0.619, p > .05, SE = 0.389) on the associations between the intervention and post-test scores of executive function.

Table 6.28

Moderation effects on associations between intervention and post-test scores of child executive function

	Model 30 - Classroom level moderation		Model 31 - Child level moderation	
Coefficient	*b*	SE	*b*	SE
Fixed effect				
Intercept	**56.021*** **	3.408	**56.482*** **	3.271
Level 1-Individual				
Pre-test	**0.284*** **	0.033	**0.287*** **	0.033
Age	**0.686** **	0.205	------	------
Gender	**-1.135***	1.180	-1.186	1.169
Level 2-Classroom				
Intervention	**6.436***	2.962	**6.775***	2.645
Diff-ECERS-E	**-4.979**	2.590	**-4.328***	1.820
Diff-SSTEW	1.778	1.350	**2.702***	1.075
Teacher qualification	2.469	2.418	2.658	2.454
Teacher degree	0.117	1.629	0.058	1.632
Children-to-teacher	0.240	0.319	0.272	0.316
Teacher Age	0.438	0.970	0.542	0.974
Classroom level moderators				
Intervention × Diff-ECERS-E	0.677	3.414	------	------
Intervention × Diff-SSTEW	2.260	2.183	------	------
Child level moderator				
Intervention × Age	------	------	-0.619	0.389
Variance components				
Level 1-individual	**218.395*** **	15.465	**215.281*** **	16.217
Level 2- classroom	**18.452***	7.431	**19.040***	7.716
Model summary				
Within-level R^2	**0.148*** **	0.025	------	------
Between-level R^2	**0.466** **	0.153	------	------
AIC	4565.905		4564.137	

6.5 Chapter Summary

This study included a post-test conducted in 95 classrooms, with 48 classrooms in the intervention group and 47 classrooms in the control group. To examine the main effects and moderation of PD on classroom quality measured by ECERS-E and SSTEW, multilevel modelling was conducted. Results indicated that PD had a significant impact on the total average scores of ECERS-E and its four subscales, which include literacy, math, science, and diversity. Specifically, classrooms in the intervention group had significantly higher ECERS-E scores than the control group, suggesting that the PD programme significantly improved classroom quality. With respect to the moderators, school type and district level moderated the association between intervention and ECERS-E literacy, suggesting that private and district-level kindergartens received less impact from the intervention. Moreover, school location and teachers' degrees negatively moderated the effects of the intervention on ECERS-E science. Specifically, classrooms in sub-urban areas and equipped with lower-degree teachers received more impact from the PD intervention on science quality.

In terms of the effects of the PD intervention on classroom quality, as measured by the SSTEW scale, the results of the multilevel analysis demonstrated significant positive impacts of the intervention on the total average scores of SSTEW and its five subscales, indicating a significant improvement in the quality of teacher-child interactions. Additionally, school type was found to moderate the effects of the PD intervention on the SSTEW Assessing subscale, with public kindergartens exhibiting a greater impact from the intervention on Assessing than private kindergartens. These findings provide important insights into the potential for PD interventions to enhance classroom quality, as well as the role of school type in shaping the effectiveness of such interventions.

In terms of the PD impacts on child development, multilevel modelling and RMANOVA analysis were conducted to examine the main effects and moderation of PD on

child development measured by IDELA. Results indicated that PD had a significant impact on children's emergent literacy, numeracy, and executive function skills. Specifically, children in the intervention classroom had significantly higher literacy, numeracy, and executive function scores than the control group, suggesting that the PD programme significantly improved children's cognitive development.

Chapter 7 Qualitative Results: Teachers' Perceptions of the PD

Teachers from the intervention group were invited to complete a questionnaire to explore the effects of PD training and the influencing factors. The questionnaire included open-ended questions related to perceived changes, the influencing factors, difficulties and challenges teachers met in the PD process and their perceptions of the PD contents. Teachers got around 45 minutes to complete the questionnaires at the end of all PD training. As shown in Table7.1, eighty-two teachers completed the questionnaire, resulting in a 72.57% response rate. Of the participants, 36 were senior teachers and 46 were assistant teachers.

Table 7.1

Teachers' demographic information

Teachers' characteristics	Number
Role	
Senior teacher	36 (43.90)
Assistant teacher	46 (56.10)
School type	
Private kindergartens	33 (40.24)
Public kindergartens	49 (59.76)
School classification	
District level	24 (30.00)
City level	34 (41.46)
Province level	24 (29.27)

Thematic analysis was conducted to analyse teachers' answers and filter emerging themes for exploring teachers' perceived effects and the influencing factors. Regarding the influencing factors, we employed the Model of Change (Egert et al., 2018) as the coding scheme and investigated the factors in the "what", "how", and "who" framework. To explore the perceived impacts, the Model of Change (Egert et al., 2018) was used as the coding scheme. The perceived impacts were analysed in three parts, including teacher outcomes, classroom outcomes, and child outcomes. More details of the data analysis can be found in Chapter 5.

7.1 Teachers' Perceived Effects of the PD Programme

7.1.1 Teachers' Outcomes

Realising weaknesses and improving learning motivation. According to the results of the survey, the PD programme has yielded positive outcomes for the participating teachers. Specifically, as shown in Table 7.2, the PD programme supported them in identifying areas of weaknesses in their teaching practice (N = 12) and their lack of theoretical knowledge (N = 5). In addition, the programme facilitated teachers' regular self-reflection (N = 3) and motivation to learn (N = 8). Prior to the implementation of the PD programme, teachers had perceived a disconnection between theoretical learning in universities and their practical experience in kindergartens. However, the PD programme addressed this issue by presenting practical examples and discussing the underlying theoretical rationales. As a result, teachers were able to see the relevance between theory and practice, leading to increased interest in reading books, joining in continuing education, and reflecting on their teaching behaviours and language use.

Table 7.2 Teachers' perceived impacts on teaching weaknesses and learning motivation

Theme	Codes	Number of teachers	Quotations
Realising teaching weaknesses and improving learning motivation	Teaching weakness	12	*The mentors provided feedback on one of our daily activities. This helped us gain a clearer understanding of the challenges that we still face in our daily teaching and allowed us to make appropriate adjustments [8-AT].*
	The lack of knowledge	5	*Prior to the training, I used to strictly follow the weekly lesson plans when delivering teaching and guidance. However, after receiving the training, I realized that my thinking was too narrow and that the current curriculum and daily teaching activities were too restrictive for children [42-AT].*
			Prior to enrolling in the teacher training program, I believed that practical experience was more valuable than theoretical knowledge in becoming a professional kindergarten teacher. I held the view that theories presented in books were often different from the actual practice. However, my perspective has changed significantly since joining the program. I now understand the importance of combining practical experience with a solid foundation of theoretical knowledge to become a skilled and professional early childhood teacher. As such, I am motivated to work hard and continue learning more theories in this field [13-ST].
	Regular self-reflection	3	*Using rating scales in daily life and teaching activities benefit my practice by creating standardized, measurable activities. Reflection on these activities allows for timely improvements, enhancing teaching quality and encouraging continuous improvement [20-ST].*
	Motivation to learn	8	*During the upcoming summer break, I plan to dedicate time to reading books focused on effective communication with young children [46-AT].*

Note: AT = Assistant teacher, ST = Senior teacher.

As reported by these teachers, teachers were able to identify their areas of weakness both in theoretical knowledge and practical skills and were motivated to engage in activities aimed at improving their performance. These activities included reading professional literature, using quality rating scales to evaluate their own teaching, and participating in continuing education programmes to achieve higher qualifications.

Child-friendly awareness. Thirty teachers reported changes in their approach to interacting with young children, as outlined in Table 7.3. Specifically, teachers began to adopt a child-friendly perspective ($N = 6$), incorporating children's opinions and need into lesson planning and activities ($N = 8$), paying attention to children's needs ($N = 7$), and adjusting the activities according to children's interests (N = 3). Additionally, teachers began to create a more engaging classroom environment by displaying children's learning progress on the walls instead of relying on teacher-made decorations (N = 6). To further involve children in their learning experience, teachers invited them to participate in setting up the classroom environment and regularly updated learning materials to align with their interests.

Table 7.3

Teachers' perceived impacts on child-friendly awareness

Theme	Codes	Number of teachers	Quotations
Child-friendly awareness	Think from children's perspectives	6	*I can better understand the behaviour of the children now. A child in my class did not stand in the queue because he was short and unable to see the front. I made an adjustment that enabled them to line up successfully. This has allowed me to build more positive relationships with children by considering their perspective rather than just an adult's perspective [70-ST & 4-ST].*
	Value children's opinions	8	*when planning to review rhythm or music, I ask the children which songs or rhythms they would like to sing. By giving children leadership roles in their own learning, I provide them with opportunities and environments that encourage independent learning rather than just directing their learning [22-AT & 63-ST].*
	Respect children's needs	7	*I develop individualized plans that cater to each child's unique learning needs, offering a variety of activities that are tailored to their interests and developmental stages [34-ST].*

Make adjustments according to children's interests	3	*I prioritise children's interests and hobbies in my teaching and make adjustments to the curriculum when necessary [75-AT].* *When the learning-centre activities fail to engage young children, I modify the layout and design to better stimulate their curiosity and interest in learning [25-ST].*
Engage children in setting classroom environment	6	*The classroom environment has become more child-centred, with traces of children's growth and development. Children are involved in the process of setting up the environment, such as making signs for different learning areas and discussing classroom rules. Teachers encourage children to record their experiences to create a more personalised and meaningful learning environment [39-AT, 82-AT & 61-ST].*

Note: AT = Assistant teacher, ST = Senior teacher.

According to teacher feedback, a child-friendly approach was adopted, such as empowering children to take the lead in event planning, involving them in setting up the classroom environment, and prioritising the child's point of view.

Obtaining knowledge of content and effective instruction. According to the responses of 27 teachers, their knowledge of effective instruction, child development, and teacher-child communications has been enhanced. As shown in Table 7.4, the participating teachers exhibited a deep understanding of educational theories and domain-specific knowledge. Specifically, 11 teachers reported gains in their understanding of educational theories and domain-specific knowledge, while 16 teachers emphasised the importance of effective interactions, sustained shared thinking, and teacher-child communications in the classroom. Notably, these practices were informed by teachers' professional knowledge, which they have developed over time through ongoing learning and development. After receiving the PD training, teachers became more sensible in seizing spontaneous teachable moments and engaging children in meaningful discussions, thereby fostering children's active learning.

Table 7.4

Teachers' perceived impacts on knowledge

Theme	Codes	Number of teachers	Quotations
Obtained more knowledge in child development and instruction	Theoretical knowledge in Child development	11	*My educational beliefs have undergone a significant transformation due to my increased knowledge and understanding of emergent literacy development. Prior to my recent learning experiences, I held the belief that emergent literacy was best suited for K3 classrooms, which typically serve 5-6-year-old children. However, my expanded knowledge on the subject has revealed that emergent literacy can and should be integrated into the daily lives of young children of all ages, though the specific instructional goals may vary depending on the age group in question [52-AT & 60-ST].* *I have a more specific understanding of some professional theoretical knowledge, and I can better apply it to my work [65-ST].*
	Effective interactions and sustained shared thinking	16	*My knowledge of early childhood education is becoming richer and clearer. Through the trainers' explanations, I have gained a better understanding of effective teaching methods and sustained shared thinking [14-AT & 32-ST].* *The training has been immensely helpful to me, as it has equipped me with practical strategies for learning alongside children during different activities and interactions. I have learned effective communication techniques. [36-AT].*

The PD programme provided teachers with instructional and content knowledge related to literacy, numeracy, science and social emotion. Through the use of video demonstrations, teachers were able to observe effective teaching practices and subsequently engage in discussions and implementation activities to develop a deeper understanding of the material (Salisu et al., 2014). These findings suggest that combining traditional lecture-style instruction with modelling and practical applications can effectively facilitate teachers' comprehension and application of PD content.

Instructional behaviours. As shown in Table 7.5, thirty-nine teachers reported their changing behaviours, including increased use of sensitive responses ($N = 8$), open-ended questioning ($N = 15$), meaningful language use ($N = 6$), and extending children's expression and thinking ($N = 10$). Moreover, the training programme enabled teachers to identify unintentional teaching habits that may negatively impact child development, such as using

overly restrictive language (e.g. “don’ts”) or providing only general, non-specific praise (e.g. “that is good”). After recognising these habits, teachers became more conscious of taking action to avoid them and promote a more positive and supportive learning environment.

Table 7.5

Teachers’ perceived impacts on instructional behaviours

Theme	Codes	Number of teachers	Quotations
Instructional behaviour	Sensitive response	8	*I would give the child more specific praise rather than giving a brief sentence that you are awesome [4ST & 21-AT].* *To a child chatting in a group activity, I say to him, “I know you want to share your thoughts (with others), but it would be better if you could raise your hand and answer.”[16-AT]*
	Open-ended questions	15	*When children are playing, I will join in more naturally. I will ask open-ended questions to guide children to think [74-AT].* *I will use open-ended questions to ask young children and encourage interaction between children [80-ST].*
	Language use	6	*When I interact with children, I will pay more attention to improving children’s vocabulary and improving their existing experience [58-ST].* *I will pay more attention to the language expression of conversations with children, and I will provide more opportunities for children to participate in teaching activities to discuss and express their ideas [62-ST].*
	Extending children’s thinking	10	*In the past, when I read picture books or had daily conversations with the children in my class and even my children, the interaction was straightforward. Since the Oxford project team has trained me, I will use inspiring language and discussion in my daily teaching [56-ST].*

After several years of teaching, educators may unintentionally adopt habitual teaching practices, particularly when faced with time-sensitive teaching situations requiring quick decisions (Tigchelaar & Korthagen, 2004). In the absence of external observation and feedback, these habits can become deeply ingrained, making it difficult for teachers to reflect on and evaluate their teaching practices. However, regular classroom visits and associated feedback help teachers to intentionally reassess their practices and make changes. Additionally, these visits can help to establish a personal commitment between mentors and teachers, which in turn can help to sustain these changes over time (Elmore & Burney, 1997).

Intentional pedagogy. According to feedback from 32 teachers, participation in PD training led to an increased purposefulness in identifying and capitalising on teachable moments to enhance children's learning. Specifically, as shown in Table 7.6, teachers reported more deliberate guidance of learning ($N = 8$), explicitly stated the learning objectives and organisational strategies in their lesson plans ($N = 9$), and were more adept at sensing and seizing upon teachable moments ($N = 15$). Prior to the training, children's learning opportunities were largely limited to teacher-directed activities such as group tasks, morning talks, and learning-centred activities. However, following the training, teachers reported a heightened awareness of how to promote children's development through meaningful responses to their spontaneous inquiries.

Table 7.6

Teachers' perceived impacts on intentional pedagogy

Theme	Codes	Number of teachers	Quotations
Intentional pedagogy	Clear learning objectives	8	*During the activity, I will focus more on my words and behaviours in interacting with my children. In each part of the daily routine, I will think more about what kind of education can penetrate each activity. For example, when playing outdoors, I will intentionally guide the children to count the instruments, arrange the materials according to the spatial orientation, feel the characteristics of natural materials, etc. [4-ST & 64-ST].* *In the daily routine, I will guide the children more purposefully. For example: in the learning-centre activities, I will consciously support children in all areas; I will read with the children after lunch every day; when children have conflicts, I take the initiative to guide children to express their feelings to teachers and peers, and guide children to solve problems by themselves [18-AT].*
	Purposeful and comprehensive teaching plan	9	*Previously, my teaching had no goals. Now, I integrate all aspects of learning in the five learning areas into weekly and monthly plans [82-AT].* *I will indicate in the educational plan that the learning activities are carried out with group activities or individual instruction to make my instruction more purposeful [6-ST].*
	Be able to sense and seize teachable moments	15	*I learned to find educational opportunities from children's actions and expressions. I will also consciously guide children to observe scientific phenomena in nature and daily life. When children find something they are interested in, I will search for relevant information on the internet and then learn together [76-ST & 37-ST].* *I pay attention to introducing mathematics into children's daily life. For example, pay attention to the numbers around us: read the page number of the book, recognize the serial number in the step diagram, etc. [23-ST].*

As a result of participating in the PD intervention, teachers demonstrated increased thoughtfulness and purposefulness in their approach to teaching. Specifically, they began to act with greater intention and knowledge, actively seeking out and taking advantage of teachable moments as they arose during daily routines, even when unplanned. By doing so, teachers were able to ensure that children were consistently gaining knowledge and deepening their understanding in various contexts.

7.1.2 Classroom Outcomes

Providing diverse content-related and provocation materials. Feedback from 61 teachers indicated significant changes in their classroom materials following participation in the intervention. As shown in Table 7.7, These changes included an increase in the presence of printed materials throughout the environment ($N = 16$), science equipment ($N = 10$), math books and materials ($N = 3$), and displays designed to challenge gender stereotypes or promote gender diversity ($N = 6$). In addition to providing diverse learning materials across various domains, teachers also made a conscious effort to create learning provocations within the classroom environment that would inspire children to engage with the materials and stimulate critical thinking. Examples of these provocations included displaying children's learning processes on the classroom walls ($N = 5$) and encouraging children to take an active role in setting up and interacting with the learning environment ($N = 15$). By incorporating materials with purposeful content knowledge, educators were able to cultivate greater interest and engagement among children, while also providing more opportunities for concept development across various learning domains through collaboration with students during the use of the learning materials.

Table 7.7

Teachers' perceived impacts on classroom materials

Theme	Codes	Number of teachers	Quotations
Learning materials	Display children's learning process	5	*I will ask more open-ended questions in the teaching sessions, and I will record the discussions with the children and show them in the classroom display [80-ST].* *The classroom presents the children's learning process and results, rich materials and so on [2-ST].*
	Children as active participants in the environment	15	*Children will be invited to create the environment [7-ST].* *The classroom environment is created by teachers and children together, and the walls are the learning process of children. Children know that the content of the wall will interact with the wall so that children can recall what they have learned [44-AT].*
	Literacy area	16	*In teaching practice, we made adjustments to the pre-writing. After we added relevant whiteboards and other materials to the writing area, we found that children became increasingly interested in pre-writing and began to carry out pre-writing-related activities independently [62-AT].*
	Science area	10	*The materials in different learning areas can meet the basic development goals of children in various subjects. For example, we provide magnifying glasses, measuring cups and other laboratory utensils in the science area to help children develop their observation and experimental manipulation abilities. We provide pictures of seed, germination, bloom and fruit to help young children understand the growth process of plants in life sciences [3-AT & 23-ST].*
	Math area	3	*I put books on mathematics in the math area, and the children are very interested [13-LT].* *I provide children with a wealth of mathematics and science materials, and provide a wider variety of books [26-AT].*
	Diversity	6	*Materials in the learning area are constantly updated; dolls of different races have been added. Diverse photos and books that break gender stereotypes—showing images of boys taking care of babies and pictures of girls' construction process- were also provided [9-AT & 18-AT].*
	General changes	7	*According to the class situation, I made adjustments to the creation of the class environment and the delivery of class materials. Appropriate materials are added to the area to make children more interested in regional games [25-ST].*

Following the acquisition of the content knowledge in the areas of literacy, numeracy, science and diversity, teachers made efforts to provide a range of materials across various domains in order to accommodate the diverse skills, interests, and characteristics of their

students. Notably, feedback from educators also indicated a focus on promoting diversity in the classrooms. Some teachers intentionally empowered students of different races and genders by providing anti-biased materials such as dolls representing diverse ethnicities and books that challenged gender stereotypes.

Domain-specific quality in literacy. Thirty-eight teachers reported changes in their provision of literacy materials and instructions. Specifically, as shown in Table 7.8, 15 teachers augmented the availability of books within reading areas and initiated a daily reading routine with children. Additionally, 19 teachers mentioned their efforts in promoting children's ability to identify words in their surroundings. Thirteen teachers acknowledged the significance of demonstrating the writing process and providing support for children's emergent writing.

Table 7.8

Teachers' perceived impacts on domain-specific quality in literacy

Theme	Codes	Number of teachers	Quotations
Literacy	Reading	15	*I used to tell stories by showing a book or PowerPoint, but now I ask children why things happened to make them think and use different materials. This creates a more interactive and engaging experience than just speaking [39-AT].* *I encourage young children to read everyday [9-AT & 18-AT].*
	Word recognition	19	*Pay attention to labelling accessible objects in the environment and creating a textual environment. During the morning talk, I will present the children's discussion contained in the form of text [23-ST & 24-AT].* *I had not previously guided children to observe the structure of words, and as a result, they have had limited exposure to Chinese characters [27-AT].*
	Emergent writing	13	*In my teaching practice, I am mindful of potential training content. For emergent writing, I transcribe children's oral language during morning talk onto the whiteboard and allow them to observe my writing process [81-AT].* *Through pre-writing training, K1 teachers will intentionally document children's language development. By incorporating regional or artistic educational activities, we aim to enhance children's pre-writing skills, honour their symbolic representation, and encourage self-expression through writing to enrich their understanding [69-ST].*

Before participating in the PD programme, teachers could not differentiate between supporting children's emergent literacy skills and formal instruction in word recognition and

writing. They often resorted to using word games or flashcards, as they perceived emergent literacy as rote learning and repetition of reading and writing. However, after acquiring content and pedagogical knowledge through the PD programme, teachers began to prioritise engaging children in recognising print in the environment and developing their word awareness through high-quality interactions. As a result, they incorporated more activities, such as talking, reading, drawing, and writing, into children's daily routines. Additionally, teachers utilised reading and book-related activities to enhance children's vocabulary and print awareness. Finally, scribbling and drawing were encouraged to help children understand the meaning of emergent writing and labels.

Domain-specific quality in math. As shown in Table 7.9, twenty-eight teachers reported changes in providing mathematics materials and math instruction, such as incorporating various math activities into morning talks ($N = 5$), using new instructional strategies ($N = 4$), developing children's mathematical concepts based on teacher observation and documentation ($N = 12$), and providing more math books ($N = 6$). Before the PD intervention, teachers primarily focused on counting and number activities, while geometry and measurement were often overlooked. Moreover, teacher-child interactions related to mathematics were mainly limited to planned or teacher-directed activities, with teachable moments during learning-centre activities, snack time, and outdoor or indoor play often being ignored. However, after participating in the PD programme, teachers extended their content knowledge on math and became more purposeful educators. Currently, teachers pay great attention to documenting teachable moments to scaffold children's math concepts in their daily routines.

Table 7.9

Teachers' perceived impacts on domain-specific quality in math

Theme	Codes	Number of teachers	Quotations
Domain-specific quality in math	More math instruction in the morning talk	5	*As an example, during morning talks, I encourage children to count and discuss the date of yesterday and tomorrow [16-AT].* *Incorporate math into morning talk [48-AT].*
	Instruction skills	4	*I now provide more focused guidance in learning centres, particularly in helping children identify shapes, which is often overlooked [12-AT].* *Foster children's understanding of the properties of various shapes and their application in different contexts [73-ST].*
	Encourage spontaneous math learning	12	*Prior to the training, I typically taught math during the morning talk. However, after making adjustments, I now also spontaneously incorporate math instruction throughout the day. For instance, I may ask children to count the number of boys and girls while they are waiting in line. Through repeated practice, children clearly understand the number of boys and girls in the class [22-AT].* *I have learned to support children's mathematical development in daily life, such as encouraging them to write the date while painting and promoting comparison and classification when observing water glasses [34-ST].*
	Mathematic books	6	*Previously, there were limited math books available, but now we have added more relevant picture books [77-ST].* *Placing math-themed books in the math area has piqued children's interest in mathematics [13-ST].*

Teachers' feedback indicated that they provided children with more opportunities to experience a variety of math concepts and used more scientific equipment to support children's exploration of math in the classroom. Children's math learning was also integrated into their daily activities rather than being limited to specific math activities.

Domain-specific quality in science. As shown in Table 7.10, around 40 teachers reported changes in their approach to science activities and the use of scientific materials. Some teachers (N = 12) increased outdoor explorations, encouraging children to make real-world discoveries in their natural environment to support their conceptual development. Other teachers (N = 6) focused on building children's scientific concepts by connecting them with their daily experiences. During science activities, some teachers (N = 5) recognised the

importance of extending children's thinking based on their natural curiosity rather than just following pre-planned science activities. Additionally, teachers (N = 12) provided the science learning area with various scientific equipment and natural materials to help children understand specific scientific concepts.

Table 7.10

Teachers' perceived impacts on domain-specific quality in science

Theme	Codes	Number of teachers	Quotations
Domain-specific quality in science	Exploring natural environment	12	*I am better at understanding the interests of young children and making scientific observations in daily life. During morning talks, I now pay more attention to guiding children to compare the weather inside and outside the kindergarten [76-ST & 43-ST].* *In the field of science, teachers encourage children to explore and discover, and they don't avoid activities that involve observing insects such as bugs [38-AT].*
	Encourage spontaneous math learning	5	*In outdoor activities, I will take the initiative to guide children to observe natural materials and environments. We may explore the vegetable patch and learn about life sciences by observing the growth of plants and the insects that visit them [41-ST & 42-AT].* *I am better at grasping the interests of young children and providing timely scientific observations and guidance in daily life [76-ST].*
	Emphasizing scientific concept	6	*There are times when children show great interest in certain scientific phenomena, but I may not have a clear explanation at that moment. In those instances, I feel that my own knowledge is insufficient and that I have much more to learn [45-AT].* *Now our class has group activities every day. In the group activity teaching plan, we will be more conscious of adding science experiments and explaining scientific concepts [9-AT].*
	Scientific equipment	12	*The science area has been reorganised, with materials arranged based on different scientific concepts. There are now more natural materials available for children to freely observe and interact with [16-AT].*

Before the PD intervention, many teachers had reservations about conducting science activities due to their lack of content knowledge and understanding of scientific concepts. They often viewed science activities as strictly experimental exercises that required a significant amount of equipment to support children in obtaining correct answers. This, in

turn, required a great deal of preparation and classroom management skills. Additionally, teachers felt uneasy when confronted with children's questions about scientific phenomena that were beyond their knowledge and expertise, which made them question their professionalism. However, after participating in the PD programme, teachers were able to see the value in promoting sustained shared thinking in the exploratory process rather than solely focusing on the results of experiments. They also learned to support children's spontaneous exploration beyond structured science activities. As a result, teachers became more open-minded and willing to explore new concepts with their students, even when the topics were previously unfamiliar to them.

Domain-specific quality in diversity. Notably, as shown in Table 7.11, ten teachers reported progress in advancing gender and racial equality after receiving the training. Before the training, boys and girls in their classrooms were always segregated into separate lines when queuing, and they were assigned different coloured name tags and activities based on their genders. For example, girls' names were on pink stickers, while boys used blue labels. Boys were given more challenging climbing frames to play with, while girls were only given shorter frames. As a result, the drawing and family play areas were dominated by girls, while boys dominated the construction areas. Additionally, preschools paid little attention to race or ethnic diversity, with few diverse figures in their classrooms. The PD programme on diversity enabled some teachers to realise the existing stereotypes in classroom settings and encouraged them to challenge traditional expectations associated with particular genders (N = 2). They decorated the classrooms with characters from different races or ethnicities (N = 8) and paid attention to children's individual needs (N = 4).

Table 7.11

Teachers' perceived impacts on domain-specific quality in diversity

Theme	Codes	Number of teachers	Quotations
Domain-specific quality in diversity	Breaking gender stereotypes	2	*To break gender stereotypes, we are no longer emphasising gender divisions in queues and encouraging girls to participate in traditionally male-dominated activities, such as difficult physical challenges, while also encouraging boys to participate in traditionally female-dominated activities, such as playing with dolls, cooking, and babysitting [28-AT].* *I had an experience teaching young children to draw and noticed that boys tended to use cooler colours while girls preferred warmer colours like pink and red. When I asked about it, a child told me that pink was a girl's colour. This made me realise the lack of guidance on gender equality and awareness in early childhood education [38-ST].*
	Minority and other ethnic figures	8	*We placed ethnic costumes in the performance area and noticed that many children were interested in wearing them [44-AT].* *Added ethnic and national skin tone puppets and decorations [77-ST].*
	Children's individual needs	4	*Listen to the opinions and suggestions of children, and be more patient and loving with children. Every child is a different individual [75-AT].*

In summary, some teachers have become aware of their role in reinforcing gender stereotypes and are making efforts to challenge them by encouraging more inclusive behaviours, such as inviting girls to play in traditionally male-dominated areas and encouraging boys to engage in domestic play. Teachers are also promoting racial diversity by incorporating dolls and figures from different cultures into the classroom environment. However, they may need further support in implementing instructional strategies that promote diversity, which is a weakness in Chinese kindergartens that requires further exploration.

Domain-specific quality in social emotion. As shown in Table 7.12, Twenty-one teachers reported their improvement in supporting children's social-emotional development. Eight teachers shared that they paid more attention to children's feelings, three teachers

would like to encourage children to express their feelings and needs, five teachers showed more sympathy and understanding of children's emotions, and five teachers reported having an agreed procedure in solving conflicts.

Table 7.12

Teachers' perceived impacts on domain-specific quality in supporting social emotion

Theme	Codes	Number of teachers	Quotations
Domain-specific quality in social emotion	Pay attention to children's feeling	8	*For example, I would not pay so much attention to children's emotions and did not take the initiative to help children sort out their feelings before. After training, I can know more clearly how to help children sort out their feelings [10-ST].* *I will pay more attention to the children's emotions according to the guidance of the mentors [28-AT].*
	Encourage children to express their feelings	3	*For example, check item 5.1 to encourage children to express their feelings and needs. In my daily life, I pay more attention to children's emotions and encourage children to express their emotions. For example, when children conflict with their peers, let them express their emotions! [77-AT]* *When I solve problems, I will first listen to the children's feelings, let them speak out, and then solve the problem [21-AT].*
	Empathy with children	5	*I've had some changes in (supporting) sociality. For example, I show sympathy and understanding to young children when they do not want to follow the rules or are upset. For example, during physical activities, the physical fitness teacher will invite some children to demonstrate the game's rules, and the children who are not invited will be disappointed. I will tell them that I know they want to show. But, we have to respect others and listen to others [66-AT].* *I will understand and recognize children's emotions and behaviours more [7-ST].*
	Conflict resolution	5	*I will now pay attention to the emotions of young children, and I will control myself to reduce the number of "no" and use more positive language to communicate [8-AT].* *When children have conflicts, I used to solve them according to the teacher's ideas. When I encounter this situation, I will use the methods I have learned to solve it [49-AT].*

Before the PD training, many teachers usually ignored emotional support and misunderstood emotional support as ensuring children are happy since they labelled the negative emotion as "bad" and hoped to get children to avoid bad moods without understanding how. They focused on conflict resolution rather than comforting children's

feelings during the process. After the training, teachers had a deeper understanding of social-emotional wellbeing, accepted diverse emotions, and encouraged children to express their feelings, showing more empathy towards them.

Teacher-child relationship. As shown in Table 7.13, after applying the knowledge gained from PD training, 14 teachers reported positive teacher-child relationships in their classrooms. Children felt closer to teachers and viewed the classrooms as a safe and supportive learning environment. For example, teachers reported that children in their classrooms became more willing to communicate with them (N = 4), developed closer relationships with teachers (N = 4), and actively invited them to play games or share discoveries with teachers (N = 7).

Table 7.13

Teachers' perceived impacts on teacher-child relationship

Theme	Codes	Number of teachers	Quotations
Teacher-child relationship	Close relationship	4	*In the past, several children were terrified of their teachers and lacked confidence in all areas. However, after my individual interactions with them, which involved acknowledging their behaviours and affirming their improvements, they gradually began to enjoy interacting with their teachers and going to kindergarten [7-ST].*
			This training is highly beneficial, with systematic and targeted content. I am particularly impressed by the suggestions and methods provided by the mentors. Applying these strategies has significantly improved the relationship between the children and me [51-ST].
	More communication	4	*Children like to chat with me now [56-ST].*
			The children have developed a closer relationship with the teacher, and they now feel comfortable communicating with the teacher when they encounter any problems [21-AT].
	Play together with children	7	*Whenever they come across something interesting or surprising, they enthusiastically invite their teachers to observe it together. [61-AT].*
			During playtime, children actively invite their teachers to participate in games, leading to more effective peer interactions [10-ST].

According to teachers' feedback, children are more likely to engage in learning when they trust their teachers and receive emotional support, comfort, and encouragement from

them. On the contrary, a lack of supportive teacher-child relationships may reduce teacher-child interactions, resulting in disengagement from learning activities.

7.1.3 Child Outcomes

Active learning attitudes. Fifteen teachers in our study reported observing a marked increase in their students' engagement as active learners. As shown in Table 7.14, they (N = 6) reported that children were more inclined to interact with their learning environment, exhibiting greater curiosity in the classroom displays and actively observing and exploring the natural world. Additionally, eight teachers reported observing heightened levels of student engagement in both communication and critical thinking. Students were more likely to ask questions, discuss their discoveries, and provide thoughtful answers to teacher inquiries.

Table 7.14

Teachers' perceived impacts on children's active learning attitudes

Theme	Codes	Number of teachers	Quotations
Active learning attitudes	Interact with the environment	6	*Children naturally interact with their environment and pay attention to the words in the classroom, including the names of their peers [20-ST].*
	Actively ask questions	8	*When presented with new materials in their environment, children often explore and ask questions to satisfy their curiosity [31-AT].* *Children's interest in the natural environment often deepens through their participation in daily activities. For instance, they may observe slugs on the playground after rainfall. During outdoor activities, children may discover small insects and actively observe and inquire about the insects' names from their teachers [18-AT].* *Young children are often proactive in expressing and communicating their thoughts and ideas. They demonstrate a natural inclination towards sharing their observations as they witness changes and developments in their environment [46-AT].*

The cultivation of active learners is facilitated by teachers providing children with choices and autonomy in selecting their activities, topics of discussion, questions to ask, and materials to use. As a result, children become more attuned and inquisitive about their

environment, taking the initiative to engage with their teachers. Teachers' responsiveness to their needs and provision of enriched learning materials further foster children's curiosity and eagerness to learn.

Developed social-emotional skills. Twelve teachers have reported that children made positive changes in their social-emotional skills, such as expressing their emotions, regulating negative emotions, collaborating with others, and using problem-solving strategies instead of crying when faced with challenges. As shown in Table 7.15, five teachers noticed an improvement in their children's ability to express their feelings, while four teachers observed a decrease in emotional instability and crying. Additionally, three teachers reported an improvement in children's collaborative skills.

Table 7.15

Teachers' perceived impacts on children's social-emotional development

Theme	Codes	Number of teachers	Quotations
Children's social-emotional development	Express feelings	5	*The most notable impact observed among children was their improved ability to express their emotions. Once they were able to regulate their feelings, they proactively approached teachers to discuss their past behaviour and developed plans for the future [10-ST].*
	Stable emotions	4	*When faced with challenges or difficulties, children demonstrate a shift towards problem-solving strategies as opposed to crying, indicating development of resilience and self-efficacy [35-AT].*
	Collaborative skills	3	*Children have made significant progress in social skills and manners. Teachers play an essential role in interacting with children so that children can learn and play in a relaxed and pleasant environment [44-AT].*

The improved literacy skills. As shown in Table 7.16, eleven teachers have reported improvements in children's literacy skills. Specifically, four teachers observed an increase in children's interest in reading, three teachers noticed an improvement in children's symbolic-making and emergent writing skills after increasing the frequency of verbal reminders, and four teachers found that their children began to recognise and compare character structures

among different words. These results demonstrate the positive impact of teacher interventions on children's literacy development.

Table 7.16

Teachers' perceived impacts on children's literacy development

Theme	Codes	Number of teachers	Quotations
Emergent literacy skills	Interest in reading	4	*The Innocent World reading area was not very popular before, and children didn't like to go there. However, after I added photos, told stories to young children, and performed with them, both boys and girls are now eager to go [21-AT].* *The adjustment of the reading area and the increase in the number of books have greatly improved children's reading interest [19-ST]*
	Emergent writing	3	*Encouraging and supporting young children to record their thoughts can be very beneficial. For example, during science activities, children can record their empirical findings when performing experimental operations. Previously, some of them didn't know how to write, but now they can assign roles independently and record their observations [25-ST].* *There are more effective pre-writings for young children [14-AT].*
	Word recognition	4	*For example, children will now be more conscious about asking for the title and author's name of a book and paying attention to similarities among certain words [24-AT].* *Children can naturally pay attention to the words in the classroom environment and the names of their peers [20-ST].*

It is worth noting that the introduction of diverse books into reading areas has been found to positively impact children's interests and skills in emergent literacy. Additionally, the implementation of text labels in classroom environments has been shown to encourage children to identify print in their surroundings, which can support their mark-making in learning activities. As such, intentional guidance from teachers has the potential to transform children into active and engaged learners in the realm of literacy.

7.1.4 School Outcomes

Inspiring colleagues' changes. Forty-one teachers reported that their teaching behaviours sparked curiosity and discussions among their colleagues and led to

improvements in their colleagues' teaching practices. As shown in Table 7.17, seven teachers reported that their colleagues were particularly admired for their effective teaching strategies and their students' progress. Additionally, eight teachers reported that their colleagues expressed a desire to imitate their teaching behaviour and sought guidance from trained teachers when facing teaching challenges. Furthermore, seven teachers shared their experiences by giving lectures or hosting classroom visits at kindergartens to disseminate the knowledge they gained from the training programme. Twelve teachers engaged in further discussions with their colleagues about the use of rating scales and strategies for enhancing teacher-child interactions. Lastly, seven teachers observed positive changes in the behaviours and communications of their colleagues regarding teacher-child interaction.

Table 7.17

Teachers' perceived impacts on their colleagues

Theme	Codes	Number of teachers	Quotations
Inspire colleagues to change	Colleagues' curiosity and reflection	7	*Other colleagues will pay attention to the changes in my classroom and ask related questions. They may also implement suitable changes in their own classes [46-AT].* *I changed the negative introductory language to use the positive introductory language. Other colleagues are very curious about our change this time and will ask us why [43-ST].*
	Learn from and imitate each other	8	*After observing the environment in my classroom, my colleagues made adjustments to their own classrooms. They incorporated a combination of text and pictures to enhance the learning environment [16-AT].* *Teachers imitate and learn from each other [7-ST & 3-ST]*
	Share learning content with colleagues	7	*My colleagues have expressed admiration for my progress in fostering sustained shared thinking and emotional development. They have asked me to share my experiences with them. In response, I integrated what I had learned from the training and shared it with my colleagues [28-AT & 58-AT].*
	More discussion with colleagues	12	*When we do the lesson plan, I can have a deeper discussion on the scale with my colleagues in the experimental classrooms [17-AT].* *My colleagues have expressed admiration for our progress in fostering sustained shared thinking and emotional development, as well as in teaching counting and its applications to young children. They have asked us to share our experiences with them [28-AT].*

Colleagues' teaching behaviours	7	*My colleagues have been inspired to pay closer attention to children's emotions, expressions, communication, and scaffolding as a result of our progress. They are now more attuned to these aspects of teaching and learning [73-ST]*

The improvement in teachers' teaching behaviours was widely recognised and commended by colleagues in the same kindergarten. Principals and curriculum coordinators invited trained teachers to share their experiences in professional meetings and facilitated classroom observations by other teachers seeking to learn from their practices. Positive changes in children's academic performance, teaching behaviour, and classroom environment were also noted by colleagues, who actively sought to learn from their trained peers. This underscores the potential for trained teachers to inspire improvement among colleagues and to foster a culture of learning within kindergartens.

7.2 Teachers' Perceived Influencing Factors of the PD Impacts

7.2.1 The "What" Components of the PD Programme

The participating teachers demonstrated a strong appreciation for high-quality PD content with diverse areas of focus. Specifically, the PD content provided opportunities for teachers to enhance their pedagogical knowledge and skills in literacy, numeracy, science, self-regulation, diversity, child assessment, scaffolding, and sustained shared thinking. As shown in Table 7.18, twenty-two teachers found the PD content to be systematic and helpful in their daily instruction. Additionally, 18 teachers placed a high value on rating scales that provided guidance for reflection and improvement in their teaching practice. Written feedback was also viewed as an essential component of the PD program, with 23 teachers reporting that it helped them identify areas of weakness and provided specific suggestions for improvement.

Participating teachers also reported various challenges they encountered during the PD programme. Sixteen teachers faced difficulties in using the rating scales, finding the task of applying all the indicators to their daily practice overwhelming. Many of them were used

to focusing on one or two learning areas in their daily teaching, such as language, math, health, arts, and social emotion, making it challenging to integrate multiple areas simultaneously. Furthermore, sixteen teachers reported encountering issues that were not covered in the PD programme, including children's special needs and instructional strategy in Arts. Eight teachers struggled with scaffolding children's learning, and ten teachers encountered difficulties with science activities. Finally, 15 teachers expressed a need for more concrete examples of teaching in real-world settings to better apply what they had learned into practice. These challenges underscore the need for ongoing support and resources to help teachers overcome barriers and achieve the desired learning outcomes

In conclusion, the diverse PD content has been effective in helping teachers integrate different learning domains and conduct interdisciplinary teaching to some extent. The use of quality rating scales as tools for improvement and self-evaluation has also guided their reflection and improvement. Nevertheless, challenges encountered by teachers in scaffolding, using rating scales, and conducting science activities provide important insights for improving the PD program. By addressing these challenges, the PD programme can continue to support teachers' professional growth and enhance their ability to promote children's learning and development across various domains.

Table 7.18

Teachers' perceived influencing factors regarding what components

Theme	Codes	Number of teachers	Quotations
The "what" components of the PD programme.	Rich content	22	*The training content is very systematic, and it has been beneficial for me to integrate the five learning areas into my daily interactions with children. For example, I now count the number of children during our morning talk, read the number on the calendar, and compare differences in word structures, among other activities [14-AT].* *Sustained shared thinking and scaffolding are helpful. Integrating these teaching methods into daily activities promotes child development [17-AT].*
	Using rating scales	18	*In my daily teaching activities, I can incorporate various scales to design and carry out standardized, specific, and clear activities. By reflecting on these activities over time, I can identify areas for improvement and make necessary adjustments [20-ST].* *When I have a question, I want to find the answer through the scale. When encountering various nouns, I want to use more vocabulary to help children enrich their vocabulary [19-ST].*
	Feedback report	23	*The content of the feedback helps me know the direction of development and makes it clear to me what level of qualification should be achieved [3-ST].* *Feedback forms can identify areas for improvement, while teacher-provided strategies can guide our practice [64-ST].*
	Challenges of using rating scales	16	*For some indicators, I cannot do them every day [16-AT].* *The indicators on the scale are all worth learning, but some indicators will be more difficult and need to be adjusted [74-AT]!*
	Teachers' individual needs	16	*How can we effectively guide individual children with weak early experience and cognition to achieve the purpose of education?[25-ST]* *Our activities cover five areas, including language, mathematics, science, and society, but the arts are still relatively underrepresented [47-ST].*
	Challenges of scaffolding	8	*Scaffolding. I have never used this strategy before. By watching the case, I am slowly trying. According to the child's developmental needs, step by step asks the questions for him to find the answer [81-AT].* *How to spot liftable concepts in time when scaffolding for toddlers [26-AT].*
	Challenges in science activities	10	*The difficulties in the field of science will be relatively more than other areas [52-ST].* *Insufficient number of scientific activities [41-ST]*
	Need more examples	15	*Provide some more specific examples from kindergarten practice [3-AT].* *Clear case guidance with examples will be more conducive to teachers' understanding and practice [78-AT].*

7.2.2 The "How" Components of the PD Programme

Regarding the mentoring process, teachers placed great emphasis on regular classroom observation and timely feedback. Firstly, biweekly classroom observations helped teachers identify the teaching problems that they may have overlooked otherwise. Regular visits also served as reminders to implement and sustain changes. Secondly, providing timely

feedback after each classroom visit offered personalised guidance tailored to teachers' specific practices and needs. Teachers received a report that identified areas of progress and challenges, along with specific examples of how to improve after each visit. Therefore, teachers could refer to individualised and practical reports for continuous improvement.

Regarding the training arrangement, four teachers reported the tight schedule of face-to-face workshops. They found the weekly workshops demanding and felt there was not enough time to practice what they had learned. Additionally, as shown in Table 7.19, 15 teachers expressed a need for more teaching modelling from mentors and professionals to support their understanding and application of instructional strategies. While teachers did watch videotapes and attended lectures during the training, they found it difficult to apply these techniques in their own classrooms since each classroom has unique features. As a result, the lack of living-teaching modelling had an impact on teachers' ability to effectively handle tasks in the classroom.

Based on the feedback from teachers, regular classroom observation and feedback were found to be helpful for their improvement, as the feedback was tailored to their specific teaching problems. Regular classroom visits can also reinforce their understanding of the training content and sustain their progress. However, the tight schedule of workshops was challenging for some teachers, as they did not have enough time to practice what they had learned. Providing teachers with more time to comprehend, experiment, and practice new skills before moving on to the next session could help them consolidate their learning. In addition, live modelling can help teachers grasp how to handle specific teaching situations and prevent misconceptions.

Table 7.19

Teachers' perceived influencing factors regarding how components

Theme	Codes	Number of teachers	Quotations
The "How" components of the PD programme	Classroom observation	20	*Mentors' classroom visits provide specific instructions for the pedagogical interactions, which are practical. I often read "The Effectiveness of Teacher-Child Interaction" book which is very theoretical. However, class observation and feedback can be more targeted and intuitive in dealing with problems in practice [3-AT].* *Regular classroom observation will serve as a reminder for us to do continuous improvement [31-AT].*
	Regular feedback	45	*The mentor's feedback lets us know what we need to improve. Initially, there were relatively few types of materials and popular science books in my science area. During the mentoring stage, we constantly adjusted and enriched the materials in the science area according to Ms Xu's suggestions. [9-AT].* *The trainers spoke very clearly about the key concepts, and the interactive sessions were great for motivating learning [78-AT].*
	Tight schedule	4	*Time issue. The teacher needs a break at noon, and the mentor's feedback takes a long time. We don't have enough energy [4-ST].* *Could the training schedule be adjusted to once every two weeks? This would allow teachers to not only fulfil their kindergarten duties but also better internalize the training content and meet learning requirements [57-ST].*
	Need modelling	15	*Demonstration in classrooms on some items [77-ST].* *Provide professional teaching demonstrations and material support [17-AT].*

7.2.3 The "Who" Components of the PD Programme

When it comes to what factors can support teachers in implementing PD training, thirty-four teachers highlighted the importance of acknowledgement and admiration from colleagues and leaders. As shown in Table 7.20, Eighteen teachers attributed their progress to positive feedback from children's parents, while thirteen teachers emphasised children's improvement and another thirteen teachers valued mentors' support. Regarding teachers' characteristics, nine teachers believed that their intrinsic motivation or professional development contributed to their progress, while another nine thought that their weakness (i.e., the lack of adequate knowledge and their unconscious teaching habits) hindered their progress. The results suggested that teachers need others' recognition, attention, and

children's improvements to help them persist with changes. These significant others involved colleagues, leaders, mentors, parents and children.

Table 7.20

Teachers' perceived influencing factors regarding who components

Theme	Codes	Number of teachers	Quotations
The "who" components of the PD programme	Children's improvement	13	*The progress that children have made in kindergarten is encouraging and motivates me to continue [49-AT].* *Children's progress and change [2-ST]*
	Family support	18	*I received recognition for my professionalism when providing parents with feedback on their children's learning [44-AT].* *Parent recognition and support [21-ST & 25-ST].*
	Colleagues' recognition	34	*Recognition from colleagues and appreciation from leaders will support me in applying what I have learned from the training in my classroom [4-ST].* *Recognition among teachers and colleagues [29-ST]*
	Inner motivation	9	*I hope to make greater progress in children's learning in my class through continuous improvement and adjustment [63-ST].* *My inner drive to learn [45-AT].*
	Personal weakness	9	*My own reason: the teacher's knowledge reserve is not enough in the practice process [61-ST].* *The challenge will be changing some of the teacher's daily habits and high-control behaviours related to management routines [7-ST].*
	Mentors' support	13	*Regular feedback from my mentors made me aware of where the problem was and where I could adjust [83-CC].*

7.2.4 The Contextual Factors

The contextual factors. Teachers' implementation of PD training can be constrained by contextual factors in the kindergarten and classroom. As shown in Table 7.21, Seventeen teachers emphasised the importance of adhering to the kindergarten and school plans and curriculum, which limited their implementation of training content to only that which aligned with their weekly and school projects. The organisation of events such as sports meetings, graduation ceremonies, and children's performances also disrupted the teaching and learning process, as rehearsals occupied most of the teachers' time. As a result, five teachers reported that their busy schedules impacted their ability to reflect on and practice the training content, as they struggled to manage the curriculum, attend to the needs of individual children,

communicate with parents, and complete administrative tasks. Furthermore, large class sizes were identified by five teachers as increasing the pressure on classroom management and making it difficult to establish high-quality teacher-student interactions. Additionally, six teachers found that certain instructional strategies did not work for all children in their classrooms, particularly those with special needs, making it challenging to apply the training content to practice. Children's individual characteristics and unpredictable responses further contributed to the difficulty in implementing the instructional strategies learned in the professional development training.

According to teachers' feedback, kindergarten support, teachers working schedules, class size, and children's individual characteristics influenced teachers' implementation of the PD training content. Teachers reported being more likely to apply what they learned in their classrooms if the training content was directly relevant to the school curriculum. Moreover, teachers identified that having a lighter workload and relatively smaller class sizes would increase their ability to adapt the PD content according to children's needs, leading to greater changes in their instructional practices. Additionally, teachers reported that having the necessary skills to adjust the PD content according to the individual needs of their students would also support the implementation of the training content in their classrooms.

Table 7.21

Teachers' perceived influencing factors regarding contextual factors

Theme	Codes	Number of teachers	Quotations
Contextual factors	Kindergarten plan	17	*Considering the situation of the class and the kindergarten-based curriculum, some items in the scales are difficult to implement every day [20-ST].*
			Due to the renovation of the picture book library in the kindergarten, there is a shortage of books in the reading area. I'm also not in an ideal condition when it comes to collecting books from parents [38-ST].
	Teachers' busy schedule	5	*Sometimes it is necessary to remind children to take the initiative to observe nature. The teacher forgot to remind because she was busy with other things, so he did not achieve the goal [22-AT].*
			The daily workload is large, and it is sometimes difficult to concentrate on how to better combine all aspects of content into daily life [24-AT].
	Class size	5	*Teachers will give advice on how to guide individual children. However, the class size is large, and individual guidance is often interrupted by other children's emergencies [49-AT].*
			Faced with 38 children, how can teachers pay more attention to individuals by dividing their labour [69-ST].
	Children's individual development	6	*Mentors' feedback is rich in content, most of which is understandable and achievable. The theoretical knowledge of how to reach the development level of children with special needs is relatively weak [25-ST].*
			Some children fail to meet the target requirements due to insufficient existing experience and ability level of the children [2-ST].

7.3 Chapter Summary

This chapter presents a qualitative analysis of 82 teachers' perceived impacts of the PD programme and the factors that influenced PD effectiveness. The PD programme generated positive effects in four aspects: (1) teacher outcomes, which involved helping teachers identify their teaching weaknesses, improving learning motivation, developing child-friendly awareness, adopting intentional pedagogical approaches, increasing their content knowledge, and using effective instructional strategies across various learning domains; (2) classroom outcomes, which included the provision of diverse content-related and provocation

materials, the cultivation of positive teacher-child relationship, and the development of domain-specific classroom quality in literacy, numeracy, science, diversity, and social-emotional learning; (3) child outcomes, which encompassed improvements in children's learning attitudes, and social-emotional and literacy skills; (4) school outcomes, which consisted of inspiring colleagues to make positive changes and building a collaborative learning community.

Furthermore, teachers reported the facilitators and constraints that affected their ability to apply what they had learned from the PD training. In terms of the "what" component of the PD programme, teachers expressed appreciation for the diverse range of PD content that was directly relevant to their daily practice and the use of rating scales to facilitate self-reflection. Meanwhile, they also emphasised the need for more guidance in using rating scales and for more teaching modelling and examples to support the implementation of scaffolding and science activities. In terms of the "how" component, teachers found that regular classroom visits and timely feedback were particularly helpful for improving their practice, while the tight schedule was challenging for them to apply the newly acquired knowledge and skills. In terms of the "who" component, teachers highlighted the importance of recognition and support from their leaders, colleagues and parents, and observing children's improvements helps them persist with changes. Meanwhile, the competing demands from kindergarten plans, daily workload and relatively large class sizes constrain their ability to trail newly learned content.

Chapter 8 Discussion

The present study aimed to investigate the effects of the adapted Leadership for Learning (LfL) PD on classroom quality and child outcomes, as well as the factors that influenced its effectiveness and working mechanism in a Chinese context. Specifically, this study explored the PD effects in the two relational aspects of classroom quality- instructional quality and interactional quality- and four aspects of child outcomes – literacy, numeracy, executive function, and social-emotional development. Furthermore, the study qualitatively analysed teachers' perceptions of the PD programme's effects and identified influencing factors using an open-ended questionnaire. This chapter summarises the research findings and discusses their contributions to knowledge on preschool teachers' PD, effective PD programme conceptualisations, and programme adaptations in cross-national research.

8.1 The Effects of PD on Classroom Quality

8.1.1 The Effects of PD on Instruction Quality

This research utilised multilevel modelling analysis to examine the main and moderation effects of the adapted PD programme on the ECERS-E total average scores and its subscales of literacy, numeracy, science, and diversity. The findings revealed that the PD intervention had a significant impact on the ECERS-E total average and its subscales. Moreover, the moderation effects of school type, school classification and location were observed in the PD programme. The implications of these results are further discussed in the subsequent sections.

The effects on total average scores of ECERS-E. The results suggest that the adapted PD programme had a significant positive impact on the scores of ECERS-E, which is consistent with previous highlights on the effectiveness of in-service PD on the quality of ECEC (Egert et al., 2018). For one thing, this is not surprising given the well-established link between PD content and instruction quality. Specifically, the ECERS-E measures the

domain-specific instructional quality in literacy, numeracy, science, and diversity. As these domains were covered in the PD content, it is reasonable to expect that the programme had a positive impact on instruction quality in these areas. For the other thing, Kulgemeyer and Riese (2018) also demonstrated that teachers' content and pedagogical content knowledge predict their teaching quality, as this knowledge enables them to use appropriate approaches and select suitable content for children's learning.

Furthermore, research has shown that using observation rubrics for peer support or self-appraisal can effectively improve teachers' practice and children's learning outcomes (Mathers, 2022). Using the rating scales enable teachers to engage in self-reflection and identify their strengths and weaknesses, thus improving their instructional practices. This approach has been widely employed in ECEC to improve practice (e.g., Hui et al., 2017; Pianta et al., 2021; Mathers et al., 2007; Weadman et al., 2022). Additionally, the rating scales provide a concrete and objective way to evaluate their own practice and receive feedback from peers. This approach aligns with the adult learning theory, which suggests that adults benefit from concrete, realistic goals and formative evaluation, which enable them to engage in self-directed learning (Bourgeois & Nizet 1997).

This study identified several factors that influence the impacts of PD on ECERS-E scores, including teacher age, qualifications, school type, and classifications. Notably, younger teachers were found to perform a higher level of instruction quality compared to their older counterparts. This finding contrasts with previous research that identified more instructional support from senior teachers, who were thought to place greater attention on sharing and teaching academic knowledge (Malmberg et al., 2010; Reid & Caudwell, 1997). However, this inconsistency may be explained by the nature of this research, which is an intervention study rather than an exploration of the correlations between teacher age and pedagogical quality. Younger teachers may benefit more from the PD intervention that

enhances their instruction quality, as they generally exhibit higher levels of learning motivation and attitudes compared to older teachers (Hartwig & Schwabe, 2018). Moreover, teachers with higher qualifications demonstrated higher levels of instruction quality. It is consistent with prior research indicating that qualifications are an essential predictor of classroom quality (Hu et al., 2016). In China, qualifications (i.e., Zhicheng 职称) are determined by the unique cultural teacher promotion system. Higher qualifications correspond to higher levels in the tiered professional rankings since teachers have met the evaluation criteria in areas such as teaching hours, education levels, professional training, and research competence. These findings underscore the importance of considering teacher age and qualifications when implementing PD interventions to improve instructional quality.

In addition, public kindergartens showed higher instructional quality than private kindergartens, which is consistent with prior research (Hu & Li, 2012). It mainly due to the superior policies of public kindergartens, as they receive full funding from the government, thus enabling them to provide children with a secure and better-equipped learning environment. Moreover, public kindergartens provide "bianzhi" (编制， a rare tenured position) for teachers, which are tenured positions with government-sponsored salaries. This results in a stable teaching workforce with higher qualifications and fewer job changes than in private kindergartens. Sufficient funding, high-quality teachers and stable teacher PD opportunities are essential elements of high-quality instruction (Hu et al., 2016; Malmberg et al., 2010). Therefore, it is not surprising that public kindergartens exhibit higher instructional quality than private ones.

School classification is also an important contextual factor in evaluating kindergartens in China. Local governments in different provinces have their quality standards for ECEC under the guidance of the Chinese educational committee. In Shenzhen, kindergartens were classified into three levels (i.e., province level, city level, and district level) based on the

government's evaluation of quality. These quality standards cover operational conditions, administration and management, safety and health, education, family and community. Province-level kindergartens represent the highest tier and receive more government funding, while district-level kindergartens were identified as not as good as kindergartens in the other two levels. The study found that the local standards could distinguish the quality measured by ECERS-E. This suggests that the government's evaluation system has a significant impact on the quality of ECEC and should be taken into consideration when implementing interventions to improve the quality of ECEC.

The effects on ECERS-E literacy. The results indicated that the PD intervention, school type, district level and location significantly predicted the ECERS-E literacy scores. Research evidence demonstrated that the intervention had a positive effect on teacher-child interactions related to print in the environment, shared reading, and emergent writing. Additionally, the PD intervention helped teachers extend children's thinking and expression about words, letters, prints, and stories by using more open-ended questions and informative feedback. Previous research has shown that Chinese literacy instruction often involves whole-class teaching, lecturing, questioning, regular copying exercises, and choral reading, as Chinese characters feature "pictographic" elements that require memorization (Li et al., 2012; Siok & Fletcher, 2001). However, the content of the PD programme in this study emphasised the role of teacher-child interaction in supporting children's emergent literacy. Specifically, the programme encouraged teachers to seize opportunities when children showed interests in print, books, and mark-making to scaffold their emergent literacy skills through joint discussions of print and characters. The follow-up mentoring process provided ongoing monitoring, evaluation and feedback on teachers' practices. Moreover, follow-up expert support was provided to teachers, requiring them to repeatedly practice new skills to replace old habits and promote changes in their teaching approaches (Sims & Fletcher-Wood, 2021).

Different from the effects of PD on the total average scores of ECERS-E, the present study found that school location significantly influenced literacy instruction, with classrooms in urban areas showing more improvement in ECERS-E literacy. The association between socioeconomic and classroom quality may explain this finding, as socioeconomically disadvantaged areas often have fewer well-trained teachers and fewer opportunities for professional development (McCoy et al., 2015). Furthermore, literacy differs from math or science because it is a socio-cultural tool (Hall et al., 2016). As such, literacy pedagogy is shaped by distinct cultural values and social beliefs and may reflect unique features and traditions of effective teaching practice (Wong, 2008). Economic development can play a critical role in promoting cultural change and replacing traditional approaches with more modern ones (Inglehart & Baker, 2000). Accordingly, our findings suggested that suburban areas exhibited lower instruction quality in literacy than urban areas, as teachers in suburban areas were less likely to adopt new pedagogical approaches.

Moreover, our study revealed that school type and classification significantly moderated the effects of PD on ECERS-E literacy scores. Specifically, the PD effects were more pronounced in classrooms in public kindergartens or kindergartens with higher classifications. These findings are consistent with prior research indicating that public kindergartens and higher-classification kindergartens tend to have more qualified teachers and better educational resources, both of which are critical elements of quality (Hu et al., 2016). Therefore, our findings underscore the importance of considering contextual factors such as school type, classification, and location when designing and implementing PD interventions aimed at improving literacy instruction in early childhood classrooms. Such interventions should be tailored to the unique needs and characteristics of different school contexts to maximise their effectiveness and promote positive outcomes for young children.

The effects on ECERS-E maths. This research illustrated that the intervention, teachers' qualifications, school type, and school classification significantly predict the quality of numeracy instruction. Our results indicated that participating teachers made changes in three key aspects: (1) providing more opportunities for children to engage in counting through morning talk, outdoor activities, and learning-centre activities; (2) providing more diverse math-content activities, such as counting, numbers, shapes, and sorting, matching, and comparing; (3) using precise mathematic language to develop children' concepts. These findings are consistent with prior research on PD programmes focused on math teaching, which has shown that intensive PD in mathematics content knowledge and children's mathematical learning can lead to shifts in teachers' practices and beliefs about the teaching and learning of mathematics (Barenthien et al., 2020). The PD content included diverse content knowledge in math, such as numbers, shapes, comparison, sorting and counting, which improved teachers' competency in teaching diverse content in math (Chen & McCray, 2012). Moreover, the improved pedagogical knowledge encouraged teachers to support children's math learning through high-quality, informal teacher-child interactions that were personally meaningful and engaging (Ginsburg & Baroody, 1990), rather than limiting math learning to structured activities.

Interestingly, teachers' qualifications became significant in predicting ECERS-E math scores, which is consistent with previous research indicating that teachers with higher degrees produce high-quality teaching (Hiebert, 2013). Teachers' degree levels reflect their pedagogical, personality, and social competencies, which are all essential components of professionalism (Tjabolo, 2020). Especially for math instruction that demands systematic mathematic knowledge to scaffold children's understanding of mathematic concepts. Therefore, teachers' degrees serve as critical indicators of math instruction quality. Furthermore, the study found that school type and classifications also significantly influenced

ECERS-E math scores, with public kindergartens and those with higher classifications exhibiting higher levels of instruction quality. This finding highlights the quality disparities that exist between public and private kindergartens, as well as between kindergartens with different classifications, which may attributable to policy, governmental funding, and the presence of qualified teachers.

The effects on ECERS-E science. This research indicated that the intervention significantly predicted ECERS-E science scores. Teachers demonstrated an increased appreciation and curiosity for nature, leading to an expanded range of science materials in classrooms and greater encouragement for children to explore them. Through facilitated discussions and questioning, teachers fostered diverse scientific concepts and actively sought answers to questions with their students. Previous research suggested that a lack of science-specific knowledge and self-efficacy beliefs pose significant barriers to effective science teaching in preschool settings (Greenfield et al., 2009). However, PD courses, as seen in this study, have been shown to efficiently enhance teachers' science-specific content knowledge and boost their confidence in conducting science activities. To ensure that the newly acquired knowledge and skills are put into practice, the success of PD courses also depends on preschool teachers' ability to translate what they have learned into practice (Barenthien et al., 2020). In this regard, the on-site mentoring provided as part of this intervention helped to facilitate the transfer of training and ensure that preschool teachers were able to successfully apply the professional development content to their teaching.

In addition, the child-to-teacher ratio and teachers' degrees were significant predictors of the quality of science instruction. Specifically, smaller class sizes were associated with a higher quality of science instruction. This is in line with existing research indicating that above-average class size negatively affects instruction quality due to challenges in classroom management and teacher decision-making (Dubosarsky, 2011; Karademir et al., 2020).

Notably, this research found that teachers with lower degrees demonstrated a higher quality of science instruction, and teachers' degrees can moderate the effects of PD on ECERS-E science. This paradoxical finding is consistent with the work of Justice et al. (2009), who reported a similar result when researching the factors influencing preschool teachers' language and literacy instruction quality. They attributed it to the fact that many teachers with higher degrees did not specialise in early childhood education, which may have resulted in less training in working with young children (Justice et al., 2009). Similarly, Williford et al. (2017) found that teachers' majors played a critical role in their engagement and performance in PD programmes, with early childhood education majors demonstrating more skill in identifying and justifying high-quality teaching behaviours. This may also apply to this study, given that Chinese kindergartens typically require teachers to have bachelor's degrees in ECEC or above bachelor's degrees in related areas, although this information was not available for analysis. Additionally, school type and classification remained significant predictors of ECERS-E science scores.

The effects on ECERS-E diversity. The results indicated that intervention had significant effects on the scores of ECERS-E diversity. Teachers adapted their lesson plans to address the specific needs of individuals, encouraged children to engage in activities that challenge gender stereotypes, and created classrooms with books, figures, dolls, and displays of people from various ethnic groups. They also demonstrated great awareness of individual, gender and race equality when interacting with young children. Regarding planning for individual needs, teachers with more PD in differentiation were more effective in differentiating instruction in their classrooms (Dixon et al., 2014). However, in this research, teachers' awareness of differentiation mainly occurred in their lesson plans rather than in their teaching with differentiating instructions. This suggested that the half-day training in diversity promoted teachers' understanding of differentiation but did not strengthen the

instructional competencies required to apply differentiation in lessons, thus requiring modelling and coaching in future PD programmes (Dettmer et al., 2014).

Issues related to race, gender and social class differences often start at preschool age. However, there is a lack of PD opportunities for teachers to implement anti-bias approaches in teaching and learning (Maude et al., 2009). This study contributes to the in-service preschool teacher education research base by analysing and validating the effects of PD on equality education. Although teachers made changes to their classroom environments by incorporating materials that break stereotypes, they rarely facilitated children's gender and race equality through discussion, PD programme in diversity may positively influence preschool teachers' beliefs and awareness, but additional training targeted at teaching practice is necessary to increase cultural competence and teaching behaviours.

Furthermore, teachers' qualifications were significantly associated with the instruction quality in diversity. Suprayogi et al. (2017) found that teachers holding higher certificates reported using more differentiated instruction than teachers with lower or no certificates. These teachers differentiated learning content, process, and environment in a flexible, equitable and intelligent way according to children's approaches to learning. Teachers with higher qualifications tended to be more sensitive to coping with race and gender diversity in their classrooms. In terms of the school characteristics, school type became non-significant in predicting the instruction quality in diversity, while school classification remained significant. Due to the influence of collectivism, Chinese teachers prioritise group success and social norms, educating children using the same content at the same pace, regardless of private or public education systems (Zhu & Zhang, 2008). This study suggested that kindergartens with higher classifications recognised the importance of children's individual needs and interests, which also contribute to preschool quality.

8.1.2 The Effects of PD on Interactional Quality

The effects on total average scores of SSTEW. The research indicated that intervention significantly predicted the interactional quality measured by the SSTEW. Teachers can support children's problem-solving, curiosity, concept development and high-order thinking through teacher-child interactions. This finding aligns with existing research that demonstrates the effectiveness of PD on teacher-child interaction (i.e., Early et al., 2017; Downer et al., 2009; Pianta et al., 2008). PD programmes allow teachers to deconstruct and reconstruct pedagogical knowledge through reflection, analysis, and actions (Phillippou et al., 2015). Meanwhile, unlike previous research that mainly relies on the CLASS instrument to measure the quality of teacher-child interaction, this research used SSTEW, which covers supporting and extending language and communication and assessing learning and language. This suggested that in addition to facilitating classroom management, emotional support, and instructional support, PD programmes also helped teachers engage children in analytic conversations, use low-frequency words and respond with complex and extended talk.

In terms of the influencing factors of teachers, this study revealed that teachers' qualifications significantly predicted the interaction quality as measured by SSTEW. This finding is not surprising, as teachers with higher qualifications possess specific instructional strategies and knowledge that promote their teaching performance (Ansari & Pianta, 2019). Additionally, school type and classification were significant predictors of interaction quality. Public kindergartens and kindergartens with higher classifications demonstrated a higher quality of teacher-child interactions. This might be because public kindergartens are fully funded by the government, therefore, less influenced by parents' demands. In contrast, teachers in private kindergartens often resort to transmissive pedagogy, such as rote learning and exercise, to develop children's academic performance and appeal to parents who value academic success.

Building trust, confidence, and independence. The PD intervention was found to be effective in promoting teacher-child interactions in building trust, confidence and independence. In terms of classroom management, teachers set clear expectations for children, showed understanding when children did not follow the rules, and solved children's conflicts using agreed processes. In terms of play, teachers actively participated in children's play when invited, provided resources to support play, and involved children in setting up the play areas. When it came to individual and group interactions, teachers involved children in making choices, regularly updated materials according to children's interests, engaged in flexible planning to meet children's needs and provided scaffolding to support their learning. These behaviours demonstrated that teachers had embraced a child-friendly approach that helped children regulate their behaviours, supported their play and created optimal learning environments and activities.

These changes observed in teachers' practices could be linked to their beliefs, which act as filters or guides for their educational practice (Fives & Buehl, 2012). Participating in PD programmes can lead to changes in teachers' knowledge and beliefs about pedagogical practices and classroom management. In traditional Chinese approaches, teachers' authority is highly valued, and communication is centred on listening to the teacher (Cong, 2008). However, after receiving the PD programmes, teachers adopted developmentally appropriate practices that are relationship-focused, enabling children to autonomously explore their environment, build their competencies, benefit from stimulating learning opportunities, and be respected as community members (Perren et al., 2017). Teacher beliefs are known to influence educational practice, and those who embrace developmentally appropriate practices tend to demonstrate gains in their teaching strategies (Lee et al., 2006).

The results also indicated that teachers' qualifications predicted the interaction quality in building trust, confidence and independence. Teachers with higher qualifications tended to

adopt a child-friendly approach in classroom management, promoting children's play and group or individual interactions. This finding is consistent with previous research indicating that teachers with higher qualifications tend to be less likely to rely on direct instruction and more likely to encourage children to reflect on their dialogue or activities (Huang, 2018). Interestingly, neither school type nor school classification was found to predict interaction quality in building trust, confidence, and independence, suggesting that teachers' characteristics may be more important than school characteristics in supporting children's confidence and independence.

Social and emotional well-being. The results indicated a positive association between the PD intervention and SSTEW social and emotional well-being scores. Teachers encouraged children to express their feelings and needs, seek help when needed, and understand others' non-verbal expressions. This is in line with Pianta et al.'s (2017) research indicating that coaching was related to teachers' emotional support. Furthermore, different from Pianta et al.'s PD design which improved teachers' emotional support by teachers' observations and assessment of high-quality examples, this research first provided teachers with knowledge of the mechanisms of children's social-emotional development and taught them how to model, teach, and react to emotions to facilitate preschoolers' emotional development. Teachers' enhanced understanding of children's social and emotional development, along with practical examples of how to support it, has improved the quality of interactions aimed at promoting social and emotional wellbeing. Furthermore, the classification of schools has been shown to predict the quality of these interactions. Kindergartens with higher classifications tend to exhibit higher quality interactions in support of social and emotional wellbeing.

Supporting and extending language and communication. The results indicated that PD intervention significantly predicted the quality of interaction between teachers and

children. With respect to children's verbal communication, children were encouraged to initiate and lead the conversations, take more turns in speaking, and provide extended and responses. In terms of listening, teachers positioned them at the children's height, repeated and rephrased the children's words to ensure comprehension, allowed adequate thinking time, and encouraged the children to listen and respond to each other. Teachers used appropriate language and terms, varied tones to maintain children's interests, and modelled vocabulary use. Following the PD intervention, teachers better understood their roles as listeners, questioners, responders, and facilitators of language development in the classroom (Massey, 2004). They use rich and complex vocabularies and language modelling to enhance children's learning of vocabulary, grammar and social aspects of conversations during interactions conversations (De Temple & Snow, 2003). Despite the PD intervention, school type was also found to predict the interaction quality in supporting and extending the language, with public kindergartens exhibiting higher quality in supporting children's language.

Supporting learning and critical thinking. The results indicated that PD intervention significantly predicted the interactional quality in supporting learning and critical thinking. Teachers employed various instructional strategies to enhance children's cognitive development. For instance, they facilitated problem-solving skills by engaging children in activities that stimulated their curiosity and creativity, such as hiding unexpected objects. During storytelling activities, teachers encouraged children to retell familiar stories, utilised factual books to support children's concept development, and encouraged them to evaluate and comment on the stories. According to Kuhn (1999), critical thinking involves thinking about thinking facilitated by reasoning and the development of metacognition. Teachers can use play and curiosity, problem-based learning, language for thinking, questioning techniques, and story-based approaches to help children better understand taught

concepts and well-structured thinking (O'Reilly et al., 2022). However, most teachers lack knowledge or training in teaching critical thinking (León et al., 2015). Therefore, the PD programme in this study can fill the research gap by training teachers' pedagogical strategies to support children's learning and critical thinking.

Furthermore, teachers' qualifications predicted the interaction quality in supporting learning and critical thinking. Teachers with higher qualifications performed higher quality of interaction. They can motivate children to actively and persistently think about problems, analyse information, evaluate arguments, make decisions, and learn new concepts since they have a better understanding of what they are teaching and can explain this clearly to children (Elder & Paul, 2020). Regarding school characteristics, this study found that school types and classifications significantly predicted the quality of interaction in supporting learning and critical thinking. Public kindergartens or kindergartens with higher quality classifications demonstrated higher interaction quality in supporting critical thinking. This is reasonable since critical thinking involves reasoning, evaluation, information transforming, and generating new ideas, which require qualified teachers to support these skills (Florea & Hurjui, 2015). Public or kindergartens with higher classifications tend to have more qualified teachers and opportunities for professional development.

Assessing learning and language. While the PD intervention showed significant improvement in teachers' assessing learning and language, it appeared to be the area of least improvement compared to other pedagogical interactions. Teachers were able to better understand the link between child assessment and ongoing development, including identifying and addressing behavioural difficulties. They also assessed children's language development in conjunction with other areas of learning, engaged parents in the assessment process, and monitored children's development. However, the improvement was not as robust as in other areas of pedagogical interaction. This suggested there were challenges for

teachers in conducting assessments and documentation in preschools. For example, teachers often documented children's engagement in different activities through photos rather than written observation and were limited in the amount of time they could dedicate to such tasks due to the demands of classroom management (Alvestad & Sheridan, 2015). It is possible that reducing class sizes or setting aside dedicated observation or assessment time for teachers could alleviate these challenges. In addition to the PD intervention, school types and classifications also played a role in teachers' assessment of learning and critical thinking. Public kindergartens or kindergartens with higher level classifications demonstrated higher quality in assessment.

8.1.3 The Summary

The results indicated that the PD intervention has a significant positive impact on both the total average and the subscale scores of ECERS-E and SSTEW. This finding supports previous research indicating that in-service PD is effective in enhancing classroom quality, including instruction, teacher-child interaction, and learning activities (Egert et al., 2020). In terms of the influencing factors at the classroom level, this research indicated that teacher qualifications significantly predicted the scores on ECERS-E diversity, SSTEW building trust, confidence, and independence, and SSTEW supporting learning and critical thinking. This suggested that teachers with higher qualifications tend to implement more differentiated instruction, child-friendly classroom management, and promote children's critical thinking skills. Additionally, teachers' degrees were found to predict the scores of ECERS-E math and science subscales. Lastly, the child-to-teacher ratio was significantly associated with ECERS-E science and SSTEW supporting learning and critical thinking.

Regarding the influencing factors of kindergartens, this research revealed that school types predicted the scores of ECERS-E literacy, math, and science, and SSTEW extending language and communications, supporting learning and critical thinking and assessing

learning and language. School classifications predicted all of the subscales of ECERS-E and SSTEW critical thinking and assessing learning and language. These findings suggested that classroom and school characteristics have distinct influences on the quality of instruction and interaction in kindergarten classrooms.

8.2 The Effects of PD on Child Developmental Outcomes

This research indicated that the PD intervention significantly affected children's literacy, numeracy, and executive function development. However, it did not predict children's development in social-emotional skills. Meanwhile, children's individual, classroom, and school characteristics influenced their development or moderated the effects of PD on child development. This section discusses the main effects and moderators of the PD intervention on child development, as well as the factors that influence PD effects.

8.2.1 The Effects of PD on Child Literacy

The results indicated that the PD intervention significantly predicted child literacy development. Children in the intervention classrooms demonstrated higher levels of emergent writing, expressive vocabulary, word sounds, word identification, story comprehension, and print awareness. This suggests that providing PD for teachers on literacy instruction and teacher-child interaction can effectively facilitate children's literacy development (Markussen-Brown et al., 2017; Wasik & Hindman, 2011). Specifically, the PD programme improved the instruction quality in literacy, providing children with more opportunities to engage in teacher-child shared book reading and mark-making, which strengthened their emergent writing, word identification, story comprehension, and print awareness (Piper et al., 2018). Additionally, the PD programme promoted teachers' ability to support and extend language and communication, which has been shown to be related to children's language and literacy development. Engaging children in cognitively challenging conversations involving explanations, narratives, and sharing experiences and ideas has been found to facilitate

children's literacy development by promoting their ability to make predictions about stories and discuss vocabulary or text in books or environments (Dickinson & Smith, 1994).

In terms of the influencing factors, children's age was found to be a significant predictor of their literacy skills. This is in line with previous research indicating that older children tended to have better literacy skills in areas such as emergent writing, oral comprehension, and word identification. Teachers' qualifications and child-to-teacher ratio were positively associated with children's literacy skills. Children tended to demonstrate higher levels of literacy development when their teachers had higher qualifications and devoted more time to literacy activities (Brown et al., 2008). Interestingly, this study found that a higher child-to-teacher ratio produced more gains in literacy development for children. This differs from previous research, which indicated that reduced class sizes facilitated more gains in preschoolers' literacy skills (i.e., Francis & Barnett, 2019). The impact of class size on child development is still under debate. It is possible that larger class sizes predispose teachers to give clear, more proactive instructions, resulting in increased child engagement in learning (Lan et al., 2009). In Chinese classrooms, even in whole-class instruction, teachers provide individualised feedback and engage in rich teacher-child conversations, which may suggest a difference between Asian and European/American settings (Schleppenbach et al., 2007). Additionally, the results showed that less score change in ECERS-E produced more gains in children's literacy development. This is likely because higher-quality classrooms tend to change less than those with lower quality due to their baseline differences. This finding suggested that the stability of high-quality classrooms may be more powerful in predicting children's development than the variability of classroom quality. Future research is needed to explore the association between change in classroom quality and child development.

8.2.2 The Effects of PD on Child Numeracy

This research indicated that PD intervention significantly predicted children's numeracy development. Children in the intervention classrooms demonstrated higher scores in emergent numeracy, which comprises skills such as classifying and sorting, comparison, counting, number identification, shape identification and simple arithmetic. Three features of the PD programme may explain the effects. Firstly, teachers improved their content knowledge of the structure of mathematics and how children approach it. Teachers' understanding of how children learn math both procedurally and conceptually positively affects children's attainment (Ball et al., 2005). Secondly, providing active learning experiences that engage teachers in tasks to help them realise their cognitive dissonance and comprehension of new knowledge, thus encouraging the articulation and implementation of new ideas (Brendefur et al., 2013). Thirdly, the PD content is coherent with the kindergarten curriculum, allowing teachers to support children's math learning through learning-centre activities and group or collective math activities. Therefore, the application of high-quality mathematics instruction promotes children's numeracy development.

This research indicated that children's age and gender significantly predicted children's numeracy development in terms of the influencing factors at the children's level. Older children or girls outperformed younger children and boys in mathematics, consistent with existing research showing that older children perform better in math skills (i.e., Cohrssen & Niklas, 2019). Differing from existing studies that identified a male advantage in numbers, subtraction, and multiplication (i.e., Perez Mejias et al., 2021), this study observed gender gaps in mathematics in favour of girls. The results suggest that girls and boys did not have significant differences in math skills at the beginning of the year, but girls surpassed boys when their teachers received the PD program. These findings underscore the importance of teacher PD programmes in promoting gender equity in math education.

In addition, the analysis revealed a similar pattern in terms of the influencing factors at the classroom level. Children demonstrated better numeracy skills if their classrooms had less change in ECERS-E scores after the PD programme. This suggested that high-quality classrooms were well-managed, and teachers established stable routines to discipline children's behaviours, conduct activities and keep them engaged in learning (Rimm-Kaufman et al., 2009). Teachers in lower-quality classrooms require more time to consolidate what they have learned in the PD programme and persist in implementing high-quality instruction before the improved quality has a positive impact on child performance. These findings highlight the importance of ongoing support and resources for teachers to maintain high-quality classroom practices and promote positive learning outcomes for children.

8.2.3 The Effects of PD on Child Executive Functions

The adapted PD programme in this study was found to promote children's executive function skills. Children in the intervention classroom outperformed their counterparts in the control group in terms of working memory and inhibitory control. Executive function involves higher-order cognitive regulatory processes that underlie attention, planning and goal-directed actions. Previous research by Raver et al. (2008) has shown that training teachers in behavioural management can lead to significant gains in children's self-regulation skills. Fuhs et al. (2014) attributed the relationship between classroom quality and children's executive function to affective quality and cognitive stimulation. Specifically, children made more gains in inhibitory control when teachers positively reacted to their behaviours, approved them to continue their activities, and did less redirecting. This is because approval represents a form of internal regulation of children's behaviours. Moreover, the proportion of time children spend on learning activities and complex thinking is associated with their attention and working memory (Redifer et al., 2019). When children are required to give

extended and inferential responses to teachers' questions, they are prompted to reason about information, which promotes their planning and working memory.

We examined the influence of demographic covariates on children's executive function skills. Age was significantly associated with children's executive function, which had been well documented (e.g., Fuhs et al., 2014). However, there was no gender difference in children's executive function development. Furthermore, the results indicated that less change in ECERS-E scores and more changes in SSTEW scores were positively associated with children's executive function skills. These results suggested that domain-specific and domain-general measurements may contribute differently to domain-general cognitive skills, such as EF as well as to domain-specific academic skills in literacy and math. Given the mixed findings regarding quality differences in existing research, further research is needed to explore potential differences.

8.2.4 The Effects of PD on Child Social-emotional Development

The analysis of PD effects on children's social-emotional development indicated no significant impacts on conflict resolution, emotional awareness, friends, personal awareness, and perspective-taking. This might suggest that the PD effects had different impacts on developing children's social-emotional and cognitive skills. It is widely acknowledged that warm and nurturing relationships in classrooms support children's social-emotional development, and emotional support and positive teacher-child relationships are critical to children's emotional experiences (Goetz et al., 2021). However, improvements in instructional quality over a short period have negative or no associations with several aspects of children's social-emotional wellbeing (McCoy & Wolf, 2018). According to the socio-cultural theory, social and communicative interactions shape children's social-emotional development in a gradual process, thus indicating that the stability of high-quality emotional support might be more critical in developing children's social-emotional skills.

Furthermore, the non-significant associations between the PD programme and child social-emotional outcomes differ from the research conducted in Australia (Siraj et al., 2018), which found that PD interventions significantly impacted social-emotional outcomes. These findings suggested that there may be unique factors in the Chinese context or adaptations of the PD programmes that did not support the expected relationships. Culture plays a significant role in shaping an individual's interactions and communication styles. In China, collectivism is valued, emphasising conformity to norms, group success and harmony while disregarding self-expression and personal choices (Zhu & Zhang, 2008). Consequently, children are less encouraged to express their emotions or resolve conflicts independently, but rather, they are taught to respect authority figures, such as their teachers, and follow their guidance on emotional regulation and problem-solving. As such, our results did not imply that training teachers to improve emotional interactions with students was unimportant or useless. Instead, it underscores the need for culturally-appropriate PD programmes in China and highlights the importance of considering cultural appropriateness in cross-national research on children's social-emotional development. Further research is needed to understand how teachers can promote children's social-emotional development in Chinese classrooms under collectivist cultures.

8.3 Teachers' Perceived Effects of PD

The qualitative analysis aimed to examine teachers' perceptions of changes to complement the quantitative findings. The analysis of teachers' questionnaires suggested that the PD programme brought changes in teachers, classrooms and kindergartens. Contrary to the quantitative results that identified non-significant associations between the PD programme and children's social-emotional development, teachers emphasised the positive changes in children's social-emotional development in the questionnaire. In addition,

teachers reported changes at the kindergarten level. Therefore, this section also discussed the similarities and differences between qualitative and quantitative findings.

8.3.1 Teachers' Outcomes

In the present study, teachers acknowledged that they had identified their teaching weaknesses, improved their motivation and child-friendly awareness, developed content and pedagogical knowledge, and changed their pedagogical behaviours. Teachers' increased motivation and awareness of their teaching problems seemed to be a prerequisite for their behavioural changes, as 28 teachers identified their lack of knowledge and expressed a desire to learn. It stands to reason that motivation is the key to professional growth, and teachers viewed the PD programme as a valuable tool for professional growth rather than just meeting their working responsibilities (Avidov-Ungar, 2016). The qualitative findings also showed that teachers developed child-friendly awareness and intentional pedagogy. They agreed that learning activities should be planned based on children's interests and needs and that learning opportunities can arise spontaneously from children's natural inquiries. These findings align with the values of the child-centred approach, which emphasises "respectfully treating children, regardless of their gender or cultural background, to make children feel safe, comfortable and happy" (Baraldi, 2021, p. 101).

Furthermore, teachers reported changes in their content knowledge, pedagogical knowledge, and instructional behaviours, consistent with the quantitative results. They gained knowledge on various topics, including literacy, numeracy, science and social emotion and perceived changes in their pedagogical practice, such as asking more open-ended questions, providing timely and informative feedback, and scaffolding children's learning and thinking. These findings suggested that the PD programme influenced teachers' knowledge and practices related to the instructional topics covered by the programme (Glover et al., 2016). Moreover, the observed improvements in teachers' knowledge and practices are promising,

as they indicate a possible association between teachers' knowledge and practice. This is useful for further investigating the mechanisms underlying the relationship between knowledge and practice.

These results supported and extended current research on PD interventions, which often focus on only one or two aspects of teachers' outcomes (Avidov-Ungar, 2016; Jamil et al., 2018). Future intervention studies could take a more holistic approach by examining the impact of PD on teachers' motivation, beliefs, knowledge, and instructional practices. While this study has found possible associations among these factors, the underlying mechanisms are unclear and require further investigation. Additionally, individual and school factors also influence how teachers approach training content and provide instruction in their classrooms. For example, some teachers may have stronger analytic skills to acquire and apply new knowledge, while others may need more guidance (Smith & Gillespie, 2007). This could explain why some teachers in this study perceived improvements in their learning but did not necessarily identify changes in their effective practice. These findings have important implications for designing and implementing effective PD programmes for teachers.

8.3.2 Classroom Outcomes

The results suggested that teachers perceived improvements in setting up classroom environments and providing domain-specific pedagogical instruction in literacy, numeracy, science, and diversity. These qualitative findings align with the quantitative results that identified positive associations between PD intervention and domain-specific quality. Notably, the qualitative results extend the quantitative findings by highlighting positive improvements in providing learning materials and setting up the classroom environment. In particular, teachers equipped learning areas with more content-related learning materials and engaged children in decorating the classrooms. Preschool classrooms are typically equipped with various learning materials and tools to inspire children to explore and build their

creativity. However, the ability of teachers to deliver meaningful learning experiences to children is also essential for maximising the use of these materials (Awang et al., 2020). This research suggested that the PD programme helped teachers provide appropriate materials and guidance to engage children in meaningful explorations, discussions, and thinking.

The results indicated that a relatively small number of teachers perceived changes in domain-specific quality in diversity compared to those who reported changes in literacy, numeracy, and science. Only ten teachers reported progress in promoting gender and racial equality, such as challenging gender stereotypes and decorating the classroom with dolls of different skin colours. Gender stereotypes can develop early in childhood, as society provides strong cues for gender-stereotypical behaviours (Sullivan et al., 2018). This research provided the first insights into encouraging stereotype-violating behaviours that may help to change gender stereotypes. However, due to the small number of teachers who perceived this change, the conclusions we can draw are limited. There are several reasons why so few teachers reported changes in this area. Gender-related cues are ubiquitous, shaping an individual's beliefs and behaviours regarding gender. For example, everyday objects are often labelled with colours identified as male or female. In preschools, children tend to differentiate boys and girls by appearance, activities, and occupations (Seitz et al., 2020). Once children become aware of their gender, they learn the contextually acceptable traits of their gender and conform to these social norms to avoid sanction. Therefore, it may be challenging for short-time PD programmes to change teachers' gender stereotypes, which have developed over many years.

Furthermore, qualitative analysis revealed teachers' emphasis on the changes in teacher-child relationships. Specifically, children became more inclined to interact with teachers, invite teachers to play games, and engage in active conversations about their discoveries. The significance of high-quality teacher-child relationships in creating a safe and

supportive environment with social backing has been emphasised by scholars (McNally & Slutsky, 2018). This study further identified that improved interactions and learning environments also help to build a stronger teacher-child relationship. Alternatively, it is also possible that this association is more evident in Chinese culture, where children are culturally expected to show respect to teachers as authorities and follow their instructions (Cong, 2008). In fact, some teachers in our study reported that their students were fearful of them. Therefore, employing child-friendly approaches helped foster healthy and secure attachments between children and teachers, leading to a protective environment that enabled children to take on social and academic challenges and have meaningful school experiences (McNally & Slutsky, 2018). The findings indicated that changes in teacher behaviours can potentially have a positive effect on teacher-child relationships in the Chinese context.

8.3.3 Child Outcomes

As per the teachers' responses to the questionnaires, they observed changes in children's learning attitudes, social-emotional skills, and literacy skills. Specifically, children exhibited greater curiosity towards learning materials and print in the environment, and were more willing to express their emotions and collaborate with others. The qualitative data further reinforced the positive effects of the PD programme, indicating that it not only enhanced children's academic skills but also their social-emotional outcomes. In line with quantitative findings, children's skills in emergent literacy improved significantly following the implementation of the PD programme by their teachers. These findings align with recent studies, which demonstrated that teacher training is associated with improved literacy achievement among children (Piper et al., 2018). It is worth noting that achieving positive child outcomes in PD models is often challenging. However, this research showed significant effects on child outcomes, which may be attributed to the high-quality content of the PD

programme, the follow-up mentoring provided to the teachers, and the immediate, explicit feedback they received during practice.

It is noteworthy that teachers reported perceiving changes in children's learning attitudes, which were vital for their success in preschool settings. While active learning attitudes such as persistence, concentration, collaboration, and openness to new and challenging knowledge have been shown to predict children's academic school readiness outcomes (Bustamante et al., 2018), the literature on the connections between teachers' PD programmes and children's learning attitudes is not well-established. However, empirical evidence from the national FACES project in the USA, Head Start programme has indicated that children's approaches to learning can mediate the impacts of classroom quality on their school readiness gains (Bustamante & Hindman, 2019). Therefore, the finding from this research highlights the potential for exploring the links between providing PD programmes, classroom practice, children's learning motivation and child development in China.

Teachers also reported the impacts of PD programmes on children's social-emotional development, which contradicted the quantitative results. Teachers observed that children exhibited more stable emotions, improved collaborative skills, and better expressions of their feelings. However, the quantitative analysis did not identify any significant associations between PD programmes and children's conflict resolution, emotional awareness, friendships, personal awareness, and perspective-taking skills. The following factors could be considered in explaining the different results. First, teachers' perceptions of children's social-emotional skills contain possible bias (Mashburn et al., 2008). Their judgments of children's social-emotional skills could be influenced by their knowledge and cultural expectations of social-emotional development, and thus may not accurately reflect child development. Secondly, the social-cultural context makes a difference. Teachers traditionally received less training in understanding children's social-emotional development and dealing with problem

behaviours since the Chinese educational system has placed more emphasis on academic learning (Kam et al., 2011). Furthermore, teachers often regard social development as moral and civic education due to the influence of collectivism, which means that they may overlook personal development (Cong, 2008). For instance, children who suppress their emotions and do not engage in arguments or fights may be perceived as having better social development than those who prefer to express their feelings or solve conflicts. These findings indicated that cultural expectations of social-emotional development might contribute to the differences between direct assessment and teachers' reported results. Thus, a more culturally and contextually appropriate tool for measuring social-emotional development is needed in China. In summary, the qualitative analysis aligns with the quantitative findings regarding children's literacy development but differs concerning social-emotional development.

8.3.4 School Outcomes

In addition to examining the effects of PD on classroom quality and children's learning outcomes, this study also investigated the impacts at the school level. Specifically, participating teachers' improvements inspired their colleagues to make changes by giving lectures, opening their classrooms for colleagues' visits, and sharing what they had learned in the PD programme. These findings implied that professional learning is not an individual endeavour but is also influenced by teachers' interpersonal relationships, as they learn from each other and contribute to turning each other into professionals. While the importance of collective learning has been widely recognised as an effective approach to developing teachers' professional learning, empirical evidence in the context of kindergarten settings is still limited. Thus, this research contributes to bridging the research gap by demonstrating that PD programmes can facilitate collective learning and create a positive school culture. While many studies have examined the impacts of in-service PD programmes, the focus has

been primarily on classrooms and children. This research further sheds light on how teachers can support their colleagues' professional growth at the school level.

Professional growth among teachers can be facilitated by both externally provided training and job-embedded activities that enhance their professional knowledge and instructional practice (Wei et al., 2009). Job-embedded activities, in particular, are important sources of professional learning and promote reflection of teachers' professionalism. Teachers learn from each other through collaborative lesson planning, reflecting on their activities, and providing feedback to one another (Yin et al., 2019). As a result, professional learning can occur during daily work and teachers may adopt improved instructional practices learned from PD programmes through peer learning. This type of peer learning is especially valuable for those teachers who have not received direct intervention, as context-based PD initiatives can be tailored to meet their specific professional needs (Peleman et al., 2018).

The changes at the school level also reflected the collective learning culture in China, which values a continuous, collaborative, and reflective sharing of knowledge and practices among a group of people. Chinese teachers have a long tradition of engaging in collective learning, such as joint lesson planning and lesson observations (Tan, 2017). Collaborative learning is rooted in the specific teaching research system (Jiaoyan 教研). Teachers from the same classrooms or grades share a common office and work together. Empirical evidence confirms the existence of solid collective learning and shared practice in China, and highlights how the school education system and traditional culture support the development of learning communities (e.g., Zhang & Pang, 2016). Moreover, collective learning fosters interactions within schools, enhancing organisational change. The limited research on the links between providing PD programmes and learning communities in China suggests the need to further explore the unique contextual and cultural characteristics.

8.4 The Influencing Factors of PD Effects

8.4.1 The What Components of the PD Programme

The facilitators of the PD programme. The analysis of teachers' feedback revealed three main facilitators of the PD programme: content, rating scales, and feedback report. Firstly, the range of the PD programme combines content knowledge in literacy, numeracy, science and self-regulation, as well as expertise in scaffolding and sustained shared thinking. Instructional effectiveness can be influenced by different theoretical constructs, including general or domain-specific factors (Dulo, 2022). The generic constructs refer to instructional characteristics that go beyond disciplines, such as classroom management, teacher-child interaction, or environment settings. In contrast, content-specific constructs focus on unique instructional features related to specific learning content or subject matters (Charalambous et al., 2017). Additionally, teachers' pedagogical knowledge is associated with the generic constructs of instructional effectiveness, with their pedagogical content knowledge linked to content-specific constructs (Kyriakides & Tsangaridou, 2008). Therefore, combining pedagogical and content expertise can enhance teachers' instructional effectiveness.

Second, rating scales helped teachers identify the problems in their teaching practice and provided guidance for improvement. Standardised rating scales have been developed to assess the process quality in ECEC and used as coaching tools to enhance teachers' language and behaviours (Weadman et al., 2022). This research extended the discussion by utilising rating scales to profile teachers' strengths and weaknesses and document changes in their practices. The feedback from teachers indicated the benefits of using training tools. This finding aligns with adults' self-directed learning theory (Tough, 1971), which suggests that adult learners plan their learning and integrate it into their daily lives. Teachers can adjust their learning pace by using rating scales for self-documentation. In addition, the examination-oriented approach in the Chinese educational system may explain teachers'

positive feedback on rating scales. In China, exams are the predominant form of assessment, and prospective teachers must pass numerous tests before entering the profession. Exams drive learning in this context. Therefore, the Chinese educational system may influence teachers' perceptions of rating scales.

Third, the feedback report, which included detailed written feedback as part of the mentoring process, was mentioned by the teachers as a facilitator of the PD effects. Feedback plays a critical role in bridging the discrepancies between practice and established professional standards by identifying flaws in current practices. Providing feedback transforms the relationship between teaching and learning into a bidirectional one, as the information in the feedback can revise teachers' decisions on their teaching strategies (Marei et al., 2021). However, generic feedback that lacks specificity, relevance and acknowledgement may confuse and constrain teachers' improvement (Henderson et al., 2019). The feedback report in the mentoring process explicitly documented teachers' behaviour and language, identified areas for improvement, and provided specific and contextual suggestions that helped participants achieve their learning goals. Preschool teachers are often exhausted due to their busy and intense daily routines and must complete the preschool requirements before having time to think about professional growth (Levkovich & Gada, 2020). Therefore, providing written feedback is a valuable way to help teachers remember their to-do list in case they forget the content of oral feedback. This approach allows teachers to practice the suggested strategies at their own pace.

The constraints of the PD programme. Teachers face a number of challenges in implementing the strategies and knowledge gained from the PD programme, including difficulties with rating scales, scaffolding, and science instructions, as well as a lack of sufficient modelling. Although teachers have identified the positive impacts of using rating scales, they have raised concerns regarding the amount of information provided and the

appropriateness of the scales. The result suggested that examinations or standards may contribute to teachers' learning and also bring in passiveness. There are mainly two reasons for the passiveness. On the one hand, such passivity can be attributed to a desire to achieve the highest standards in the rating scales, akin to a student striving for the highest grades to demonstrate their abilities, thus leading to their learning anxiety. This reflects teachers' lack of understanding of the nature of professional growth. According to Shulman (1978), comprehension, reasoning, transformation, and reflection are the four procedures of teachers' changes in the training process. Comprehension of the training knowledge, transforming the learning into practice and reflecting on the outcomes guide teachers' actions. In light of this, explicit instruction on the appropriate use of rating scales is necessary for future professional development programmes. On the other hand, the challenges associated with cross-cultural contexts must also be taken into account. The development of measurements based on the expectations of one culture may not be appropriate for another, thus presenting difficulties in implementing rating scales in such contexts (Limlingan, 2011). Therefore, changes and adaptations should be made prior to their use in social and cultural contexts beyond their original development.

Teachers reported their challenges in providing scaffolding and science activities, both of which were identified as their weaknesses in the pilot study. Scaffolding is defined as the process in which adults support children to complete a task that is slightly beyond their current ability and gradually withdraw their support to enable children to complete the task independently (Vygotsky, 1978). Effective scaffolding entails engaging children in learning, providing appropriate feedback in responsive interactions, and transferring more responsibilities to children (Sun & Rao, 2012). It requires teachers to possess a thorough understanding of tasks and children to decide what kind of support to provide. Consequently, the intricacies of scaffolding may account for the findings indicating that teachers often fail

to use diverse scaffolding strategies (Pentimonti & Justice, 2010). In addition, it has been established that implementing science activities in preschools is a challenge due to the lack of pre-service education and in-service training. Furthermore, the crowded classrooms and physical inadequacy of classrooms exacerbate teachers' pressure on science activities (Dogan & Simsar, 2018). These results highlight the necessity for more training in scaffolding to enhance teachers' scaffolding skills.

The insufficiency of differentiation represents a significant challenge during the PD programme. Specifically, teachers in the workshops received identical content at the same pace, regardless of their working experiences or educational background. PD providers must advocate for responsive training, rather than adhering to the "one-size-fits-all" approach, by tailoring their delivery to teachers' diverse needs and knowledge of the curriculum and children (Hawkins, 2009, p. 11). As such, like the onsite mentoring process that can be responsive to teachers' individual needs, the collective workshops should also be differentiated to meet those needs. However, this approach requires smaller group sizes and additional time for implementation. In future PD programmes, it is essential to target specific content and provide differentiated instruction, such as assigning different tasks to teachers with varying abilities and working experiences.

8.4.2 The How Components of the PD Programme

The facilitators of the PD programme. The current study indicated that classroom observations and regular feedback were perceived by teachers as essential components of the PD program, contributing positively to their teaching practices. Through regular observations and feedback, teachers became aware of the limitations of their current teaching practices and received specific suggestions for improvement. Classroom observation is a crucial method of evaluating and recording teachers' practices and exposing them to new teaching strategies, particularly since teachers, even experienced ones, may not be aware of the patterns of their

instructional interaction (Halim et al., 2018). By providing teachers with feedback on their instructional practices, they were able to identify their strengths and weaknesses and gain insights into the potential consequences of their teaching behaviours. Moreover, as previously stated, years of repeating certain teaching behaviours can lead to the formation of unconscious teaching habits that are resistant to change (Loyalka et al., 2019; Sheeran & Webb, 2016). In this regard, classroom observation and feedback from external experts can provide new perspectives for teachers to reflect on their teaching behaviours consciously and make informed decisions, thus promoting habit change.

The constraints of the PD programme. Teachers also indicated the tight schedule and the lack of actual modelling in the delivery of PD programmes. The PD programme included weekly workshops and follow-up four biweekly on-site mentoring. However, teachers reported feeling overwhelmed by the amount of new information presented in the weekly workshops. This is understandable since school schedules do not typically incorporate time for professional development activities such as workshops, school visits, and peer observations (Gaikhorst et al., 2019). The tight schedule was also revealed in the FEEL project, which indicated that bi-weekly training was more appropriate for teachers as it allowed them one week to absorb the knowledge and one week for practice before bringing their reflections to new sessions (Siraj et al., 2018).

Moreover, collective events such as sports meetings and big performances draw teachers away from professional learning or even engagement with students, as they have to spend much time on rehearsals. In addition, teachers' busy routines, including lesson planning, teaching, and caring for children, further limit their available time for professional development activities. Several scholars have demonstrated that principal leadership can indirectly enhance collaboration and classroom quality by allocating specific time for PD in their daily schedules (Youngs & King, 2002). PD providers and principals can negotiate the

practice and reflection time embedded in teachers' schedules to promote the PD effects and alleviate teachers' anxiety regarding the tight schedule.

The lack of actual teaching modelling was identified as a concern by participating teachers. While the PD programme provided follow-up mentoring for teachers, mentors were responsible for delivering regular observation and feedback on teachers' teaching practices without actually modelling how to interact with young children. Current research suggested two possible solutions to this issue. Firstly, videos can be used to introduce and model new curricula, activities, and strategies, allowing teachers to discuss authentic activities and learn from teaching practice (Hollingsworth & Clarke, 2017). This PD programme provided videos to create vicarious experiences for teachers to observe actions and inspect decision-making in the videos. Comparing one's own and observed practices is a powerful mechanism for reflection (Schwarts & Karsenty, 2020). Secondly, teaching is a social-cultural activity, and teachers' decisions on teaching strategies may differ in different contexts. Therefore, while videos are helpful, actual modelling from experienced teachers or coaches may be more responsive to teachers' individual needs. Further PD programmes could incorporate experienced teachers to model teaching activities for participants.

8.4.3 The Who Components of the PD Programme

Teachers reported that children's improvements, family support, colleagues' recognition, inner motivation and trainers' support inspired them to sustain their changes. These results suggested that children's improvement was not only the result of effective PD programmes but also a factor influencing PD programmes. This supports Guskey's (2002) statement that changes in teachers' classroom practices are attributed to students' learning progress because children's learning outcomes imply the effectiveness of teachers' change. Children extend their knowledge through interacting with teachers, and teachers construct their teaching behaviour through interacting with children. This illustrated the bidirectional

relations underlie the mechanism of PD programmes. In addition, the perceived influence of children's family support extended current research in examining the influencing factors of PD programmes. Children's improvements and teachers' professional feedback on children's learning enables parents to recognise teachers' professionalism, which motivates teachers' professional learning. A virtuous circle can be built as teachers' professional knowledge further supports children's learning progress, which partly explains the working mechanism of effective PD programmes.

Furthermore, around half of the participating teachers highlighted the critical role of colleagues' recognition in motiving their improvement. In particular, teachers were more motivated to sustain their changes when their leaders and colleagues acknowledged and supported their progress. To some extent, advancing teachers' continuous learning requires a commitment to development that can be fostered by ongoing positive feedback from peers (Marei et al., 2021). Support from leaders and colleagues helps teachers transform what they have learned into practice. This result reflected the importance of collaboration, as mentioned previously. On the contrary, less than a quarter of teachers emphasised their personal characteristics, such as learning motivation or training needs, which appears inconsistent with self-determination theory (Ryan & Deci, 2000) in adult learning. Collectivism in Chinese culture could explain this finding as the Chinese context values group success and is concerned with maintaining harmonious relations (Ren et al., 2021). Individuals tend to perform behaviours that conform to group values and build harmony in the community. Interestingly, teachers did not mention the constraints of the PD programme regarding the who components, which also reflected teachers' emphasis on harmony.

In addition, participating teachers placed a high value on the expertise of the trainers, which enabled them to identify the shortcomings in their teaching practices. This finding corroborates the notion that PD providers should possess a combination of content

knowledge, evaluation and monitoring skills, and interpersonal competencies to effectively support teacher learning (Cordingley et al., 2015). Successful facilitators work collaboratively with teachers to co-construct knowledge and encourage them to implement new strategies by providing appropriate challenges (Clarke & Hollingsworth, 2002).

8.4.4 The Contextual Factors

Contextual factors influence teachers' practices in their classrooms and kindergartens. First, the large class size was reported to hinder teachers from providing personalised guidance to young children, as teachers must ensure the safety of all children and attend to their needs simultaneously. This finding is consistent with prior research by several scholars, who have observed that large class sizes and the mismatch between the content and time allotted often result in teachers continuing to employ traditional teaching methods (Mohammed, 2020). However, this finding appears to contradict our quantitative result, which did not identify any significant associations between child-to-teacher ratio and classroom quality. Toth and Montagna's (2002) meta-analysis of this relation revealed mixed results, with some studies showing a positive relationship (e.g., Owuor, 2018) and others indicating the opposite (Tseng, 2010). The difficulties perceived by teachers in managing large class sizes could be explained by Blatchford and Russell's (2018) research, which found that class size did not directly affect attainment but did present challenges for teachers in making ongoing decisions about how to manage and teach children in large classes. Therefore, while class size may not directly affect teaching quality, it can present challenges to teachers and lead to negative perceptions.

Second, kindergarten plans and daily work practices influenced teachers' implementation of what they learned from PD training. Teachers were more likely to change their practices if PD programmes aligned with kindergartens' curriculum and standards. This point is consistent with Desimone's (2009) emphasis on coherence as a critical characteristic

of an effective PD programme. The extent to which a PD programme is consistent with district goals, schools, policies, students' learning standards, and teachers' knowledge and beliefs can influence teachers' aspirations. This is relevant to knowledge transfer, which determines how much teachers apply what they have learned to their jobs (García-Almeida., 2019). In addition, the findings extended Desimone's (2009) definition of coherence by showing that teachers consider the PD content as relevant and practical but require specific time to practice and integrate the content into their daily schedules. Therefore, coherence also includes the consistency of their daily schedules. These findings highlight the importance of building a PD-kindergarten partnership and integrating PD content into kindergartens' schedules in future PD programmes.

In summary, this chapter has discussed the results of the study on PD impacts and the influencing factors, as revealed by both quantitative and qualitative analysis. The adapted PD programme had positive impacts at four levels: child, teacher, classroom, and school. It improved children's emergent literacy, numeracy, and executive function skills, while also helping teachers identify and overcome their teaching challenges, improve their learning motivation and child-friendly awareness, and adopt intentional pedagogy. At the classroom level, the PD programme led to significant improvements in the environment settings and the instruction and interaction quality as measured by ECERS-E and SSTEW. The results also revealed that teachers' qualifications, degrees, age and school classifications, types and locations significantly influenced the improvements at the classroom level. Moreover, intervention teachers played a significant role in inspiring their colleagues' learning by providing lectures and teaching modelling.

Meanwhile, some facilitators and constraints were identified. Regarding the "what" component, the relevance of PD content, the use of rating scales, and the provision of continuous feedback reports facilitated the PD effectiveness; Nonetheless, teachers desired

differentiated PD content, more teaching modelling, and explicit guidance on using rating scales in classrooms. Regarding the "how" component, on-site mentoring was valued by teachers, and they required more time to practice and model teaching in their classrooms. In terms of the "who" components, the recognition from their colleagues and leaders was emphasised by teachers.

Chapter 9 Conclusions

9.1 Key Findings and Contributions

The current research identified that providing evidence-based in-service PD programmes can improve teachers' pedagogical quality and promote children's development in emergent literacy, numeracy and executive function skills by utilising both quantitative and qualitative approaches. As previously noted, ECEC plays an essential role in children's learning and development, and the positive influence of quality ECEC on child development persists until at least adolescence (Taggart et al., 2015). While only six children were randomly selected in each classroom, the teacher's improved pedagogical practice would affect all children in the classrooms. Therefore, the first contribution of this research is the enhancement of teaching and learning by conducting an effective PD programme in educational practice.

Second, the findings are significant considering the billions of pounds and substantial teacher hours invested in PD programmes each year. According to an international survey, teachers spend an average of 10.5 days per year participating in PD programmes, yet the effectiveness of these programmes remains largely unexamined (Sellen, 2016). In addition, public investment in ECEC has been increasing worldwide. However, the high cost of PD programmes has often generated low returns, with budgets yielding little effect, as only 10% of knowledge or skills are transferred in China's NTTP programme (Brion, 2020). Given the fragmented landscape of PD and the challenges that teachers face in providing high-quality teacher-child interaction, the adapted Leadership for Learning (LfL) PD programme represents a promising approach. Moreover, the framework for adapting effective PD programmes developed in this study could inform future intervention research.

Third, although current research on effective PD programmes and their impacts has been conducted, there is a dearth of studies on PD effectiveness in China, particularly with regard to its impacts on child development. This study thus begins to address this research gap by investigating PD effectiveness in a specific region of China, Shenzhen, which serves as a pilot site for national educational and economic reforms in China. Therefore, the effective PD programme in this study contributes to the reforms in Shenzhen, which can inform broader research aiming at enhancing the quality of teaching and learning in China. In addition, Since 2001, China has undergone significant reform in early childhood curriculum and pedagogy aimed at promoting participatory pedagogy and child-centeredness, individualising children's needs, and emphasising play-based learning (Huang et al., 2019). However, despite this reform, many Chinese teachers still rely on whole-class teaching and rarely conduct one-on-one or small-group pedagogical interactions, especially in rural places (Hu et al., 2016). Accordingly, the continuous in-service PD in this study aims to bridge the gap between policy-driven participatory pedagogy and the teacher-directed approach that is commonly observed in practice. Therefore, this research not only informs the development of effective PD programmes but also supports the implementation of pedagogical reforms in ECEC in China.

Fourth, this research is a cross-national and cross-cultural investigation that adapted the LfL PD programme from Australia into the Chinese context. While prior studies have discussed the challenges of cross-cultural adaptations of research, most of these adaptions have focused on validating rating scales in different languages or contexts (Byrne, 2016). In contrast, this research adapted a PD programme considering the social and cultural aspects of PD design, delivery, and communications, as well as knowledge structuring for learners from diverse cultural backgrounds. Specifically, this adaptation framework combined the theoretical framework of 3CPAs with three approaches of cross-national research and

empirical evidence in the Chinese context. This research extended current discussions on cross-national studies by proposing a comprehensive adaptation framework and operationalising it into practice using Li's (2007) 3CPAs framework. Additionally, the effective adaptation of Siraj et al.'s (2018) work provided a rigorous test of the cross-national transportability of the LfL PD programme, which could inform larger-scale and cross-national studies aimed to enhance children's learning outcomes.

Fifth, previous research has identified positive associations between classroom quality and child development and has investigated the impacts of PD programmes on classroom quality and child outcomes. However, few studies have explored the associations between changes in classroom quality and child development. The results of the multi-level modelling in this study indicated significant associations between quality improvements and child outcomes. Furthermore, Pianta et al. (2021) identified that greater improvements in instructional quality predicted a greater increase in child development. Therefore, this study contributed to current research by implying a possible mechanism of how PD works on classroom quality and child development. Moreover, this study revealed some significant moderators that influenced the impacts of PD on classroom quality and child development. These findings could inform the future PD intervention in PD design and participant selection to make the PD programmes appropriate to participants' needs.

Sixth, based on the Model of Change (Egert et al., 2018), this research observed the effects of the PD programme on child, teacher, and classroom outcomes. Meanwhile, going beyond these changes, the results also revealed the school changes, such as inspiring colleagues' improvement and building a learning community. Therefore, this study also contributes to the Model of Change (Egert et al., 2018). In addition, the PD programme showed significant impacts on children's literacy, numeracy, and executive function skill, but not on social-emotional development. This suggests the differences between the development

of children's cognitive and social-emotional skills. Social-emotional skills are gradually shaped by social interactions, which may require a longer time to facilitate. Therefore, it is possible that merely focusing on teachers' pedagogical knowledge and practices in different developmental domains may not be sufficient for developing children's social-emotional outcomes. Future research is needed to explore the link between improvements in classroom quality and children's social outcomes.

9.2 Limitations and Future Research Directions

The present research could be further enhanced in the following ways. First, in terms of the research design, all participants were from Shenzhen, a special economic zone with a more developed social-economic status than other parts of China. Therefore, caution is needed when generalising the findings, as the educational resources and contextual features are diverse across China. This limitation highlights two possible directions for future research. The first is to include samples from less developed or rural areas to examine the PD's effectiveness on teaching and learning, as these areas tend to have less qualified teachers and limited resources. The second is to engage participants from more developed regions with mature educational systems to examine PD effectiveness. Additionally, future research could compare the effectiveness of PD programmes in different contexts to inform adaptations that make the programmes more appropriate to diverse contexts and increase their flexibility.

Second, in terms of the sample size, it should be noted that only 24 kindergartens and six children in each classroom were included in this study. While children were randomly selected from each classroom, selection bias may have influenced the results. For example, teachers may have recommended only a few children for assessment if some randomly selected children were absent due to health problems or family issues. Moreover, the sample size of children in each classroom cluster did not support the three-level modelling that

involves child-, classroom-, and kindergarten levels. As a result, it remains unknown whether classroom quality mediates the effects of PD on child development. Therefore, future research should consider increasing the sample size of young children in each classroom to further explore the working mechanism of PD programmes by adopting more comprehensive models. Based on the present study, future research should conduct a power analysis regarding three-level models when determining the sample size in each cluster. A sufficient sample size would enable future research to explore how PD affects teachers and children, thus contributing to current discussions on the model of change.

Third, the present research was conducted during the Covid-19 pandemic, which necessitated adjustments to the implementation of PD programmes to accommodate emergencies, such as changing schedules of workshops, on-site mentoring, and teachers taking leave due to quarantine. These factors, along with the pandemic's influence, contribute to additional covariates in the study compared to the FEEL project. To future test the effectiveness of the PD programme, future research should consider conducting studies during typical periods while controlling for covariates related to Covid-19, such as the number of children not attending school due to Covid-19, teacher absenteeism due to health problems, and working conditions. These considerations may lead to more robust findings that can inform PD programme design during extraordinary periods.

Fourth, despite the experience children gain from attending preschools, the home learning environment is another significant predictor of their current and long-term development, with a larger effect size than preschool variables (Melhuish et al., 2008). Siraj et al. (2018) found that children whose mothers were more educated or from higher-income families performed better on literacy and numeracy development, suggesting that family backgrounds and home environments may also influence the PD effects on child development. Therefore, the impacts of family backgrounds and the home environment

deserve attention for further exploration. However, this project did not collect information on children's home learning environments due to time constraints and the lack of suitable measurements in China. Future research should address this issue by collecting relevant information and controlling variables to explore the PD effects. Additionally, it is worth exploring whether these variables would moderate the impacts of PD on child development, as the result can inform the target PD participants.

Fifth, the current PD programme provided personalised on-site mentoring for teachers, yet the workshop sessions were delivered in a traditional face-to-face setting led by experts, which might not cater to teachers' diverse needs. Therefore, a survey of teachers' prior knowledge and desired improvement areas could be conducted to tailor the PD sessions to their individual needs. Differentiating teachers' training according to their baseline assessment might be another way to provide individualised PD. In addition, empowering the principals, curriculum coordinators and teachers to explore, explain and exchange information on the PD content might make the PD training personally and professionally relevant (McDonald, 2016). Incorporating assessments into the PD programme would also allow teachers to set goals, track their progress and reflect on how to integrate the PD sessions into their classroom practices. These approaches should be considered in future research to improve PD effectiveness and ensure that it meets the diverse needs of teachers.

Last but not least, the current research revealed that the ECERS-E diversity dimension demonstrated less improvement compared to other aspects of the ECERS-E scale. This finding is consistent with Siraj et al.'s (2018) observation of non-significant changes in ECERS-E diversity in the intervention group. Implementing instruction based on children's different genders, cultural backgrounds, and developmental levels is challenging for teachers. The present study's findings suggest that although the adapted LfL PD programme led to significant improvements, the changes in the diversity dimension were relatively small. These

results highlight the need for further adaptations of the LfL PD programme to address the diversity aspect comprehensively. Specifically, the programme should support teachers in understanding and accommodating children's differences in gender, temperament, interests, learning styles, life experiences, and culture, enabling them to provide more individualised teaching.

9.3 Implications

There are several theoretical and practical implications of this research. First, this study contributes to the ongoing discussion on cross-cultural research by demonstrating the procedure of cross-cultural adaptations of the LfL PD programme. The adapted PD programme proved to be effective in promoting teachers' teaching and children's cognitive development across different cultural contexts. These findings suggest that sociocultural elements must be carefully considered to guide the adaptation of PD programmes. However, it is important to note that our adapted PD programmes did not promote children's social-emotional development as effectively as the original LfL PD. It is possible that children's social-emotional development is more strongly influenced by social-cultural factors and may not improve as quickly as cognitive development. Children's previous experience and knowledge would affect their social capabilities when they are still under the same cultural expectations and contextual demands. Therefore, it is recommended that future research consider the role of sociocultural forces in explaining the significant improvements in literacy, numeracy, and executive function observed in our study, as well as the non-significant improvements in social-emotional development.

Moreover, practitioners need to consider the effectiveness of PD programmes when arranging or participating in PD training. Merely advocating for teachers to engage in in-service training or increasing investment in teachers' training is insufficient to improve the ECEC quality, as only effective PD programmes will have a positive impact. For

policymakers and practitioners, providing PD programmes for teachers without evaluating their effectiveness may result in a waste of teachers' time and public resources. Evidence-based decision-making is necessary to establish a solid foundation for improving ECEC quality. For scholars, designing PD programmes based on substantial research evidence and special context, rigorously examining PD effectiveness, and improving the PD programme through continual assessment would contribute to current knowledge of PD effectiveness and practice. As informed by the theory of change (Weiss, 1997), when establishing a new PD programme, it is crucial to integrate desired outcomes, implementation approaches, and contextual factors to promote ECEC quality.

Fostering the development and unlocking the full potential of young children play pivotal roles in fostering human capital growth and securing a sustainable future. Therefore, it is important to involve various stakeholders in collaborative planning for ECEC reforms. In this study, the process of adapting a PD programme involving various stakeholders can contribute to its effectiveness as it facilitates consensus-building among researchers, teachers and school leaders regarding the aim, content and delivery approach of PD programme. Moreover, the significant policy-practice gap in Shenzhen ECEC systems highlights the challenges of a top-down policy-making approach and underscores the importance of obtaining broad consensus among policymakers, practitioners, school leaders, researchers, and other stakeholders regarding ECEC provision and quality. Therefore, this study also has implications for policy-makers, suggesting that in addition to their authoritative role, they should undertake coordination responsibilities to minimise fragmentation in policy development, implementation and evaluation (Hasan, 2007).

In terms of the implications for future research, the current study demonstrated that in-service and evidence-based PD programmes can effectively improve pedagogical quality and child development. In designing PD programmes for future studies, researchers may

consider constructing a PD framework based on the "what", "how", and "who" aspects of effective PD and integrating elements supported by research evidence. Additionally, the participants in this research emphasised the importance of on-site mentoring, regular classroom visits and feedback, and modelling teacher practice. It is, thereby, worthwhile for future research to explore the effectiveness of on-site coaching, as teachers require fresh input from outside experts to identify their teaching problems and monitor their improvements. These findings suggest that integrating multiple effective elements into PD programmes may further enhance the effectiveness of PD in improving pedagogical quality and child development.

9.4 Future Works

Future studies stemming from this research could explore the impact of the adapted LfL PD programme on various outcomes, including classroom quality, teacher beliefs, self-efficacy, and leadership. Although the current research suggested that teachers who participated in the intervention demonstrated improvements in classroom quality, as measured by ECERS-E and SSTEW, the collected information on teachers' beliefs, self-efficacy and leadership has not been analysed due to time constraints. Future research could integrate the impacts of PD on teachers' characteristics, classroom quality, and child development to provide a whole picture of the PD effects. This could enhance our understanding of the overall effectiveness of PD programmes.

Some academic papers could be generated based on this research to explore the effects of PD programmes on children's development. For one thing, based on the initial report, a paper could be prepared to investigate the impacts of the PD programme on children's emergent literacy, numeracy, executive function, and social-emotional development. These results would highlight the importance of evidence-based PD in promoting children's academic attainment and shed light on the differences between

cognitive development and social-emotional development. For the other thing, exploring the influencing factors of PD effectiveness would be another direction of future papers, which aims to explore the facilitators and challenges of improving teachers' practice through evidence-based PD programmes.

Exploring the indirect impacts of PD on child outcomes via classroom quality. The current data analysis has focused on the direct impacts of PD intervention on classroom quality, teachers' characteristics, and child development. However, exploring the indirect association of PD with child outcomes via classroom quality is also crucial. Previous research has revealed that classroom quality significantly predicted child academic attainment (Hu et al., 2019). In line with this, the current study also found that the score change in the ECERS-E function on executive function (B = - 4.752, p < .05) and emergent numeracy (B = - 11.356, p < .001). Yet, the extent to which the PD intervention operates on emergent numeracy and executive function by influencing classroom quality remains unclear. Therefore, further analysis is warranted to examine the indirect relationship using Structural Equation Modelling, with intervention as the independent variable, classroom quality as the mediator, and child outcomes as the dependent variable.

References

Abraham, C., Sheeran, P., & Johnston, M. (1998). From health beliefs to self-regulation: Theoretical advances in the psychology of action control. *Psychology and Health*, *13*(4), 569-591.

Ahmad, M., Badusah, J., Mansor, A. Z., Abdul Karim, A., Khalid, F., Daud, M. Y., ... & Zulkefle, D. F. (2016). The Application of 21st Century ICT Literacy Model among Teacher Trainees. *Turkish Online Journal of Educational Technology-TOJET*, *15*(3), 151-161.

Ainsworth, M. S. (1989). Attachments beyond infancy. *American psychologist*, *44*(4), 709.

Alderman, M. K. (2013). *Motivation for achievement: Possibilities for teaching and learning*. Routledge.

Allison, P. D. (1990). Change scores as dependent variables in regression analysis. *Sociological methodology*, 93-114.

Alvestad, T., & Sheridan, S. (2015). Preschool teachers' perspectives on planning and documentation in preschool. *Early Child Development and Care*, *185*(3), 377-392.

Angelle, P. S., & DeHart, C. (2010). A four factor model of teacher leadership: Construction and testing of the Teacher Leadership Inventory. In *annual meeting of the American Educational Research Association, Denver, CO*.

Ansari, A., & Pianta, R. C. (2019). Teacher–child interaction quality as a function of classroom age diversity and teachers' beliefs and qualifications. *Applied Developmental Science*, *23*(3), 294-304.

Argentin, G., Pennisi, A., Vidoni, D., Abbiati, G., & Caputo, A. (2014). Trying to raise (low) math achievement and to promote (rigorous) policy evaluation in Italy: Evidence from a large-scale randomized trial. *Evaluation review*, *38*(2), 99-132.

Avalos, B. (2011). Teacher professional development in teaching and teacher education over ten years. *Teaching and teacher education*, *27*(1), 10-20.

Avidov-Ungar, O. (2016). A model of professional development: Teachers' perceptions of their professional development. *Teachers and Teaching*, *22*(6), 653-669.

Awang, Z., Yakob, N., Hamzah, A., & Talling, M. M. (2020). Exploring STEAM Teaching in Preschool Using Fred Rogers Approach. *International Journal of Evaluation and Research in Education*, *9*(4), 1071-1078.

Babinski, L. M., Amendum, S. J., Knotek, S. E., Sánchez, M., & Malone, P. (2018). Improving young English learners' language and literacy skills through teacher professional development: A randomized controlled trial. *American Educational Research Journal*, *55*(1), 117-143.

Baldwin, T. T., & Ford, J. K. (1988). Transfer of training: A review and directions for future research. *Personnel psychology*, *41*(1), 63-105.

Ball, D. L., Hill, H. C., & Bass, H. (2005). Knowing mathematics for teaching: Who knows mathematics well enough to teach third grade, and how can we decide?.

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of social and clinical psychology*, *4*(3), 359-373.

Baraldi, C. (2021). The Approach of the CHILD-UP Project to Children-Centred and Dialogic Education. *Migrant Children's Integration and Education in Europe*, 119.

Barenthien, J., Oppermann, E., Anders, Y., & Steffensky, M. (2020). Preschool teachers' learning opportunities in their initial teacher education and in-service professional development–do they have an influence on preschool teachers' science-specific professional knowledge and motivation?. *International Journal of Science Education*, *42*(5), 744-763.

Barth, R. S. (2001). Teacher leader. Phi Delta Kappan, 82, 443–449.

Bassok, D., Dee, T. S., & Latham, S. (2019). The effects of accountability incentives in early childhood education. *Journal of Policy Analysis and Management, 38*(4), 838-866.

Bates, C. C., & Morgan, D. N. (2018). Seven elements of effective professional development. *The Reading Teacher*, *71*(5), 623-626.

Bergman Deitcher, D., Aram, D., Khalaily-Shahadi, M., & Dwairy, M. (2021). Promoting preschoolers' mental-emotional conceptualization and social understanding: A shared book-reading study. *Early Education and Development*, *32*(4), 501-515.

Blatchford, P., & Russell, A. (2019). Class size, grouping practices and classroom management. *International Journal of Educational Research*, *96*, 154-163.

Blewitt, C., O'Connor, A., Morris, H., May, T., Mousa, A., Bergmeier, H., ... & Skouteris, H. (2021). A systematic review of targeted social and emotional learning interventions in early childhood education and care settings. *Early Child Development and Care*, *191*(14), 2159-2187.

Boles, K., & Troen, V. (1994). Teacher Leadership in a Professional Development School.

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational researcher*, *33*(8), 3-15.

Bourgeois, E., & Nizet, J. (1997). Apprentissage et formation des adultes Paris: Presses universitaires de France.

Brackett, M. A., Rivers, S. E., Reyes, M. R., & Salovey, P. (2012). Enhancing academic performance and social and emotional competence with the RULER feeling words curriculum. *Learning and Individual Differences*, *22*(2), 218-224.

Brady, S., Gillis, M., Smith, T., Lavalette, M., Liss-Bronstein, L., Lowe, E., ... & Wilder, T. D. (2009). First grade teachers' knowledge of phonological awareness and code concepts: Examining gains from an intensive form of professional development and corresponding teacher attitudes. *Reading and writing*, *22*(4), 425-455.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101.

Bredekamp, S., & Copple, C. (1997). *Developmentally Appropriate Practice in Early Childhood Programs (Revised Edition)*: National Association for the Education of Young Children, 1509 16th Street, NW, Washington, DC 20036-1426.

Brendefur, J., Strother, S., Thiede, K., Lane, C., & Surges-Prokop, M. J. (2013). A professional development program to improve math skills among preschool children in Head Start. *Early Childhood Education Journal*, *41*(3), 187-195.

Brenneman, K., Lange, A., & Nayfeld, I. (2019). Integrating STEM into Preschool Education; Designing a Professional Development Model in Diverse Settings. *Early Childhood Education Journal*, *47*(1), 15-28.

Brion, C. (2020). Learning transfer: The missing linkage to effective professional development. *Journal of Cases in Educational Leadership*, *23*(3), 32-47.

Broekhuizen, M. L., Slot, P. L., van Aken, M. A., & Dubas, J. S. (2017). Teachers' emotional and behavioral support and preschoolers' self-regulation: Relations with social and emotional skills during play. *Early Education and Development*, *28*(2), 135-153.

Bronfenbrenner, U., & Morris, P. A. (2006). The bioecological model of human development. In R. M. Lerner (Ed.), *Theoretical models of human development. Handbook of child psychology* (Vol. 1, 6th ed., pp. 793-828). Hoboken, NJ: Wiley.

Brown, A., & Danaher, P. (2008). Towards collaborative professional learning in the first year early childhood teacher education practicum: Issues in negotiating the multiple interests of stakeholder feedback. *Asia-Pacific Journal of Teacher Education*, *36*(2), 147-161.

Brown, E. T., Molfese, V. J., & Molfese, P. (2008). Preschool student learning in literacy and mathematics: Impact of teacher experience, qualifications, and beliefs on an at-risk sample. *Journal of Education for Students Placed at Risk*, *13*(1), 106-126.

Brunsek, A., Perlman, M., Falenchuk, O., McMullen, E., Fletcher, B., & Shah, P. S. (2017). The relationship between the Early Childhood Environment Rating Scale and its revised form and child outcomes: A systematic review and meta-analysis. *PloS one*, *12*(6).

Burchinal, J., Zaslow, M., & Tarullo, L. (2016). Quality thresholds, features, and doses in early care and education: Secondary data analyses of child outcomes. *Monograph for the Society for Research in Child Development, 81,* 1– 128.

Burts, D. C., Buchanan, T. K., Charlesowrth, R., and Jambunathan, S. (2000). *Rating Scale for Measuring the Degree of Developmentally Appropriate Practice in Early Childhood Classrooms (3-5 Year Olds).* Baton Rouge, LA: Louisiana State University College of Education.

Bustamante, A. S., & Hindman, A. H. (2019). Classroom quality and academic school readiness outcomes in Head Start: The indirect effect of approaches to learning. *Early Education and Development*, *30*(1), 19-35.

Bustamante, A. S., White, L. J., & Greenfield, D. B. (2018). Approaches to learning and science education in Head Start: Examining bidirectionality. *Early Childhood Research Quarterly*, *44*, 34-42.

Buysse, V., Winton, P. J., & Rous, B. (2009). Reaching consensus on a definition of professional development for the early childhood field. *Topics in Early Childhood Special Education*, *28*(4), 235-243.

Byrne, B. M. (2016). Adaptation of assessment scales in cross-national research: Issues, guidelines, and caveats. *International Perspectives in Psychology: Research, Practice, Consultation*, *5*(1), 51.

Byrne, R. M. (2016). Counterfactual thought. *Annual review of psychology*, *67*(1), 135-157.

Charalambous, C. Y., Kyriakides, E., Tsangaridou, N., & Kyriakides, L. (2017). Exploring the reliability of generic and content-specific instructional aspects in physical education lessons. *School Effectiveness and School Improvement*, *28*(4), 555-577.

Chen, J. Q., & McCray, J. (2012). A conceptual framework for teacher professional development: The whole teacher approach. *NHSA dialog*, *15*(1), 8-23.

Chen, X. (2010). Socioemotional development in Chinese children. *Handbook of Chinese psychology*, 37-52.

Cherrington, S., & Thornton, K. (2015). The nature of professional learning communities in New Zealand early childhood education: an exploratory study. *Professional Development in Education*, *41*(2), 310-328.

Clarke, V., Braun, V., & Hayfield, N. (2015). Thematic analysis. *Qualitative psychology: A practical guide to research methods*, *3*, 222-248.

Clarke, D., & Hollingsworth, H. (2002). Elaborating a model of teacher professional growth. *Teaching and teacher education*, *18*(8), 947-967.

Cobanoglu, R., Capa-Aydin, Y., & Yildirim, A. (2019). Sources of teacher beliefs about developmentally appropriate practice: a structural equation model of the role of teacher efficacy beliefs. *European Early Childhood Education Research Journal, 27*(2), 195-207.

Cohen, D. K., Raudenbush, S. W., & Ball, D. L. (2003). Resources, instruction, and research. *Educational Evaluation and Policy Analysis, 25,* 119–142.

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge.

Cohrssen, C., & Niklas, F. (2019). Using mathematics games in preschool settings to support the development of children's numeracy skills. *International Journal of Early Years Education*, *27*(3), 322-339.

Cong, X. (2008). *Towards a framework of knowledge management in the chinese public sector: a case study of china customs*. University of Northumbria at Newcastle (United Kingdom).

Connell, J. P., & Kubisch, A. C. (1998). Applying a theory of change approach to the evaluation of comprehensive community initiatives: progress, prospects, and problems. *New approaches to evaluating community initiatives*, *2*(15-44), 1-16.

Copur-Gencturk, Y., & Papakonstantinou, A. (2016). Sustainable changes in teacher practices: A longitudinal analysis of the classroom practices of high school mathematics teachers. *Journal of Mathematics Teacher Education*, *19*(6), 575-594.

Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications.

Corcoran, T. B., McVay, S., & Riordan, K. (2003). Getting it right: The MISE approach to professional development.

Cordingley, P., Higgins, S., Greany, T., Buckler, N., Coles-Jordan, D., Crisp, B., ... & Coe, R. (2015). Developing great teaching: lessons from the international reviews into effective professional development.

Cordoba, T. E., & Sanders-Smith, S. C. (2018). A closer look: Socio-structural influences on teacher–child interactions during project work. *Journal of Early Childhood Research*, *16*(4), 407-420.

Costa, A. L., & Garmston, R. J. (2002). *Cognitive coaching: A foundation for renaissance schools*. Norwood, MA: Christopher-Gordon.

Cunningham, A. E., Zibulsky, J., & Callahan, M. D. (2009). Starting small: Building preschool teacher knowledge that supports early literacy development. *Reading and Writing*, *22*(4), 487-510.

Dalli, C. (2008). Pedagogy, knowledge and collaboration: Towards a ground-up perspective on professionalism. *European Early Childhood Education Research Journal*, *16*(2), 171-185.

Danis, B., & Harter, S. (1996). Self-perceptions of anorectic and bulimic female college students. *Unpublished manuscript, University of Denver, Denver, CO*.

Darling-Hammond, L., & McLaughlin, M. W. (1995). Policies that support professional development in an era of reform. *Phi delta kappan*, *76*(8), 597-604.

Darling-Hammond, L., & Richardson, N. (2009). Research review/teacher learning: What matters. *Educational leadership*, *66*(5), 46-53.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. Retrieved from https://static1.squarespace.com/static/56b90cb101dbae64ff707585/t/5ade348e70a6ad624d417339/1524511888739/NO_LIF~1.PDF

De Temple, J., & Snow, C. E. (2003). Learning words from books. *On reading books to children*, 29-48.

DeBaryshe, B. D., & Gorecki, D. M. (2007). An experimental validation of a preschool emergent literacy curriculum. *Early Education and development*, *18*(1), 93-110.

Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational researcher, 38*(3), 181–199.

Dettmers, C., Nedelko, V., Hassa, T., Starrost, K., & Schoenfeld, M. A. (2014). Video Therapy": Promoting hand function after stroke by Action Observation Training–a pilot randomized controlled trial. *Int J Phys Med Rehabil*, *2*(189), 2.

Dickinson, D. K., & Smith, M. W. (1994). Long-term effects of preschool teachers' book readings on low-income children's vocabulary and story comprehension. *Reading research quarterly*, 105-122.

Dixon, F. A., Yssel, N., McConnell, J. M., & Hardin, T. (2014). Differentiated instruction, professional development, and teacher efficacy. *Journal for the Education of the Gifted*, *37*(2), 111-127.

Dogan, Y., & Simsar, A. (2018). Preschool Teachers' Views on Science Education, the Methods They Use, Science Activities, and the Problems They Face. *International Journal of Progressive Education*, *14*(5), 57-76.

Downer, J. T., Kraft-Sayre, M. E., & Pianta, R. C. (2009). Ongoing, web-mediated professional development focused on teacher–child interactions: Early childhood educators' usage rates and self-reported satisfaction. *Early Education and Development*, *20*(2), 321-345.

Downer, J., Sabol, T. J., & Hamre, B. (2010). Teacher–child interactions in the classroom: Toward a theory of within-and cross-domain links to children's developmental outcomes. *Early Education and Development*, *21*(5), 699-723.

Dubosarsky, M. D. (2011). *Science in the eyes of preschool children: findings from an ınnovative research tool.* Unpublished phd thesis, The University of Minnesota, USA.

Dulo, A. A. (2022). In-service teachers' professional development and instructional quality in secondary schools in Gedeo Zone, Ethiopia. *Social Sciences & Humanities Open*, *5*(1), 100252.

Dunst, C. J. (2015). Improving the design and implementation of in-service professional development in early childhood intervention. *Infants & young children*, *28*(3), 210-219.

Durksen, T. L., Klassen, R. M., & Daniels, L. M. (2017). Motivation and collaboration: The keys to a developmental framework for teachers' professional learning. *Teaching and teacher education*, *67*, 53-66.

Early, D. M., Maxwell, K. L., Burchinal, M., Alva, S., Bender, R. H., Bryant, D., ... & Henry, G. T. (2007). Teachers' education, classroom quality, and young children's academic skills: Results from seven studies of preschool programs. *Child development*, *78*(2), 558-580.

Early , D. M. , Bryant , D. M. , Pianta , R. C. , Clifford , R. M. , Burchinal , M. R. , Ritchie , S. , … Barbarin , O. (2006). Are teachers' education, major, and credentials related to classroom quality and children's academic gains in pre-kindergarten? *Early Childhood Research Quarterly* , 21, 174–195.

Early, D. M., Maxwell, K. L., Ponder, B. D., & Pan, Y. (2017). Improving teacher-child interactions: A randomized controlled trial of Making the Most of Classroom Interactions and My Teaching Partner professional development models. *Early Childhood Research Quarterly*, *38*, 57-70.

Egert, F., Dederer, V., & Fukkink, R. G. (2020). The impact of in-service professional development on the quality of teacher-child interactions in early education and care: A meta-analysis. *Educational Research Review*, *29*, 100309.

Egert, F., Fukkink, R. G., & Eckhardt, A. G. (2018). Impact of in-service professional development programs for early childhood teachers on quality ratings and child outcomes: A meta-analysis. *Review of Educational Research*, *88*(3), 401-433.

Elder, L., & Paul, R. (2020). *Critical thinking: Tools for taking charge of your learning and your life*. Foundation for Critical Thinking.

Elmore, R. F., & Burney, D. (1997). *Investing in teacher learning: Staff development and instructional improvement in Community School District# 2, New York City*. National Commission on Teaching & America's Future, Box 117, Teachers College, Columbia University, New York, NY 10027.

European Commission. (2012). Supporting the Teaching Profession for Better Learning Outcomes. *Strasbourg: European Commission*.

Ezzaki, A. (2010). A multifaceted perspective on leadership for learning: A case study on Moroccan education, in Bush, T., Bell, L., & Middlewood, D. (eds). *The Principles of Educational Leadership & Management*. London: SAGE Publication Ltd.

Farquhar, S. & White, E. J. (2014). Philosophy and pedagogy of early childhood. *Educational Philosophy and Theory, 46,* 821-832.

Fischer, C., Fishman, B., Dede, C., Eisenkraft, A., Frumin, K., Foster, B., ... & McCoy, A. (2018). Investigating relationships between school context, teacher professional development, teaching practices, and student achievement in response to a nationwide science reform. *Teaching and Teacher Education*, *72*, 107-121.

Fives, H., & Buehl, M. M. (2012). Spring cleaning for the "messy" construct of teachers' beliefs: What are they? Which have been examined? What can they tell us?.

Florea, N. M., & Hurjui, E. (2015). Critical thinking in elementary school children. *Procedia-Social and behavioral sciences*, *180*, 565-572.

Fontaine, S. J. (2018). The role of reflective practice in professional development. *The Veterinary Nurse*, *9*(7), 340-347.

Francis, J., & Barnett, W. S. (2019). Relating preschool class size to classroom quality and student achievement. *Early childhood research quarterly*, *49*, 49-58.

Fuhs, M. W., Nesbitt, K. T., Farran, D. C., & Dong, N. (2014). Longitudinal associations between executive functioning and academic skills across content areas. *Developmental psychology*, *50*(6), 1698.

Fukkink, R. G., & Lont, A. (2007). Does training matter? A meta-analysis and review of caregiver training studies. *Early childhood research quarterly, 22*(3), 294-311.

Fullan, M. (1982). Implementing Educational Change: Progress at Last.

Fullan, M. (2007). Change theory as a force for school improvement. In *Intelligent leadership* (pp. 27-39). Springer, Dordrecht.

Gaikhorst, L., März, V., du Pré, R., & Geijsel, F. (2019). Workplace conditions for successful teacher professional development: School principals' beliefs and practices. *European journal of education*, *54*(4), 605-620.

García-Almeida, D. J. (2019). Knowledge transfer processes in the authenticity of the intangible cultural heritage in tourism destination competitiveness. *Journal of Heritage Tourism*, *14*(5-6), 409-421.

Gasteiger, H., & Benz, C. (2018). Enhancing and analyzing kindergarten teachers' professional knowledge for early mathematics education. *The Journal of Mathematical Behavior*, *51*, 109-117.

Gee, K. A. (2014). Multilevel growth modelling: an introductory approach to analyzing longitudinal data for evaluators. *American Journal of Evaluation*, *35*(4), 543-561.

Ginsburg, H., & Baroody, A. (1990). Children‟ s mathematical learning: A cognitive view. *Journal for Research in Mathematics Education, Monograph,(4)*, 51-210.

Glazzard, J., Denby, N., & Price, J. (2014). *Learning to teach*. McGraw-Hill Education (UK).

Glover, T. A., Nugent, G. C., Chumney, F. L., Ihlo, T., Shapiro, E. S., Guard, K., ... & Bovaird, J. (2016). Investigating Rural Teachers' Professional Development,

Instructional Knowledge, and Classroom Practice. *Journal of Research in Rural Education*, *31*(3), n3.

Goetz, T., Bieleke, M., Gogol, K., van Tartwijk, J., Mainhard, T., Lipnevich, A. A., & Pekrun, R. (2021). Getting along and feeling good: Reciprocal associations between student-teacher relationship quality and students' emotions. *Learning and Instruction*, *71*, 101349.

Gore, J., Lloyd, A., Smith, M., Bowe, J., Ellis, H., & Lubans, D. (2017). Effects of professional development on the quality of teaching: Results from a randomised controlled trial of Quality Teaching Rounds. *Teaching and Teacher Education*, *68*, 99-113.

Graham, L. J., White, S. L., Cologon, K., & Pianta, R. C. (2020). Do teachers' years of experience make a difference in the quality of teaching?. *Teaching and teacher education*, *96*, 103190.

Greenfield, P. M. (2009). Linking social change and developmental change: shifting pathways of human development. *Developmental psychology*, *45*(2), 401.

Grow, G. O. (1991). Teaching learners to be self-directed. *Adult education quarterly*, *41*(3), 125-149.

Guskey, T. R. (2002). Professional development and teacher change. *Teachers and teaching*, *8*(3), 381-391.

Hadar, L. & Brody, D. (2013). The interaction between group processes and personal professional trajectories in a professional development community for teacher educators. *Journal of Teacher Education*, *64*(2), 145-161.

Halim, S., Wahid, R. A., & Halim, T. (2018). Classroom observation-A powerful tool for continuous professional development (Cpd). *International Journal on Language, Research and Education Studies*, *2*(2), 162-168.

Hall, K., Cremin, T., Comber, B., & Moll, L. C. (Eds.). (2016). *International handbook of research on children's literacy, learning and culture*. John Wiley & Sons.

Halpin, P. F., Wolf, S., Yoshikawa, H., Rojas, N., Kabay, S., Pisani, L., & Dowd, A. J. (2019). Measuring early learning and development across cultures: Invariance of the IDELA across five countries. *Developmental psychology*, *55*(1), 23.

Hamre, B. K., Pianta, R. C., Burchinal, M., Field, S., LoCasale-Crouch, J., Downer, J. T., ... & Scott-Little, C. (2012). A course on effective teacher-child interactions: Effects on teacher beliefs, knowledge, and observed practice. *American Educational Research Journal*, *49*(1), 88-123.

Hasan, A. (2007). Public policy in early childhood education and care. *International Journal of Child care and education Policy*, *1*(1), 1-10.

Harms, T., Clifford, R. M., & Cryer, D. (1998). *Early childhood environment rating scale*. Teachers College Press, Columbia University, 1234 Amsterdam Avenue, New York, NY 10027.

Harris, A., & Jones, M. (2018). Professional learning communities and system improvement. In J. Hattie, G. Fulcher, & K. Ting (Eds.), *International handbook of educational effectiveness and improvement* (pp. 271-285). Springer.

Hartwig, S. J., & Schwabe, F. (2018). Teacher attitudes and motivation as mediators between teacher training, collaboration, and differentiated instruction. *Journal for educational research online*, *10*(1), 100-122.

Hawkins, V. J. (2009). Barriers to implementing differentiation: Lack of confidence, efficacy and perseverance. *New England Reading Association Journal*, *44*(2), 11-16.

Hayes, A. F. (2013). Mediation, moderation, and conditional process analysis. *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*, *1*, 20.

He, J., & van de Vijver, F. (2012). Bias and equivalence in cross-cultural research. *Online readings in psychology and culture*, *2*(2), 2307-0919.

Heckman, J. J. (2008). The case for investing in disadvantaged young children. *CESifo DICE Report, 6*(2), 3-8.

Henderson, M., Ryan, T., & Phillips, M. (2019). The challenges of feedback in higher education. *Assessment & Evaluation in Higher Education*.

Hiebert, J. (2013). The constantly underestimated challenge of improving mathematics instruction. In *Vital directions for mathematics education research* (pp. 45-56). Springer, New York, NY.

Hilton, A., Hilton, G., Dole, S., & Goos, M. (2016). Promoting middle school students' proportional reasoning skills through an ongoing professional development programme for teachers. *Educational Studies in Mathematics*, *92*(2), 193-219.

Ho, D. (2012). The paradox of power in leadership in early childhood education. *Peabody Journal of Education, 87*(2), 253-266.

Hollingsworth, H., & Clarke, D. (2017). Video as a tool for focusing teacher self-reflection: Supporting and provoking teacher learning. *Journal of Mathematics Teacher Education*, *20*(5), 457-475.

Housel, D. A. (2020). When co-occurring factors impact adult learners: Suggestions for instruction, preservice training, and professional development. *Adult Learning*, *31*(1), 6-16.

Howard, S. J., & Melhuish, E. (2017). An early years toolbox for assessing early executive function, language, self-regulation, and social development: Validity, reliability, and preliminary norms. *Journal of Psychoeducational Assessment*, *35*(3), 255-275.

Howard, S. J., Siraj, I., Melhuish, E. C., Kingston, D., Neilsen-Hewett, C., de Rosnay, M., . . . Luu, B. (2018). Measuring interactional quality in pre-school settings:

introduction and validation of the Sustained Shared Thinking and Emotional Wellbeing (SSTEW) scale. *Early Child Development and Care*, 1-14. doi:10.1080/03004430.2018.1511549

Howard, S., & Melhuish, E. (2017). An Early Years Toolbox for Assessing Early Executive Function, Language, Self-Regulation, and Social Development: Validity, Reliability, and Preliminary Norms. *Journal Of Psychoeducational Assessment*, *35*(3), 255-275. https://doi.org/10.1177/0734282916633009

Howe, C., & Mercer, N. (2007). Children's social development, peer interaction and classroom learning. Retrieved from: http://image.guardian.co.uk/sys-files/Education/documents/2007/12/14/learning.pdf

Hox, J. (2010). *Multilevel analysis: Techniques and applications, second edition.* New York: Routledge.

Hu, B. Y., Fan, X., Wu, Y., & Yang, N. (2017). Are structural quality indicators associated with preschool process quality in China? An exploration of threshold effects. *Early Childhood Research Quarterly*, *40*, 163-173.

Hu, B. Y., Zhou, Y., Chen, L., Fan, X., & Winsler, A. (2017). Preschool expenditures and Chinese children's academic performance: The mediating effect of teacher-child interaction quality. *Early Childhood Research Quarterly*, *41*, 37-49.

Hu, B., Mak, M. C. K., Neitzel, J., Li, K., & Fan, X. (2016). Predictors of Chinese early childhood program quality: Implications for policies. *Children and Youth Services Review, 70*, 152-162.

Hu, B., Zhou, Y., & Li, K. (2014). Pinpointing Chinese early childhood teachers' professional development needs through self-evaluation and external observation of classroom quality. *Journal of Early Childhood Teacher Education, 35*, 54-78.

Huang, R. (2018). Constructivisim in form, instructivism in function: a mixed-method investigation of instructional interactions in Chinese kindergartens. *HKU Theses Online (HKUTO)*.

Huang, R., Yang, W., & Li, H. (2019). On the road to participatory pedagogy: A mixed-methods study of pedagogical interaction in Chinese kindergartens. *Teaching and Teacher Education, 85*, 81-91.

Hudson, P. (2013). Mentoring as professional development:'growth for both mentors and mentee. *Professional development in education*, *39*(5), 771-783.

Hui, A. N., Lee, M. L., Yeung, P. S., Chick, J. H., Ho, A. K., & Ng, C. K. (2017). Enhancement of Quality in Early Childhood Education: Using the Early Childhood Environment Rating Scale-Extension (ECERS-E) and Revised (ECRES-R) as Formative Assessment Tools for Professional Development-An Experience from Hong Kong. *Asia-Pacific Journal of Research in Early Childhood Education*, *11*(3).

Hulpia, H. & Devos, G. (2010). How distributed leadership can make a difference in teachers' organizational commitment? A qualitative study. Teaching and teacher education, 26 (3), 565–575.

Inglehart, R., & Baker, W. E. (2000). Modernization, cultural change, and the persistence of traditional values. *American sociological review*, 19-51.

Jagers, R. J., Rivas-Drake, D., & Williams, B. (2019). Transformative social and emotional learning (SEL): Toward SEL in service of educational equity and excellence. *Educational Psychologist*, *54*(3), 162-184.

Jamil, F. M., Linder, S. M., & Stegelin, D. A. (2018). Early childhood teacher beliefs about STEAM education after a professional development conference. *Early childhood education journal*, *46*(4), 409-417.

Jennings, J. H., Sparta, D. R., Stamatakis, A. M., Ung, R. L., Pleil, K. E., Kash, T. L., & Stuber, G. D. (2013). Distinct extended amygdala circuits for divergent motivational states. *Nature*, *496*(7444), 224-228.

Jennings, P. A., & Greenberg, M. T. (2009). The prosocial classroom: Teacher social and emotional competence in relation to student and classroom outcomes. *Review of educational research*, *79*(1), 491-525.

Jiang, Y., Pang, L., & Sun, J. (2017). Early childhood teacher education in China. In N. Rao, J. Zhou, & J. Sun (Eds.), *Early childhood education in Chinese societies* (pp. 85-100): Dordrecht: Springer Netherlands.

Johnson, S. R., Finlon, K. J., Kobak, R., & Izard, C. E. (2017). Promoting student–teacher interactions: Exploring a peer coaching model for teachers in a preschool setting. *Early Childhood Education Journal*, *45*(4), 461-470.

Jones, L. D., Burts, D. C., Buchanan, T. K., & Jambunathan, S. (2000). Beginning prekindergarten and kindergarten teachers' beliefs and practices: Supports and barries to developmently appropriate practices. *Journal of Early Childhood Teacher Education*, *21*(3), 397-410.

Joyce, B., & Showers, B. (1982). The coaching of teaching. *Educational Leadership*, *40*(1), 4-10.

Joyce, B., & Showers, B. (2002). *Designing training and peer coaching: Our needs for learning.* VA: ASCD.

Justice, L. M., Kaderavek, J. N., Fan, X., Sofka, A., & Hunt, A. (2009). Accelerating preschoolers' early literacy development through classroom-based teacher–child storybook reading and explicit print referencing. *Language, Speech, and Hearing Services in Schools, 40*(1), 67-85.

Kalland, M., & Linnavalli, T. (2022). Associations Between Social-Emotional and Language Development in Preschool Children. Results from a Study Testing the Rationale for an Intervention. *Scandinavian Journal of Educational Research*, 1-14.

Kam, C. M., Wong, L. W. L., & Fung, K. M. S. (2011). Promoting social-emotional learning in Chinese schools: A feasibility study of PATHS implementation in Hong Kong.

Karademir, A., Kartal, A., & Türk, C. (2020). Science education activities in Turkey: A Qualitative comparison study in preschool classrooms. *Early Childhood Education Journal*, *48*(3), 285-304.

Kelly, M. P., & Moore, T. A. (2012). The judgement process in evidence-based medicine and health technology assessment. *Social Theory & Health*, *10*(1), 1-19.

Kim, K. (2005). Teacher beliefs and practices survey: Operationalizing the 1997 NAEYC guidelines. (Doctoral dissertation, Louisiana State University and Agricultural and Mechanical College, 2005). *Dissertation Abstract International, 66*, 2486.

Knowles, M. S. (1968). Andragogy, not pedagogy. *Adult leadership*, *16*(10), 350-352.

Knowles, M. S., Holton, E., & Swanson, R. (2005). The adult learner: the definitive classic in adult education and human resource development (6th). *Burlington, MA: Elsevier*.

Kokkinos, C. M. (2007). Job stressors, personality and burnout in primary school teachers. *British journal of educational psychology*, *77*(1), 229-243.

Kraft, M. A., Blazar, D., & Hogan, D. (2018). The effect of teacher coaching on instruction and achievement: A meta-analysis of the causal evidence. *Review of educational research*, *88*(4), 547-588.

Kreft, I. G., & De Leeuw, J. (1998). *Introducing multilevel modelling*. Sage.

Kuhn, D. (1999). A developmental model of critical thinking. *Educational researcher*, *28*(2), 16-46.

Kulgemeyer, C., & Riese, J. (2018). From professional knowledge to professional performance: The impact of CK and PCK on teaching quality in explaining situations. *Journal of Research in Science Teaching*, *55*(10), 1393-1418.

Kunter, M., Klusmann, U., Baumert, J., Richter, D., Voss, T., & Hachfeld, A. (2013). Professional competence of teachers: Effects on instructional quality and student development. *Journal of Educational Psychology*, *105*(3), 805.

Kyriakides, L., & Tsangaridou, N. (2008). Towards the development of generic and differentiated models of educational effectiveness: A study on school and teacher effectiveness in physical education. *British Educational Research Journal*, *34*(6), 807-838.

La Paro, K., & King, E. (2019). Professional Development in Early Childhood Education. *The Wiley Handbook of Early Childhood Care and Education*, 427.

Lai, E., & Cheung, D. (2015). Enacting teacher leadership: The role of teachers in bringing about change. *Educational management administration & leadership*, *43*(5), 673-692.

Lan, X., Liu, Y., Lv, H., Wang, X., Leng, J., & Du, S. (2009). Fiber reinforced shape-memory polymer composite and its application in a deployable hinge. *Smart Materials and Structures*, *18*(2).

Landry, S. H., Swank, P. R., Smith, K. E., Assel, M. A., & Gunnewig, S. B. (2006). Enhancing early literacy skills for preschool children: Bringing a professional development model to scale. *Journal of Learning Disabilities*, *39*(4), 306-324.

Lee, Y. S., Baik, J., & Charlesworth, R. (2006). Differential effects of kindergarten teacher's beliefs about developmentally appropriate practice on their use of scaffolding following inservice training. *Teaching and Teacher Education*, *22*(7), 935-945.

León, J. M. (2015). A baseline study of strategies to promote critical thinking in the preschool classroom. *GIST–Education and Learning Research Journal*, (10), 113-127.

Levkovich, I., & Gada, A. (2020). "The Weight Falls on My Shoulders": Perceptions of Compassion Fatigue Among Israeli Preschool Teachers. *Asia-Pacific Journal of Research in Early Childhood Education*, *14*(3), 91-112.

Lewis, J., & West, A. (2017). Early childhood education and care in England under austerity: continuity or change in political ideas, policy goals, availability, affordability and quality in a childcare market?. *Journal of Social Policy*, *46*(2), 331-348.

Leyva, D., Weiland, C., Barata, M., Yoshikawa, H., Snow, C., Treviño, E., & Rolla, A. (2015). Teacher–child interactions in Chile and their associations with prekindergarten outcomes. *Child development*, *86*(3), 781-799.

Li , K., Zhang, P., Hu, B. Y., Burchinal, M. R., Fan, X., & Qin, J. (2019). Testing the 'thresholds' of preschool education quality on child outcomes in China. *Early Childhood Research Quarterly, 47*, 445-456. doi:10.1016/j.ecresq.2018.08.003

Li, H. (2007). Story approach to integrated learning: The curricula and pedagogies. Hong Kong: Oxford University Press.

Li, H., & Chen, J. J. (2017). Evolution of the early childhood curriculum in China: The impact of social and cultural factors on revolution and innovation. *Early Child Development and Care*, *187*(10), 1471-1483.

Li, H., Corrie, L. F., & Wong, B. K. M. (2008). Early teaching of Chinese literacy skills and later literacy outcomes. *Early Child Development and Care*, *178*(5), 441-459.

Li, H., Rao, N., & Tse, S. K. (2012). Adapting Western Pedagogies for Chinese Literacy Instruction: Case Studies of Hong Kong, Shenzhen, and Singapore Preschools. *Early Education & Development, 23*(4), 603-621. doi:10.1080/10409289.2010.536441

Li, H., & Wang, X. C. (2008). Transformation of public kindergartens in Shenzhen: Internet study of public views. *Chinese Education & Society*, *41*(2), 41-70.

Li, H., Wong, J. M. S., & Wang, X. C. (2010). Affordability, accessibility, and accountability: Perceived impacts of the pre-primary education vouchers in Hong Kong. *Early Childhood Research Quarterly*, *25*(1), 125-138.

Li, H., Yang, W., & Chen, J. J. (2016). From 'Cinderella'to 'Beloved Princess': The evolution of early childhood education policy in China. . *International Journal of Child Care and Education Policy, 10*(1), 2.

Li, J., & Julian, M. M. (2012). Developmental relationships as the active ingredient: A unifying working hypothesis of "what works" across intervention settings. *American journal of orthopsychiatry*, *82*(2), 157.

Li, K., Hu, B. Y., Pan, Y., Qin, J., & Fan, X. (2014). Chinese early childhood environment rating scale (trial)(CECERS): A validity study. *Early Childhood Research Quarterly*, *29*(3), 268-282.

Li, M., Liu, L., & Fan, X. (2017). Is China pre-primary teacher workforce ready for a big jump in enrolment? In M. Li, J. L. Fox, & S. Grieshaber (Eds.), *Contemporary issues and challenges in early childhood education in the Asia-Pacific region* (pp. 741-780). Singapore: Springer.

Li, Y., Coplan, R. J., Archbell, K. A., Bullock, A., & Chen, L. (2016). Chinese kindergarten teachers' beliefs about young children's classroom social behavior. *Early Childhood Research Quarterly*, *36*, 122-132.

Lieb, S., & Goodlad, J. (2005). Principles of adult learning.

Limlingan, M. C. (2011). On the Right Track: Measuring Early Childhood Development Program Quality Internationally. *Current Issues in Comparative Education*, *14*(1), 38-47.

Lin, Y. C., & Magnuson, K. A. (2018). Classroom quality and children's academic skills in child care centers: Understanding the role of teacher qualifications. *Early Childhood Research Quarterly*, *42*, 215-227.

Lipowsky, F., & Rzejak, D. (2015). Key features of effective professional development programmes for teachers.

Liu, Y., & Feng, X. (2005). Kindergarten educational reform during the past two decades in mainland China: Achievements and problems. *International Journal of Early Years Education, 13*(2), 93-99.

Loyalka, P., Popova, A., Li, G., & Shi, Z. (2019). Does teacher training actually work? Evidence from a large-scale randomized evaluation of a national teacher training program. *American Economic Journal: Applied Economics*, *11*(3), 128-54.

Luneta, K. (2012). Designing continuous professional development programmes for teachers: A literature review. *Africa Education Review*, *9*(2), 360-379.

MacBeath, J. (2012). Leadership for learning: Concepts, principles and practice. Retrieved from http://oer.educ.cam.ac.uk/w/images/9/98/LfL-Concepts_Principles_Practices_cc_1.pdf

Macdonald, N., Gealy, A. M., & Tinney, G. (2021). Exploring the effect of an attachment intervention in areas of multiple deprivation on adult–child interaction and the implications for children's social, emotional and behavioural development. *Early Child Development and Care*, *191*(5), 670-684.

MacFarlane, B. (2012). Differentiating Teacher Professional Development with Design. *Understanding Our Gifted*, *24*(2), 9-14.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. Multivariate Behavioral Research, 39, 99–128. https://doi.org/ 10.1207/s15327906mbr3901_4

Malmberg, L. E., Hagger, H., Burn, K., Mutton, T., & Colls, H. (2010). Observed classroom quality during teacher education and two years of professional practice. *Journal of Educational Psychology*, *102*(4), 916.

Marei, A., Yoon, S. A., Yoo, J. U., Richman, T., Noushad, N., Miller, K., & Shim, J. (2021). Designing feedback systems: Examining a feedback approach to facilitation in an online asynchronous professional development course for high school science teachers. *Systems*, *9*(1), 10.

Markussen-Brown, J., Juhl, C. B., Piasta, S. B., Bleses, D., Højen, A., & Justice, L. M. (2017). The effects of language-and literacy-focused professional development on early educators and children: A best-evidence meta-analysis. *Early childhood research quarterly*, *38*, 97-115.

Mashburn, A. J., Pianta, R. C., Hamre, B. K., Downer, J. T., Barbarin, O. A., Bryant, D., ... & Howes, C. (2008). Measures of classroom quality in prekindergarten and children's development of academic, language, and social skills. *Child development*, *79*(3), 732-749.

Massey, S. L. (2004). Teacher–child conversation in the preschool classroom. *Early childhood education journal*, *31*(4), 227-231.

Mathers, S. J. (2022). Considerations when using rating scales to support teacher professional development: A commentary on Weadman, Serry and Snow (2022). *First Language*, 01427237221096512.

Mathers, S., Linskey, F., Seddon, J., & Sylva, K. (2007). Using quality rating scales for professional development: Experiences from the UK. *International Journal of Early Years Education*, *15*(3), 261-274.

Maude, S., Hodges, L. N., Brotherson, M. J., Hughes-Belding, K., Peck, N., Weigel, C., & Sharp, L. (2009). Critical reflections on working with diverse families: Culturally

responsive professional development strategies for early childhood and early childhood special educators. *Multiple Voices for Ethnically Diverse Exceptional Learners*, *12*(1), 38-53.

McCoy, D. C., & Wolf, S. (2018). Changes in classroom quality predict Ghanaian preschoolers' gains in academic and social-emotional skills. *Developmental Psychology*, *54*(8), 1582.

McCoy, D. C., Connors, M. C., Morris, P. A., Yoshikawa, H., & Friedman-Krauss, A. H. (2015). Neighborhood economic disadvantage and children's cognitive and social-emotional development: Exploring Head Start classroom quality as a mediating mechanism. *Early Childhood Research Quarterly*, *32*, 150-159.

McDonald, B. (2016). Individualised Professional Development in Higher Education. In *5th International Conference on Research in Humanities, Sociology and Education. London. http://icehm. org/upload/4871ED1116067. pdf [09.11. 2020]*.

McIntyre, E. M., Baker, C. N., & Overstreet, S. (2019). Evaluating foundational professional development training for trauma-informed approaches in schools. *Psychological services*, *16*(1), 95.

McLeod, R. H., Kaiser, A. P., & Hardy, J. K. (2019). The Relation Between Teacher Vocabulary Use in Play and Child Vocabulary Outcomes. *Topics in Early Childhood Special Education*, *39*(2), 103-116.

McNally, S., & Slutsky, R. (2018). Teacher–child relationships make all the difference: Constructing quality interactions in early childhood settings. *Early Child Development and Care*, *188*(5), 508-523.

McNerney, S., Corcoran Nielsen, D., & Clay, P. (2006). Supporting literacy in preschool: Using a teacher-observation tool to guide professional development. *Journal of Early Childhood Teacher Education*, *27*(1), 19-34.

Melhuish, E. C., Phan, M. B., Sylva, K., Sammons, P., Siraj-Blatchford, I., & Taggart, B. (2008). Effects of the home learning environment and preschool centre experience upon literacy and numeracy development in early primary school. *Journal of Social Issues*, *64*(1), 95-114.

Melhuish, E., & Gardiner, J. (2019). Structural factors and policy change as related to the quality of early childhood education and care for 3-4 year olds in the UK. *Frontiers in Education*, 4, 35.

Merriam, S. B. (2001). Andragogy and self-directed learning: Pillars of adult learning theory. *New directions for adult and continuing education, 89*, 3-14.

Ministry of Education in the People's Republic of China. (2010). 2010 National Primary and Secondary School Teachers. Retrieved from http://www.moe.gov.cn/srcsite/A10/s7058/201006/t20100630_92835.html

Ministry of Education in the People's Republic of China. (2012) The announcement of ministry of education's issuing the learning and developmental guidance of 3-6 years old children. Retrieved from http://www.moe.gov.cn/srcsite/A06/s3327/201210/t20121009_143254.html

Ministry of Education of the People's Republic of China. (2001). Outline of Kindergarten Education Guidance (for Trial Implementation). Retrieved from http://www.moe.gov.cn/srcsite/A06/s3327/200107/t20010702_81984.html

Ministry of Education of Peolple's Republic of China. (2013). Kindergarten Staffing Standards. Retrieved from: http://library.ttcdw.com/uploadfiles/wysztsg/1461663104.pdf

Ministry of Education of the People's Republic of China. (2015). *New achievements, new breakthroughs, and comprehensive advancement of China's preschool education*

reform and development (in Chinese). Retrieved from http://www.moe.gov.cn/jyb_xwfb/s5148/201511/t20151124_220801.html

Ministry of Education of the People's Republic of China. (2016). 2016 National Education Development Statistical Bulletin. Retrieved from http://www.moe.gov.cn/jyb_sjzl/sjzl_fztjgb/201707/t20170710_309042.html

Ministry of Education of the People's Republic of China. (2022). *2021 National Education Development Statistics Bulletin. (in Chinese)*. Retrieved from http://www.moe.gov.cn/jyb_sjzl/sjzl_fztjgb/202209/t20220914_660850.html

Ministry of Education of the People's Republic of China. (2019). *Report of the State Council on the Reform and Development of Preschool Education (in Chinese)*. Retrieved from http://www.npc.gov.cn/npc/c30834/201908/1c9ebb56d55e43cab6e5ba08d0c3b28c.shtml

Ministry of Finance of the People's Republic of China. (2021). *How much money is spent on where? Look at the central financial account of rural teacher construction together (in Chinese). Retrieved from http://www.mof.gov.cn/zhengwuxinxi/caijingshidian/gmrb/202109/t20210909_3751821.htm*

Mitchell, L., & Cubey, P. (2003). *Characteristics of professional development linked to enhanced pedagogy and children's learning in early childhood settings: Best evidence synthesis*. Wellington, New Zealand: Ministry of Education.

Mohammed, A. A. (2020). The Status of Teachers' Professional Development and Code of Ethics: The Case of Madda Walabu University—Ethiopia. *Open Access Library Journal*, *7*(6), 1-19.

Mukhalalati, B. A., & Taylor, A. (2019). Adult learning theories in context: a quick guide for healthcare professional educators. *Journal of medical education and curricular development*, *6*, 2382120519840332.

Murphy, C., Smith, G., & Broderick, N. (2021). A starting point: Provide children opportunities to engage with scientific inquiry and nature of science. *Research in Science Education*, *51*(6), 1759-1793.

National Professional Development Center on Inclusion (NPDCI). (2008). *What do we mean by professional development in the early childhood field?* Chapel Hill: The University of North Carolina, FPG Child Development Institute.

Neale, D. C., Smith, D., & Johnson, V. G. (1990). Implementing conceptual change teaching in primary science. *The Elementary School Journal*, *91*(2), 109-131.

Neuman, S. B., & Cunningham, L. (2009). The impact of professional development and coaching on early language and literacy instructional practices. *American Educational Research Journal*, *46*(2), 532-566.

Newsom. (2019). *Sample size issues and power.* Retrieved from http://web.pdx.edu/~newsomj/mlrclass/ho_sample%20size.pdf

O'Reilly, C., Devitt, A., & Hayes, N. (2022). Critical Thinking in the Preschool Classroom-A systematic literature review. *Thinking Skills and Creativity*, 101110.

OECD (2006), Starting Strong II: Early Childhood Education and Care, OECD, Paris.

OECD. (2016). *School leadership for learning: Insights from TALIS 2013.* OECD Publishing Paris. Retrieved from https://read.oecd-ilibrary.org/education/school-leadership-for-learning_9789264258341-en#page3

Ottley, J. R., Piasta, S. B., Mauck, S. A., O'Connell, A., Weber-Mayrer, M., & Justice, L. M. (2015). The nature and extent of change in early childhood educators' language and literacy knowledge and beliefs. *Teaching and Teacher Education*, *52*, 47-55.

Owuor, N. A. (2018). Class Size and Student Achievement. *UKH Journal of Social Sciences*, *2*(1), 19-24.

Pan, Y., Liu, Y., & Lau, E. Y. H. (2010). Evaluation of the Kindergarten Quality Rating System in Beijing. *Early Education & Development, 21*(2), 186-204. doi:10.1080/10409281003631134

Peleman, B., Lazzari, A., Budginaitė, I., Siarova, H., Hauari, H., Peeters, J., & Cameron, C. (2018). Continuous professional development and ECEC quality: Findings from a European systematic literature review. *European Journal of Education*, *53*(1), 9-22.

Pellicer, L. O., & Anderson, L. W. (1995). *A handbook for teacher leaders*. Corwin Press, Inc., Sage Publications, 2455 Teller Road, Thousand Oaks, CA 91320.

Peña-López, I. (2009). Creating effective teaching and learning environments: First results from TALIS.

Pentimonti, J. M., & Justice, L. M. (2010). Teachers' use of scaffolding strategies during read-aloud in the preschool classroom. *Early childhood education journal*, *37*(4), 241-248.

Perez Mejias, P., McAllister, D. E., Diaz, K. G., & Ravest, J. (2021). A longitudinal study of the gender gap in mathematics achievement: evidence from Chile. *Educational Studies in Mathematics*, *107*(3), 583-605.

Perren, S., Herrmann, S., Iljuschin, I., Frei, D., Körner, C., & Sticca, F. (2017). Child-centred educational practice in different early education settings: Associations with professionals' attitudes, self-efficacy, and professional background. *Early Childhood Research Quarterly*, *38*, 137-148.

Philippou, S., Papademetri-Kachrimani, C., & Louca, L. (2015). 'The exchange of ideas was mutual, I have to say': negotiating researcher and teacher 'roles' in an early years

educators' professional development programme on inquiry-based mathematics and science learning. *Professional development in education*, *41*(2), 382-400.

Piaget, J. (1954). The construction of reality in the child. New York, NYC: Basic.

Pianta, R. C., & Hamre, B. K. (2009). Conceptualization, measurement, and improvement of classroom processes: Standardized observation can leverage capacity. *Educational researcher*, *38*(2), 109-119.

Pianta, R. C., Lipscomb, D., & Ruzek, E. (2021). Coaching Teachers to Improve Students' School Readiness Skills: Indirect Effects of Teacher–Student Interaction. *Child Development*.

Pianta, R. C., Mashburn, A. J., Downer, J. T., Hamre, B. K., & Justice, L. (2008). Effects of web-mediated professional development resources on teacher–child interactions in pre-kindergarten classrooms. *Early childhood research quarterly, 23* (4), 431-451.

Pianta, R., Downer, J., & Hamre, B. (2016). Quality in early education classrooms: Definitions, gaps, and systems. *The Future of Children*, 119-137.

Pianta, R., Hamre, B., Downer, J., Burchinal, M., Williford, A., Locasale-Crouch, J., ... & Scott-Little, C. (2017). Early childhood professional development: Coaching and coursework effects on indicators of children's school readiness. *Early Education and Development*, *28*(8), 956-975.

Pianta, R., Howes, C., Burchinal, M., Bryant, D., Clifford, R., Early, D., & Barbarin, O. (2005). Features of pre-kindergarten programs, classrooms, and teachers: Do they predict observed classroom quality and child-teacher interactions?. *Applied developmental science*, *9*(3), 144-159.

Piper, B., Destefano, J., Kinyanjui, E. M., & Ong'ele, S. (2018). Scaling up successfully: Lessons from Kenya's Tusome national literacy program. *Journal of Educational Change*, *19*(3), 293-321.

Podhajski, B., Mather, N., Nathan, J., & Sammons, J. (2009). Professional development in scientifically based reading instruction: Teacher knowledge and reading outcomes. *Journal of learning disabilities*, *42*(5), 403-417.

Polly, D., S. Martin, C., McGee, J. R., Wang, C., Lambert, R. G., & Pugalee, D. K. (2016). Designing Curriculum-Based Mathematics Professional Development for Kindergarten Teachers. *Early Childhood Education Journal, 45*(5), 659-669. doi:10.1007/s10643-016-0810-1

Poo, M. M. (2019). Culture and history of Chinese science. *National Science Review*, *6*(4), 607-607.

Popova, A., Evans, D. K., Breeding, M. E., & Arancibia, V. (2022). Teacher professional development around the world: The gap between evidence and practice. *The World Bank Research Observer*, *37*(1), 107-136.

Prast, E. J., Van de Weijer-Bergsma, E., Kroesbergen, E. H., & Van Luit, J. E. (2018). Differentiated instruction in primary mathematics: Effects of teacher professional development on student achievement. *Learning and Instruction*, *54*, 22-34.

Qi, X., & Melhuish, E. C. (2017). Early childhood education and care in China: History, current trends and challenges. *Early Years*, *37*(3), 268-284. https://doi.org/10.1080/09575146.2016.1236780

Rao, N., Ng, S. S., & Pearson, E. (2010). Preschool pedagogy: A fusion of traditional Chinese beliefs and contemporary notions of appropriate practice. In *Revisiting the Chinese learner* (pp. 255-279). Springer, Dordrecht.

Rao, N., Sun, J., Zhou, J., & Zhang, L. (2012). Early achievement in rural China: The role of preschool experience. *Early Childhood Research Quarterly*, *27*(1), 66-76.

Raver, C. C., Jones, S. M., Li-Grining, C. P., Metzger, M., Champion, K. M., & Sardin, L. (2008). Improving preschool classroom processes: Preliminary findings from a

randomized trial implemented in Head Start settings. *Early childhood research quarterly*, *23*(1), 10-26.

Redifer, J. L., Bae, C. L., & DeBusk-Lane, M. (2019). Implicit theories, working memory, and cognitive load: impacts on creative thinking. *Sage Open*, *9*(1), 2158244019835919.

Reid, I., & Caudwell, J. (1997). Why did secondary PGCE students choose to teach as a career?. *Research in Education*, *58*(1), 46-58.

Ren, X., Cang, X., & Ryder, A. G. (2021). An integrated ecological approach to mapping variations in collectivism within China: introducing the triple-line framework. *Journal of Pacific Rim Psychology*, *15*, 1834490921991436.

Rimm-Kaufman, S. E., Curby, T. W., Grimm, K. J., Nathanson, L., & Brock, L. L. (2009). The contribution of children's self-regulation and classroom quality to children's adaptive behaviors in the kindergarten classroom. *Developmental psychology*, *45*(4), 958.

Roberts, A., LoCasale-Crouch, J., Hamre, B., & DeCoster, J. (2016). Exploring teachers' depressive symptoms, interaction quality, and children's social-emotional development in Head Start. *Early Education and Development*, *27*(5), 642-654.

Romano, M., & Woods, J. (2018). Collaborative coaching with early head start teachers using responsive communication strategies. *Topics in Early Childhood Special Education*, *38*(1), 30-41.

Rosenholtz, S. J. (1989). Workplace conditions that affect teacher quality and commitment: Implications for teacher induction programs. *The Elementary School Journal*, *89*(4), 421-439.

Roth, K. J., Garnier, H. E., Chen, C., Lemmens, M., Schwille, K., & Wickler, N. I. (2011). Videobased lesson analysis: Effective science PD for teacher and student learning. *Journal of Research in Science Teaching*, *48*(2), 117-148.

Rucker, K. (2018). The six flaws of "traditional" professional development. *Getting Smart*.

Rush, D. D., & Shelden, M. L. (2005). Evidence-based definition of coaching practices. *CASEinPoint*, *1*(6), 1-6.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist*, *55*(1), 68.

Salisu, W. J., Dehghan Nayeri, N., Yakubu, I., & Ebrahimpour, F. (2019). Challenges and facilitators of professional socialization: A systematic review. *Nursing Open*, *6*(4), 1289-1298.

Sammons et al. (2002), The Effective Provision of Pre-School Education (EPPE) Project: Technical Paper 8a - Measuring the Impact of Pre-School on Children's Cognitive Progress over the Pre-School Period, London: DfES/Institute of Education, University of London.

Sanders, Lianne MJ, et al. "Dose-response relationship between exercise and cognitive function in older adults with and without cognitive impairment: a systematic review and meta-analysis." *PloS one* 14.1 (2019).

Sandilos, L. E., Goble, P., Rimm-Kaufman, S. E., & Pianta, R. C. (2018). Does professional development reduce the influence of teacher stress on teacher–child interactions in pre-kindergarten classrooms?. *Early Childhood Research Quarterly*, *42*, 280-290.

Save the Children. (2011). *About IDELA - IDELA*. IDELA. Retrieved 1 July 2021, from https://idela-network.org/about/.

Sayre, R. K., Devercelli, A. E., Neuman, M. J., & Wodon, Q. (2015). *Investing in early childhood development: Review of the World Bank's recent experience*. Retrieved

from https://olc.worldbank.org/sites/default/files/Investing%20in%20Early%20Chidhood%20Development_Review%20of%20the%20WB%20Recent%20Experience_eBook_0.pdf

Schleppenbach, M., Flevares, L. M., Sims, L. M., & Perry, M. (2007). Teachers' responses to student mistakes in Chinese and US mathematics classrooms. *The elementary school journal*, *108*(2), 131-147.

Schmitt, S. A., Pratt, M. E., Korucu, I., Napoli, A. R., & Schmerold, K. L. (2018). Preschool classroom quality and social-emotional functioning: Findings across geographic regions. *Early Childhood Research Quarterly*, *43*, 11-22.

Schwarts, G., & Karsenty, R. (2020). "Can this happen only in Japan?": mathematics teachers reflect on a videotaped lesson in a cross-cultural context. *Journal of Mathematics Teacher Education*, *23*(6), 527-554.

Seger, C. A., & Spiering, B. J. (2011). A critical review of habit learning and the basal ganglia. *Frontiers in systems neuroscience*, *5*, 66.

Seitz, M., Lenhart, J., & Rübsam, N. (2020). The effects of gendered information in stories on preschool children's development of gender stereotypes. *British Journal of Developmental Psychology*, *38*(3), 363-390.

Sellen, P. (2016). Teacher workload and professional development in England's secondary schools: insights from TALIS. *Education policy institute*.

Shaari, M. F., & Ahmad, S. S. (2016). Physical learning environment: Impact on children school readiness in Malaysian preschools. *Procedia-Social and Behavioral Sciences*, *222*, 9-18.

Sheeran, P., & Webb, T. L. (2016). The intention–behavior gap. *Social and personality psychology compass*, *10*(9), 503-518.

Shenzhen Bureau of Statistics. (2022). Shenzhen 2021 National Economic and Social Development Statistical Bulletin. Retrieved from: http://tjj.sz.gov.cn/zwgk/zfxxgkml/tjsj/tjgb/content/post_9763042.html

Shenzhen goernment. (2022). Notice of Shenzhen Municipal People's Government on the issuance of the "14th Five-Year Plan" for the development of education in Shenzhen. Retrieved from: http://www.moe.gov.cn/srcsite/A06/s3327/201705/t20170502_303514.html

Shenzhen government. (2023). *Shenzhen residents per capita disposable income of 72,718 yuan in the Last year.* retrieved from http://www.sz.gov.cn/cn/ydmh/zwdt/content/post_10430794.html

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, *15*(2), 4-14.

Sims, S., & Fletcher-Wood, H. (2021). Identifying the characteristics of effective teacher professional development: a critical review. *School effectiveness and school improvement*, *32*(1), 47-63.

Siok, W. T., & Fletcher, P. (2001). The role of phonological awareness and visual-orthographic skills in Chinese reading acquisition. *Developmental psychology*, *37*(6), 886.

Siraj-Blatchford, I., Sylva, K., Muttock, S., Gilden, R., & Bell, D. (2002). *Researching effective pedagogy in the early years*. Retrieved from http://www.327matters.org/docs/rr356.pdf

Siraj-Blatchford, I., Sylva, K., Taggart, B., Sammons, P., Melhuish, E., & Elliot, K. (2003). *The Effective Provision of Pre-School Education [EPPE] Project: A longitudinal study funded by the DfES (1997–2003) technical paper 10 intensive case studies of*

practice across the foundation stage. Retrieved from http://www.ioe.ac.uk/EPPETechnicalPaper_10_2003.pdf

Siraj, I., & Kingston, D. (2015). An independent review of the Scottish Early Learning and Childcare (ELC) workforce and Out of School Care (OSC) workforce.

Siraj, I., Kingston, D., & Melhuish, E. (2015). *Assessing quality in early childhood education and care. Sustained shared thinking and emotional wellbeing (SSTEW) Scale for 2–5 year olds provision.* London: UCL and IOE Press.

Siraj, I., Kingston, D., & Neilsen-Hewett, C. (2019). The Role of Professional Development in Improving Quality and Supporting Child Outcomes in Early Education and Care. *Asia-Pacific Journal of Research in Early Childhood Education*, *13*(2).

Siraj, I., Kingston, D., Neilsen-Hewett, C. M., Howard, S. J., Melhuish, E., de Rosnay, M., ... & Luu, B. (2016). Fostering Effective Early Learning: A review of the current international evidence considering quality in early childhood education and care programmes-in delivery, pedagogy and child outcomes.

Siraj, I., Kingston, K., Neilsen-Hewett, C., Howard, S. J., Melhuish, E., de Rosnay, M.,...Luu, B. (2017). *A review of the current international evidence considering quality in early childhood education and care programmes– in delivery, pedagogy and child outcomes.* Sydney: NSW Department of Education.

Siraj, I., Melhuish, E., Howard, S., Neilsen-Hewett, C., Kingston, D., de Rosnay, M., Duursma, E., Feng, X. & Luu, B. (2018). *Fostering Effective Early Learning (FEEL) Study: Final Report.* Sydney, Australia: NSW Department of Education.

Siraj, I., Melhuish, E., Howard, S. J., Neilsen-Hewett, C., Kingston, D., De Rosnay, M., ... & Luu, B. (2023). Improving quality of teaching and child development: A randomised controlled trial of the leadership for learning intervention in preschools. *Frontiers in Psychology*, *13*, 8061. doi: 10.3389/fpsyg.2022.1092284

Slot, P. L., Bleses, D., Justice, L. M., Markussen-Brown, J., & Højen, A. (2018). Structural and process quality of Danish preschools: Direct and indirect associations with children's growth in language and preliteracy skills. *Early Education and Development*, *29*(4), 581-602.

Smith, C., & Gillespie, M. (2007). Research on professional development and teacher change: Implications for adult basic education. *Review of adult learning and literacy*, *7*(7), 205-244.

Snyder, P., Hemmeter, M. L., McLean, M., Sandall, S., McLaughlin, T., & Algina, J. (2018). Effects of professional development on preschool teachers' use of embedded instruction practices. *Exceptional Children*, *84*(2), 213-232.

Snyder, P., Hemmeter, M. L., Meeker, K. A., Kinder, K., Pasia, C., & McLaughlin, T. (2012). Characterizing key features of the early childhood professional development literature. *Infants & Young Children*, *25*(3), 188-212.

Speck, M., & Knipe, C. (Eds.). (2005). *Why Can' t We Get It Right?: Designing High-Quality Professional Development for Standards-Based Schools*. Corwin Press.

Sullivan, J., Moss-Racusin, C., Lopez, M., & Williams, K. (2018). Backlash against gender stereotype-violating preschool children. *PloS one*, *13*(4), e0195503.

Sun, J., & Rao, N. (2012). Scaffolding preschool children's problem solving: A comparison between Chinese mothers and teachers across multiple tasks. *Journal of Early Childhood Research*, *10*(3), 246-266.

Suprayogi, M. N., Valcke, M., & Godwin, R. (2017). Teachers and their implementation of differentiated instruction in the classroom. *Teaching and Teacher Education*, *67*, 291-301.

Sutherland, K. S., Conroy, M. A., Algina, J., Ladwig, C., Jessee, G., & Gyure, M. (2018). Reducing child problem behaviors and improving teacher-child interactions and

relationships: A randomized controlled trial of BEST in CLASS. *Early Childhood Research Quarterly*, *42*, 31-43.

Sylva, K., Siraj-Blatchford, I., & Taggart, B. (2003). Assessing quality in the early years: Early Childhood Environment Rating Scale: Extension (ECERS-E). Stoke-on-Trent, Staffordshire, England: Trentham Books.

Sylva, K., Stephen, C., Ang, L., Brooker, L., Melhuish, E., Sammons, P., . . . Taggart, B. (2011). Pre-school quality and educational outcomes at age 11: Low quality has little benefit. *Journal of Early Childhood Research, 9*(2), 109-124. doi:10.1177/1476718x10387900

Taggart, B., Sylva, K., Melhuish, E., Sammons, P., & Siraj, I. (2015). *Effective pre-school, primary and secondary education project (EPPSE 3-16+): How pre-school influences children and young people's attainment and developmental outcomes over time.* Retrieved from https://pdfs.semanticscholar.org/a184/228deaa434a7786c2516a19c47021d42fa60.pdf

Tamis-LeMonda, C. S., Way, N., Hughes, D., Yoshikawa, H., Kalman, R. K., & Niwa, E. Y. (2008). Parents' goals for children: The dynamic coexistence of individualism and collectivism in cultures and individuals. *Social development*, *17*(1), 183-209.

Tan, C. (2017). Constructivism and pedagogical reform in China: Issues and challenges. *Globalisation, Societies and Education*, *15*(2), 238-247.

Tang, T. (2022). The implementation effect, value and path of the policy of "transforming people to public" to promote the quality development of preschool education──takes Shenzhen city as an example (in Chinese). *Modern Education and Practice, 6*(4), 196-199.

Taylor, M., Yates, A., Meyer, L. H., & Kinsella, P. (2011). Teacher professional leadership in support of teacher professional development. *Teaching and teacher education*, *27*(1), 85-94.

Tigchelaar, A., & Korthagen, F. (2004). Deepening the exchange of student teaching experiences: implications for the pedagogy of teacher education of recent insights into teacher behaviour. *Teaching and teacher Education*, *20*(7), 665-679.

Tjabolo, S. A. (2020). The Influence of Teacher Certification on the Performance of Elementary School Teachers in Gorontalo Province, Indonesia. *International Journal of Instruction*, *13*(4), 347-360.

Tobin, J. (2005). Quality in early childhood education: An anthropologist's perspective. *Early Education and Development*, *16*(4), 421-434.

Tobin, K., & Roth, W. M. (2007). *The culture of science education: Its history in person*. BRILL.

Tomlinson, C. A. (2000). Reconcilable differences: Standards-based teaching and differentiation. *Educational leadership*, *58*(1), 6-13.

Tompkins, V., Benigno, J. P., Kiger Lee, B., & Wright, B. M. (2018). The relation between parents' mental state talk and children's social understanding: A meta-analysis. *Social Development*, *27*(2), 223-246.

Tooley, M., & Connally, K. (2016). *No panacea: Diagnosing what ails teacher professional development before reaching for remedies*. Washington, DC: New America.

Toth, L. S., & Montagna, L. G. (2002). Class size and achievement in higher education: A summary of current research. *College Student Journal*, *36*(2), 253-261.

Tough, A. (1971). The Adult's Learning Projects. A Fresh Approach to Theory and Practice in Adult Learning.

Townsend, T. & MacBeath, J. (2011). *International handbook of leadership for learning.* Springer Science & Business Media.

Tseng, S. M. (2010). The correlation between organizational culture and knowledge conversion on corporate performance. *Journal of knowledge management*.

Van Driel, J. H., & Berry, A. (2012). Teacher professional development focusing on pedagogical content knowledge. *Educational researcher*, *41*(1), 26-28.

Van Woerkom, M. (2004). The concept of critical reflection and its implications for human resource development. *Advances in developing human resources*, *6*(2), 178-192.

Vandenbroucke, L., Spilt, J., Verschueren, K., Piccinin, C., & Baeyens, D. (2018). The classroom as a developmental context for cognitive development: A meta-analysis on the importance of teacher–student interactions for children's executive functions. *Review of Educational Research*, *88*(1), 125-164.

Vangrieken, K., Meredith, C., Packer, T., & Kyndt, E. (2017). Teacher communities as a context for professional development: A systematic review. *Teaching and teacher education*, *61*, 47-59.

Vernon-Feagans, L., Mokrova, I. L., Carr, R. C., Garrett-Peters, P. T., Burchinal, M. R., & Family Life Project Key Investigators. (2019). Cumulative years of classroom quality from kindergarten to third grade: Prediction to children's third grade literacy skills. *Early Childhood Research Quarterly*, *47*, 531-540.

Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education*, *24*(1), 80-91.

von Suchodoletz, A., Jamil, F. M., Larsen, R. A., & Hamre, B. K. (2018). Personal and contextual factors associated with growth in preschool teachers' self-efficacy beliefs

during a longitudinal professional development study. *Teaching and Teacher Education*, *75*, 278-289.

Vygotsky, L. S. (1978). Interaction between learning and development. In M. Cole, V. J. Steiner, S. Scribner, & E. Souberman (Eds.), Mind and Society: The develop- ment of higher psychological processes (pp. 79-91). Cambridge, MA: Harvard University Press.

Wasik, B. A., & Hindman, A. H. (2011). Improving vocabulary and pre-literacy skills of at-risk preschoolers through teacher professional development. *Journal of educational psychology*, *103*(2), 455.

Weadman, T., Serry, T., & Snow, P. C. (2022). The development and psychometric properties of a shared book reading observational tool: The Emergent Literacy and Language Early Childhood Checklist for Teachers (ELLECCT). *First Language*, *42*(4), 552-578.

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological bulletin*, *132*(2), 249.

Wei, H. S., Williams, J. H., Chen, J. K., & Chang, H. Y. (2010). The effects of individual characteristics, teacher practice, and school organizational factors on students' bullying: A multilevel analysis of public middle schools in Taiwan. *Children and Youth Services Review*, *32*(1), 137-143.

Weiss, C. H. (1997). How can theory-based evaluation make greater headway?. *Evaluation review*, *21*(4), 501-524.

Williford, A. P., Carter, L. M., Maier, M. F., Hamre, B. K., Cash, A., Pianta, R. C., & Downer, J. T. (2017). Teacher engagement in core components of an effective, early

childhood professional development course: Links to changes in teacher–child interactions. *Journal of Early Childhood Teacher Education*, *38*(1), 102-118.

Winton, P. J., McCollum, J. A., & Catlett, C. (Eds.). (2008). *Practical approaches to early childhood professional development: Evidence, strategies, and resources.* Washington, DC: ZERO TO THREE.

Wiswall, M. (2013). The dynamics of teacher quality. *Journal of Public Economics*, *100*, 61-78.

Wolf, S., Raza, M., Kim, S., Aber, J. L., Behrman, J., & Seidman, E. (2018). Measuring and predicting process quality in Ghanaian pre-primary classrooms using the Teacher Instructional Practices and Processes System (TIPPS). *Early Childhood Research Quarterly, 45*, 18-30. doi:10.1016/j.ecresq.2018.05.003

Wolter, S. C., & Ryan, P. (2011). Apprenticeship. In *Handbook of the Economics of Education* (Vol. 3, pp. 521-576). Elsevier.

Wong, R. M. (2008). Competency-Based English Teaching and Learning: Investigating Pre-Service Teachers of Chinese's Learning Experience. *Online Submission*.

Wood, F. H., & McQuarrie, F. R. A. N. K. (1999). On-the-job learning. New approaches will shape professional learning in the 21st century. *Journal of staff development*, *20*, 10-13.

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological review*, *114*(4), 843.

Yang, W., & Li, H. (2018). A school-based fusion of East and West: A case study of modern curriculum innovations in a Chinese kindergarten. *Journal of Curriculum Studies, 50*(1), 17-37.

Yang, W., Huang, R., Li, Y., & Li, H. (2021). Training teacher-researchers through online collective academic supervision: Evidence from a postgraduate teacher education programme. *Journal of Computer Assisted Learning*, *37*(4), 1181-1193.

Yang, Y., & Rao, N. (2020). Teacher professional development among preschool teachers in rural China. *Journal of Early Childhood Teacher Education*, 1-26.

Yin, H., To, K. H., Keung, C. P. C., & Tam, W. W. Y. (2019). Professional learning communities count: Examining the relationship between faculty trust and teacher professional learning in Hong Kong kindergartens. *Teaching and teacher education*, *82*, 153-163.

Youngs, P., & King, M. B. (2002). Principal leadership for professional development to build school capacity. *Educational administration quarterly*, *38*(5), 643-670.

Zdonek, P. (2016). Why don't we differentiate professional development. *Retrieved January*, *23*, 2017.

Zhang , Y., & Xie, J. (2019). A review of research on in-service training for kindergarten teachers in the past decade (in Chinese). *Journal of Ningxia University (Humanities & Social Science Edition), 41*(2), 185-192.

Zhang, J., & Pang, N. S. K. (2016). Exploring the characteristics of professional learning communities in China: A mixed-method study. *The Asia-Pacific Education Researcher*, *25*(1), 11-21.

Zhang, J., & Zhu, J. (2016). What does the gap between advocated theories and realistic practice mean: A re-conceptualization of the early childhood curriculum reforem in China. In M. Li, J. L. Fox, & S. Grieshaber (Eds.), *Conyemporary issues and challenge in early childhood education in the Asia-Pacific region*. Singapore: Springer.

Zhang, L., F. Lai, X. Pang, H. Yi, and S. Rozelle. (2013). The Impact of Teacher Training on Teacher and Student Outcomes: Evidence from a Randomized Experiment in Beijing Migrant Schools. *Journal of Development Effectiveness* 5 (3): 339–358. doi:10.1080/19439342.2013.807862.

Zhang, L., Yu, S., & Liu, H. (2019). Understanding teachers' motivation for and commitment to teaching: profiles of Chinese early career, early childhood teachers. *Teachers and Teaching*, *25*(7), 890-914.

Zhang, X., Hu, B. Y., Ren, L., & Zhang, L. (2019). Family socioeconomic status and Chinese children's early academic development: Examining child-level mechanisms. *Contemporary Educational Psychology*, *59*, 101792.

Zhu, J. (2012). Rethinking kindergarten teacher training (in Chinese). *Early Childhood Education (Educational Sciences)*(4), 4-5.

Zhu, J., & Zhang, J. (2008). Contemporary trends and developments in early childhood education in China. *Early Years, 28*(2), 173-182. doi:10.1080/0957514080216358

Zinsser, K. M., Shewark, E. A., Denham, S. A., & Curby, T. W. (2014). A mixed-method examination of preschool teacher beliefs about social-emotional learning and relations to observed emotional support. *Infant and Child Development*, *23*(5), 471-493.

Appendix A Ethics

Appendix A1 CUREC Approval Confirmation

From: Joshua McGrane <joshua.mcgrane@education.ox.ac.uk>
Date: Monday, 12 October 2020 at 22:30
To: Runke Huang <runke.huang@education.ox.ac.uk>
Cc: Jackie Bridges <jackie.bridges@education.ox.ac.uk>, Iram Siraj <iram.siraj@education.ox.ac.uk>
Subject: RE: Runke Huang CUREC + fieldwork form + risk assesssment

Dear Runke,

Title: "Exploring the Effects of an Evidenced-Based Professional Development Programme on Teacher Instruction and Children's Learning Outcomes in Chinese Kindergartens"

The above application (reference number ED-CIA-21-010) has been considered on behalf of the Departmental Research Ethics Committee (DREC) in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

I am pleased to inform you that, on the basis of the information provided to DREC, the proposed research has been judged as meeting appropriate ethical standards, and accordingly, approval has been granted.

If your research involves participants whose ability to give free and informed consent is in question (this includes those under 18 and vulnerable adults), then it is advisable to read the following NSPCC professional reporting requirements for cases of suspected abuse http://www.nspcc.org.uk/Inform/research/questions/reporting_child_abuse_wda74908.html

Should there be any subsequent changes to the project which raise ethical issues not covered in the original application you should submit details to research.office@education.ox.ac.uk for consideration.

Good luck with your research study.

Yours sincerely,
Joshua McGrane
Member of DREC

Hi Runke,

Given the very minor nature of this change in terms of any ethical implications, I approve this change without the need for submitting an amended CUREC application.

Kind regards,
Josh

> On 26 Feb 2021, at 05:57, Runke Huang <runke.huang@education.ox.ac.uk> wrote:
>
> Dear Joshua,
>
> I hope you are well.
>
> As my study progresses, the sample size of children needs to be increased from 288 to 576. All procedures for child assessment and classroom observation remain the same. Given that the ethical issues are covered in the original application, should I still submit details to research.office@education.ox.ac.uk for consideration?
>
> Thank you very much!
>
> Best wishes,
> Runke

Appendix A2 Invitation Letter to principals

Dear Principal,

This is Runke Huang, a doctoral student at the University of Oxford, supervised by Prof. Iram Siraj and Prof. Edward Melhuish. I am conducting the pilot study about the effect of an evidence-based professional development programme on effective teaching and learning. I am wiring this letter to see if it would be possible to collect data from your school. The objectives of the proposed investigation are to: (i) validate the measurements for classroom quality, child development and teachers' characteristics; and (ii) identify the characteristics of teaching and learning in the classrooms for designing a contextual appropriate professional development programme.

The research will take place with one K1 classroom (serving 3-4 years old children) and one K2 classroom (serving 4-5 years old children). All K1 and K2 classroom teachers and ten children in each classroom will be invited to participate in this study. I am not aiming to change what or how the teacher chooses to teach and will not be making any judgements about teaching.

The research will provide the opportunity for teachers to reflect practical ideas and expertise in early years teaching and learning. All the participating teachers will be invited to attend semi-structured teacher interviews (during June in 2020), classroom observations (during May 2020), and to complete the questionnaire to report their beliefs and practices as well as the teacher-report questionnaire to assess children's approach to learning, social emotional development and self-regulation ability. The children will participate a in a 50-minute assessment to ascertain their language and mathematics attainment. The interviews will be audio-taped, the observations will be video-taped and later transcribed. I would audio-record students engaged in whole class discussion, video the teacher and observe and take notes. The video camera will focus on the teacher and the board throughout and any incidental images of students will not be seen by anyone else or used for research without further explicit permission.

Oxford University has strict ethical procedures on conducting ethical research with teachers and students, consistent with current British Educational Research Association guidelines. Before beginning the research, I would inform parents/guardians about the research and offer the students and parents/guardians the opportunity to refuse to participate. Throughout the research, students and parents/guardians will be able to refuse to participate at any time.

All participants, including students, teachers and the school, would be made anonymous in all research reports. The data collected would be kept strictly confidential, available only to my supervisor and myself and not used other than specified without the further consent of all involved being obtained. All recordings would be destroyed at the end of the research period, and kept in locked conditions until then. I have an enhanced DBS check from 08-01-2020. I have enclosed copies of the information for parents/guardians and students with this letter.

If your school would like to take part in the study, or you need more information about what is involved, please contact me. Whether or not you feel it would be appropriate for your school to participate, I would be grateful if you would complete the pro-forma below and return it to me in the stamped addressed envelope enclosed in this letter.

Thank you for your time and attention. I look forward to hearing from you.

Yours Sincerely,

Runke Huang

Exploring the Effects of an Evidence-Based Professional Development Programme on Teacher Instruction and Children's Learning Outcomes in Chinese Kindergartens: The Pilot Study

Runke Huang
Department of Education

School name:

School address:

Head Teacher name:

☐ We do not wish to participate in this project.

☐ We would like to find out more about this project.

☐ We would like to take part in this project.

If you would like further information, or are interested in taking part, please give the name of a contact person for your school, and details of the best way to contact him or her.

Contact name: _____

Contact email: _____

Contact telephone number: _____

Please return this form in the stamped addressed envelope enclosed with this letter.

Thank you for your help.

Appendix A3 Information Sheet for Teachers

1. *Why is this research being conducted?*

Children who attend early years settings tend to demonstrate better cognitive, behavioural and social-emotional outcomes than those who do not. The positive impacts are especially robust when the early year's settings are of high quality. The objectives of the proposed investigation are to: (i) validate the measurements for classroom quality, child development and teachers' characteristics; and (ii) identify the characteristics of teaching and learning in the classrooms for designing a contextual appropriate professional development programme.

2. *Why have I been invited to take part?*

You have been invited because you are the teachers teaching in K1 or K2 classrooms. Your experience and perceptions of teaching and learning will be valuable for this research.

3. *Do I have to take part?*

No. You can ask questions about the research before deciding whether or not to take part. If you do agree to take part, you may withdraw yourself from the study, without giving a reason, by advising me of this decision. If you withdraw, your data will be destroyed accordingly. If you agree to take part, your information will be kept confidential. Consent forms will be collected from you before the researcher conducts the study. The anticipated end date of this doctoral study is October 2022.

4. *What will happen to me if I take part in the research?*

You will be invited to attend three sessions at your classroom. If you are still happy to take part, I will ask you to sign a consent form. With your consent, I would like to video record your classroom teaching, audio record your interview and invite you to fill in a paper-and-pencil questionnaire. The video-recoding-session will last for a whole week in your classroom. Your will plan and run lessons as usual. A video-taping device will be put in your classroom to record your teaching activities, but you can stop the video recording at any time. The interview session should take approximately 30 minutes. It is about reflecting on your teaching practice and what kind of support you need for professional development. The interview will be audio recorded. You can also ask to pause or stop the interview at any time. After the interview, I will invite you to fill the paper-and-pencil questionnaire which is about your teaching practice and teaching beliefs as well as children's social development, approach to learning and self-regulation ability in your classroom.

5. *Are there any potential risks in taking part?*

This is a low risk research which is not anticipated to cause any disadvantage or discomfort to participants. The potential physical and/or psychological harm or distress will be the same as any experienced in everyday life. Your personal data will be pseudonymised or anonymised to protect your privacy.

6. *Are there any benefits in taking part?*

There might be no immediate benefit for taking part in this research. However, you may reflect on your own teaching practices while sharing your experience with the researcher during the interview. Whilst the results will be shared with you upon the completion, it is hoped that you would get some suggestions about how to make teaching more effective. Besides, the data will be considered for designing a contextual appropriate professional development which is expected to help with your classroom teaching.

7. *What happens to the data provided?*

The information you provide during the study is the **research data**. Any research data from which you can be identified (e.g. name, your class, your school, contact details) is known as **personal data**.

Personal data will be kept strictly confidential and stored in a locked cabinet at the University of Oxford. Only the researcher has the access to it. Upon the completion of this research, your personal data will be destroyed.

Other research data (including consent forms) will be stored for at least three years after publication or public release of the work of the research. You will be kept anonymous during the data analysis and reporting process and will not be able to be identified in any reports or publications. All recordings will be deleted immediately after being transcribed to electronic documents. The research data will be stored confidentially using password-protected files in my encrypted personal laptop. All data will be stored for at least three years after publication.

8. *Will the research be published?*

The research may be published in academic journals. The results will be written in my doctoral thesis. Upon successful submission, the thesis will be archived both in hard copies and electronic version with open access. However, you and your school will not be identified in the publication. If you wish to be given a copy of the thesis, please ask me directly.

9. *Who has reviewed this study?*

This study has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee.

10. *Who do I contact if I have a concern about the study or I wish to complain?*

If you have a concern about any aspect of this study, please contact please contact Runke Huang via Tel: 44-0-7107347734 or email: runke.huang@education.ox.ac, and I will do our best to answer your query. I will acknowledge your concern within 10 working days and give you an indication of how it will be dealt with. If you remain unhappy or wish to make a formal complaint, please contact the Chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter as soon as possible:
Chair, **Social Sciences & Humanities Inter-Divisional Research Ethics Committee**; Email: ethics@socsci.ox.ac.uk; Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD

11. *Data Protection*

The University of Oxford is the data controller with respect to your personal data, and as such will determine how your personal data is used in the study.
The University will process your personal data for the purpose of the research outlined above. Research is a task that is performed in the public interest.
Further information about your rights with respect to your personal data is available from http://www.admin.ox.ac.uk/councilsec/compliance/gdpr/individualrights/.

12. *Further Information and Contact Details*

If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:

Runke Huang
DEPARTMENT OF EDUCATION
15 Norham Gardens, Oxford. OX2 6PY

Exploring the Effects of an Evidence-Based Professional Development Programme on Teacher Instruction and Children's Learning Outcomes in Chinese Kindergartens: The Pilot Study

		Please initial each box
1	I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without any adverse consequences or penalty.	☐
3	I understand that research data collected during the study may be looked at by authorised people outside the research team. I give permission for these individuals to access my data.	☐
4	I understand that this project has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee.	☐
5	I understand who will have access to personal data provided, how the data will be stored and what will happen to the data at the end of the project.	☐
6	I understand how this research may be written up and published.	☐
7	I understand how to raise a concern or make a complaint.	☐
8	I understand that researchers will observe lessons and other aspects of my teaching, as detailed on the information sheet, and discussed and agreed with the researchers.	☐
9	I consent to being audio/video recorded	☐
10	I understand how audio recordings /videos / photos will be used in research outputs	☐
11	I agree to take part in the study	☐

_____	dd / mm / yyyy	_____
Name of Participant	Date	Signature
_____	dd / mm / yyyy	_____
Name of person taking consent	Date	

Appendix A4 Information Sheet for Parents/Guardians

In partnership with researchers at the University of Oxford, the kindergarten has agreed to take part in a research study. We would like to invite your child, to be involved in this study, which is focussed on the class teacher and the teaching and learning activities, not individual students. We very much hope you would like your child to be involved, but before you decide, it is important that you understand why the study is being done.

What are we trying to find out?
Children who attend early years settings tend to demonstrate better cognitive, behavioral and social-emotional outcomes than those who do not. The positive impacts are especially robust when the early year's settings are of high quality. The objectives of the proposed investigation are to: (i) validate the measurements for classroom quality and child development; and (ii) identify the characteristics of teaching and learning in the classrooms for designing a contextual appropriate professional development programme for teachers. The research will help to improve children's classroom experience and development.

Why has my child been invited to be involved in this research?
We are inviting your child because they are in year 3-5. All pupils in their class are invited to be involved in this research.

Does my child have to be involved?
No. You can ask questions about the study before deciding whether to allow your child to be involved. If you do agree to their involvement, you may withdraw your child at any time, without giving a reason and without any effect on their education, by advising the school or researchers of this decision.
If your child is not involved in the research, they will receive alternative provision of equivalent educational value, or be placed where they cannot be observed or recorded.

What will my child be asked to do?
Your child's teacher will plan and run lessons as usual. From the start of May 2020 until the end of May 2020, I will join these lessons for one week. Each lesson in this week will be audio recorded, the teacher will be videoed, and I will watch and listen to what children do in class. The video camera will only record the actions of the teacher. After the observation, ten children will be randomly selected to participate in a 45-minute assessment which will assess their language and mathematics ability. One researcher assistant who are excellent in communicating with children and major in Early Childhood education or Psychology will conduct the assessment with your child (if selected) in the classroom. Children's real names will not be used, and any written material produced by the students will be made anonymous before being handed to the researcher.
If your child is accidentally filmed or named, the images/names will be cut from the recording and will never be used for research or be seen by anyone other than members of the research team.
In order to compensate students for their help with the study, I will sometimes work with your child's teacher as a classroom assistant in lessons. This will help the teacher in supporting students' learning.

What are the advantages / disadvantages of taking part?
There might be no immediate benefit for taking part in this research. However, the information from

the pilot study will inform a contextual appropriate professional development programmes for teachers to help them improve their teaching practice and better support children's learning. It might benefit your children's learning.
There is no risk in participating in this research. Your child's information will be anonymous and only used for research purpose. The data will be stored safely and destroyed according to the University's regulation.

What happens to the data provided?
Any information your child provides during the study is the **research data**. No personal data about your child will be stored beyond the duration of the study. During the study, video and voice recordings of the teacher will be made. There is a possibility that your child's image and/or voice may be incidentally recorded as part of this. Recordings will be securely stored in a password protected, encrypted file and will only ever be shown to other members of the research team. The researchers will retain Consent forms for 3 years after publication of the work of the research.

I will ensure all other data I collect in the study is made anonymous as soon as possible after collection. Audio and/or video recordings, my notes, and all other data will be stored in a locked cabinet in a locked office in the University of Oxford. At the end of the study, recordings will be erased. The researcher or the research team will have access to the research data. Responsible members of the University of Oxford may be given access to data for monitoring and/or audit of the research.

I will send a brief report on the research to your child's school at the end of the study, and you are welcome to see this. I will not identify the school, teacher or any students in any reports of the research.

Will the research be published?

The research may be published in academic journals. The results will be written in my doctoral thesis. Upon successful submission, the thesis will be archived both in hard copies and electronic version with open access. However, you and your school will not be identified in the publication. If you wish to be given a copy of the thesis, please ask me directly.

Who is conducting this research?
The research is organised by Runke Huang, who is a doctoral student. I am also a fully qualified and experienced kindergarten teacher. I have a current enhanced DBS certificate. The research is funded by the China Scholarship Council.

Ethics
This study has been reviewed by, and received ethics clearance through, the University of Oxford's Central University Research Ethics Committee.
Any research with students will be conducted with care and sensitivity. Some students might feel shy about having a researcher in the classroom, and they might feel concerned about being recorded.

What if there is a problem?
If you have a concern about any aspect of this study, please contact Runke Huang via Tel: 44-0-7107347734 or email: runke.huang@education.ox.ac, and we will do our best to answer your query. I

will acknowledge your concern within 10 working days and give you an indication of how it will be dealt with. If you remain unhappy or wish to make a formal complaint, please contact the Chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter as soon as possible:

Chair, **Social Sciences & Humanities Inter-Divisional Research Ethics Committee**; Email: ethics@socsci.ox.ac.uk; Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD

Data Protection

The University of Oxford is the data controller with respect to any personal data collected, and as such will determine how this personal data is used in the study.
The University will only process personal data for the purpose of the research outlined above. Research is a task that is performed in the public interest.
Further information about your rights with respect to personal data is available from http://www.admin.ox.ac.uk/councilsec/compliance/gdpr/individualrights/.

What should I do next?

Please fill in the enclosed form and return it to your child's class teacher if you would not like your child to take part in this study. Please remember that you may withdraw your child at any time, without affecting their education and without giving a reason, by notifying the researcher.

If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:

Runke Huang
DEPARTMENT OF EDUCATION
15 Norham Gardens, Oxford. OX2 6PY
United Kingdom
University tel: 44-0-7107347734
University email: runke.huang@education.ox.ac.uk

Exploring the Effects of an Evidence-Based Professional Development Programme on Teacher Instruction and Children's Learning Outcomes in Chinese Kindergartens: The Pilot Study

OPT-OUT FORM

If you **DO NOT** want your child to be included in the above-named research study please fill out the form below and return it to the school by [20/04/2020].

If we do not receive an opt-out form from you by this date, your child may be included in this study, as described in the accompanying information sheet.

I, the undersigned, hereby DO NOT give permission for my child to be included in the study titled Exploring the Effects of an Evidence-Based Professional Development Programme on Teacher Instruction and Children's Learning Outcomes in Chinese Kindergartens: The Pilot Study

Name of child: _____

Name of parent/guardian: _____

Signature: _____ Date: _____

Name of researcher: _____

Appendix A5 Confidential Agreement

_____

place and date

I, _____, being appointed a Research Assistant for the purposes of a research project in China which is about effective teaching and learning from April 2020 to June 2020 (the "Research Project") on behalf of the University of Oxford (the "University") agree:

(1) that all information (whether or not recorded in documentary form, or stored on any magnetic or optical disk or memory) about the Research Project including and in particular personal information regarding the participants of the Research Project coming into my possession or of which I am made aware in the course of my involvement in the Research Project will remain confidential ("Confidential Information").

(2) not to disclose any Confidential Information to any person, company or other organisation whatsoever at any time other than to the Responsible Researcher named below or persons nominated in writing by this Researcher, and to use my best endeavours to prevent the publication of or disclosure of any Confidential Information. that I shall only use the Confidential Information for the purposes of conducting research activity for the Research Project and not for any other purpose.

(3) that all the documents and recordings (including but not limited to forms, notes, voice recordings and electronic documents) regarding the Research Project given to me for the duration of the Research Project will remain the property of the University and that I will handle with care and protect all such documents and recordings.

(4) at the conclusion of the Research Project or on termination of my appointment, whichever is earlier, to return all documents and recordings provided to me or produced by me for the purposes of discharging my duties as a Research Assistant during the Research Project to the University, and to delete irretrievably any Confidential Information (including any copies) stored on any magnetic or optical disk or memory, including personal computer networks, personal e-mail accounts or personal accounts on websites, and all matter derived from such sources which is in my possession or under my control outside of the University's premises

(5) Inform the Responsible Researcher immediately if I become aware or suspect that any Confidential Information has been disclosed to any person, company or organisation other than the Responsible Researcher or any person nominated in writing to receive that Confidential Information by the Responsible Researcher.

Responsible Researcher: Runke Huang

Signed as a deed on (date) by

……
[signature of party]

in the presence of:

……
[signature of witness]

Name:
Address:
Occupation:

Appendix B PD Intervention Outline

Appendix B1 Workshop Schedule

There will be 96 teachers and 12 curriculum coordinators participating in the PD programme. In terms of the first full-day session, teachers were allocated into two group. Regarding the weekly half-day session, teachers were allocated into three groups.

	Date	Topic
Full-day training	12.05/12.06 9:00-12:30 3.5-hour workshop: Lectures & discussions	Quality ECEC and effective educators: evidence from research • The characteristics of a professional teacher **(Discussion)** • Professional understandings • EPPSE study (the importance of high-quality ECEC) • The characteristics of pedagogical strategies **(Discussion)** • REPEY project • Relational pedagogy and intentional pedagogy • Understanding and how to support SST • Concept development • Metacognition • Characteristics of playful learning Follow-up activity Reflection for improvement • Completing a checklist for pedagogy • Discussing how to improve pedagogy • Completing the improvement cycle for effective pedagogy • Presentation
	12.05/12.06 14:00-17:30 3.5-hour workshop and one-hour follow-up coaching	Communication and language development • Key features of language • There is more to talk than words: communication and language • How does language develop • Children's and adults' communitive role • Strategies to support the responsive partner role • The key points in ECERS-E and SSTEW Discussion and reflection and planning for changes • The improvement cycle: reflect, assess, plan, implement and evaluate • Reflect and Assess: Gathering information • Purposes of assessment (some Chinese regulations) • Important considerations for LLC • Completing the RAPIE • Children's vocabulary development and SSTEW and ECERS-E scale for vocabulary Reflection for improvement • Discussing how to improve pedagogy in language and vocabulary • Completing the improvement cycle for effective pedagogy • Presentation **Follow up coaching (one hour in each classroom; conducted by curriculum coordinator)**
Weekly Half-day session	12.11/12.12/12.13 9:00-12:30 3.5-hour workshop and one-hour follow-up coaching	Fostering effective early learning literacy • What is emergent literacy • How to make a high-quality print environment • How to support emergent writing • How to do dialogic reading • *The improvement cycle: reflect, assess, plan, implement and evaluate* Reflection for improvement • Key points in ECERS-E and SSTEW

		• Discussing how to improve literacy activities • Completing the improvement cycle for effective pedagogy • Presentation **Follow up coaching (one hour in each classroom; conducted by curriculum coordinator)** Materials: Dialogic reading and how well do I support literacy
Weekly Half-day session	Dec18 17:30-21:00 Dec19 14:00-17:30 Dec 20 9:00-12:30 3.5-hour workshop and one-hour follow-up coaching	Promoting self-regulation • Understand the influence of regulatory abilities for later development • The role of the educator in teaching self-regulatory skills • Specific activities that can be used in individual and group settings • Reflect on your own practice and identify areas for further focus Promoting social emotional wellbeing • Understanding social and emotional development • Discussing specific activities that can be used in individual and group settings • The role of the educator in promoting social emotional wellbeing • Reflect on your own practice and identify areas for further focus Reflection for improvement • Key points in ECERS-E and SSTEW • Discussing the improvement focus • Completing the improvement cycle for effective pedagogy • Presentation **Follow up coaching (one hour in each classroom; conducted by curriculum coordinator)** Reading materials: assessment of self-regulation in young children; positive behaviour management.
Weekly Half-day session	Dec.25 17:30-21:00 Dec.26 14:00-17:30 Dec.27 9:00-12:30 3.5-hour workshop plus one-hour follow-up coaching	Supporting children's mathematical development • Develop a shared understanding of maths in the early years • Chinese Educational guideline about math • High-quality mathmatics environment and pedagogical practice • Numbers, patterns, counting, shape and space in math • Explore, discuss and reflect on the activities and opportunities Reflection for improvement • Key points in ECERS-E and SSTEW • Discussing the improvement focus • Completing the improvement cycle for effective pedagogy • Presentation **Follow up coaching (one hour in each classroom; conducted by curriculum coordinator)** Materials: diagnostic map, measurement; early mathematical patterning assessment; monitoring map-numeracy
Weekly Half-day session	Jan 8 17:30-21:00 Jan 9 14:00-17:30 Jan 10 9:00-12:30 3.5-hour workshop plus one-hour follow-up coaching	Promoting science and critical thinking • Define emergent science • Chinese guideline about science • The adult's role in science activities • Activity: exploring the contents of the box • The process of science • How to support science activity • Science resources Reflection for improvement • Key points in ECERS-E and SSTEW • Discussing the improvement focus • Completing the improvement cycle for effective pedagogy • Presentation **Follow up coaching (one hour in each classroom; conducted by curriculum coordinator)**

		Materials: SSTEW scale in science; science books; integrating science activities
Biweekly Half-day session	Mar 5 17:30-21:00 Mar 6 14:00-17:30 Mar 21 9:00-12:30 3.5-hour workshop plus one-hour follow-up coaching	Promoting planning for individual needs • The aims of planning • Individual needs within the ECEC context • How do to evidence-based observation • How to integrate individual observation into planning • Explore, discuss and reflect on the current planning • Gender and race equality and awareness Reflection for improvement • Key points in ECERS-E • Discussing the improvement focus Completing the improvement cycle for effective pedagogy **Follow up coaching (one hour in each classroom; conducted by curriculum coordinator)**
	Mar 20 17:30-21:00 Mar 21 14:00-17:30 Mar 28 9:00-12:30 3-hour workshop plus one-hour follow-up coaching	Review Sustained shared thinking (SST) • Understanding SST • How to support SST Encourage SST through storytelling, sharing books • Introduce dialogic reading strategies and review ECERS-E item 3 adult reading with the children; SSTEW item 10 7.2; 7.3 • Videos: dialogic reading • Watch teachers' own videotapes • Select a book and discuss how to read it Encouraging SST in investigation and exploration • Review item 11 5.2, 5.3, 7.1, 7.2 • Video: block play • Example: light-up shoes • Watch teachers' own video-tapes Role-play**Follow up coaching (one hour in each classroom; conducted by curriculum coordinator)**
1	Follow-up coaching Literacy	The researcher will coach teachers' practice based on observation. • Classroom observation • Providing feedback to teachers • Teachers complete the RAPIE
2	Follow-up coaching Mathematics	The researcher will coach teachers' practice based on observation. • Classroom observation • Providing feedback to teachers • Teachers complete the RAPIE
3	Follow-up coaching Science	The researcher will coach teachers' practice based on observation. • Classroom observation • Providing feedback to teachers • Teachers complete the RAPIE
4	Follow-up coaching Social-emotion	The researcher will coach teachers' practice based on observation. • Classroom observation • Providing feedback to teachers • Teachers complete the RAPIE

Appendix B2 On-site Mentoring

Planning for Mentoring

Mentoring, a professional development tool, aims to help an individual mentee to gain a deeper understanding of current and future practices and acquire new abilities to renovate existing ones (Zan & Donegan-Ritter, 2014). It is a combination of in-service training, individual feedback, and consultation serving the professional development of teachers. Several researchers have different procedures but in general, it includes goal-setting, observation, practice/role play, partnership development and feedback/consultation sessions (Diamond & Powell, 2011). The second phase of PD will employ on-site mentoring which involves observation, feedback, reflection, joint planning and evaluation to help teachers to implement what they have learned in the workshops.

1. The aim of mentoring
    - Establishing rapport, building trust among practitioners and facilitating teachers' reflection on pedagogical practice
    - Promoting teachers' pedagogical practice regarding children's learning outcomes in language, mathematics and self-regulation through on-going continuing education

2. The criteria of mentors
    - Masters' degree in early childhood or psychology
    - Teaching experience in early childhood settings
    - Working experience with adults
    - Participated in PD sessions

3. The procedure of mentoring

3.1 Developing a manual
    - **Duration.** Mentoring will start in the first week of March and complete at the end of May. Mentors will spend two hours on observation and one hour for discussion when visiting each classroom.
    - **Frequency.** Mentors will visit each kindergarten on weekly basis. They will observe two classrooms in each visit. Each classroom will be observed on a biweekly basis.
    - **Topic in each month.** Emotional well-being (March); Literacy (April); Math (May);

3.2 Training mentors

- Five mentors will be recruited. Two of them have been involved in the pre-test and PD workshops. One has joined the PD workshops. They will take a previous course in using ECERS-E and SSTEW to do classroom observation.
- Prior to the mentoring intervention, a 2-day training session will be held, providing orientation and training to mentors. Course syllabi will be discussed and distributed to coaches.
- Two mentors will visit four classrooms together to practice rating and observation and ensure their equivalent understanding of the indicators before they provide mentoring in different classrooms separately.

3.2 Biweekly visiting in each classroom

- **Selecting four items.** Classroom teachers select three items from ECERS-E or SSTEW and send the results to mentors at least three days before observation. The mentor will select one more item for observation.
- **Discussing four items.** The mentor has to prepare for classroom observation based on these four items and hold an online-meeting with classroom teachers to explain and discuss these four items.
- **Teachers' goal setting.** After discussion, teachers tick the indicators they desire to achieve.
- **Two-hour-observation.** The mentor will do classroom observation in the classroom.
- **One-hour discussion.** Teachers do self-reflection. The mentor listens, provides feedback, asks questions and supports instructional practices that improve child outcomes.
- **Teachers' completing reflection sheet.** The mentor collaborates with teachers to identify one or two indicators for further improvement. They will set goals, strategies and action plans together for the next step.
- **Follow-up support.** At the end of each week, the mentor will phone the teachers to ask about their progress and challenges.

To maintain fidelity to the mentoring model, mentors were required to record their visits and document their daily progress with practitioners using a reflection sheet. The reflection sheets will be collected weekly at their debriefing meetings with the researchers. The sheets can also provide information on any missed or rescheduled sessions and the number of hours they worked—two unannounced visits to coaches throughout the year.

Appendix C Samples of Measures

C1. The Sample of ECERS-E

Inadequate 1 | 2 | Minimal 3 | 4 | Good 5 | 6 | Excellent 7

3. Adult Reading with the Children

1.1 Adults rarely read to the children.* P, Q

3.1 Adults read with children daily.* P, Q

3.2 There is some involvement of the children during reading times (Ex. children are encouraged to join in with repetitive words and phrases in the text, adult shares pictures with the child/ren or asks simple questions).*

5.1 Children take an active role during reading times, and the words and/or story are usually discussed.*

5.2 Children are encouraged to think about and consider "what if" questions, and/or link the content of the book to other experiences.*

7.1 There is discussion about print and letters as well as content.*

7.2 There is support material for the children to engage with stories by themselves (Ex. tapes, interactive displays, puppets, story activity bags, computer games). D

7.3 There is evidence of one to one reading with some children. *

Notes for Clarification

1.1. Score "Yes" if no reading with the children is seen during the observation and there is no daily reading time listed on the schedule.

3.1. Give credit if two or more examples of informal reading with groups or individual children are seen during the observation. Alternatively, credit can be given if there is evidence of a planned daily reading time that includes all (or the majority of) the children, even if this happens outside the observation time. This could include whole-group reading or planned small-group reading times.

3.2. Reading with children must be observed on at least one occasion in order to score this indicator. If several reading times are observed, involvement of children should be a feature of the majority of sessions in order to give credit.

5.1. This must be observed at least once. If several reading sessions are observed, this should be true for most sessions.

5.2. Examples might include an adult asking: "What do you think [the character] will do next?" or (when reading a factual book about pets) "Do any of you have a pet at home? How do you take care of them?" If several reading sessions are observed, this should be true for most sessions.

7.1. This should be observed at least once to give credit.

7.3. Several examples should be observed. It should be clear that informal reading with individual children is a regular part of the daily routine.

C2. The Sample of SSTEW

Sub-scale 3. Supporting and extending language and communication

Item 6. Staff actively listen to children and encourage children to listen

Inadequate 1 | 2 | Minimal 3 | 4 | Good 5 | 6 | Excellent 7

1.1 Staff stifle communication by, e.g. being judgemental or by humiliating, ignoring or belittling the children.

1.2 Requests for help are ignored *(whether the requests be direct or indirect, e.g. crying, withdrawal, inactivity).*

3.1 Children's verbal messages are understood.

3.2 Staff respond to verbal and non-verbal signs from children.

3.3 The body language of the staff shows that they want to communicate *(open arms, inclined head, smiles, waiting and listening).*

5.1 Staff position themselves at the children's height when talking or listening to them.

5.2 Rephrasing and/or repeating is used to check that the children have been understood.

5.3 Where meaning or speech is unclear, staff make an 'educated guess' rather than asking the child to constantly repeat her/himself. Then, if they have guessed wrongly, staff take the blame for it.*

7.1 Staff allow long pauses, so the children have time to think and respond. They also show how they allow different lengths of pauses with different children.*

7.2 Staff encourage the children to talk and listen to each other by suggesting they tell another person. Or by inviting other children to come and listen to what another child has to say or show.*

Examples and supplementary information

5.3 If not seen, ask **Questions:** How do you manage children with unclear speech? What do you do if you really do not understand what they are saying?

7.1 If not seen, ask **Question:** How do you and other staff ensure that children have enough time to think before responding to questions?

7.2 Examples may be encouraging children to show and talk about models, paintings, resources, props, ideas, collaborate in play etc. with each other. For younger children, the talk may be limited to labelling what they show while older children might explain processes and engage in positive evaluations.

C3 Sample of IDELA

Item 7. addition and subtraction (Emergent math)

Materials: Rocks/blocks used in previous item, Picture cards with bikes and apples

I have another game with apples. **Here I have 3 apples**

Lay out 3 **apples**

Now my friend gives me 2 more apples

*Lay these out near the first objects but leaving a little space between the two groups***.**

How many apples do I have in total?

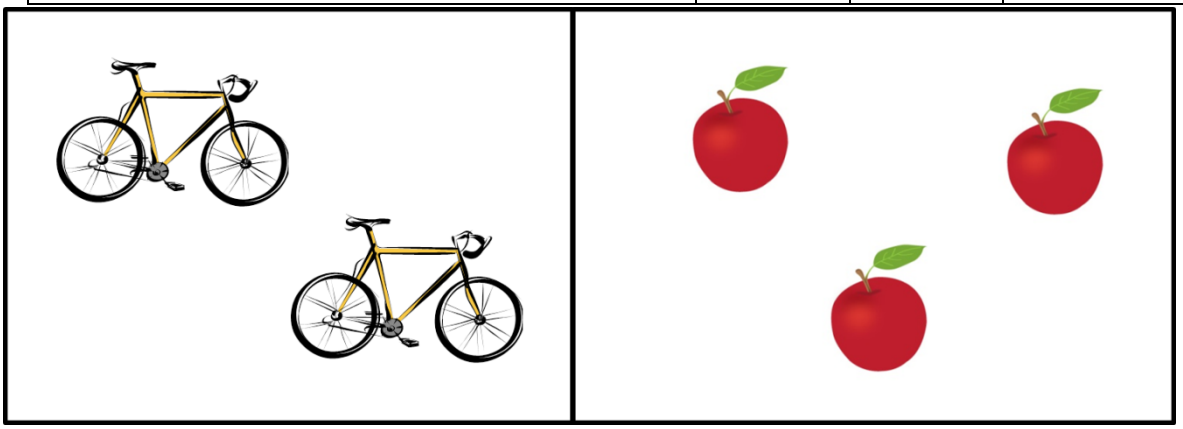
Wait for the child to count and score response. Then show the picture with the bikes and say

Let's try another one. Here are 2 bikes, if you put 2 more bikes in the picture how many would there be?

Ok. Now I have another picture. Here are 3 apples. If you took one away how many apples would be left?

Scoring

a) Child adds 3 and 2	Correct	Incorrect	No response
b) Child adds 2 and 2	Correct	Incorrect	No response
c) Child subtracts 1 from 3	Correct	Incorrect	No response



Item 8. Puzzle completion (Emergent math)

Time Estimate: 2 minutes

Materials: 4 or 5 piece jigsaw puzzle (laminated and standardized, cut appropriately). Include a picture of the puzzle for the child to see.

Show the picture of the puzzle to child and say,

We are going to have some fun with this puzzle. This is a picture of what you are going to try to make with these pieces.

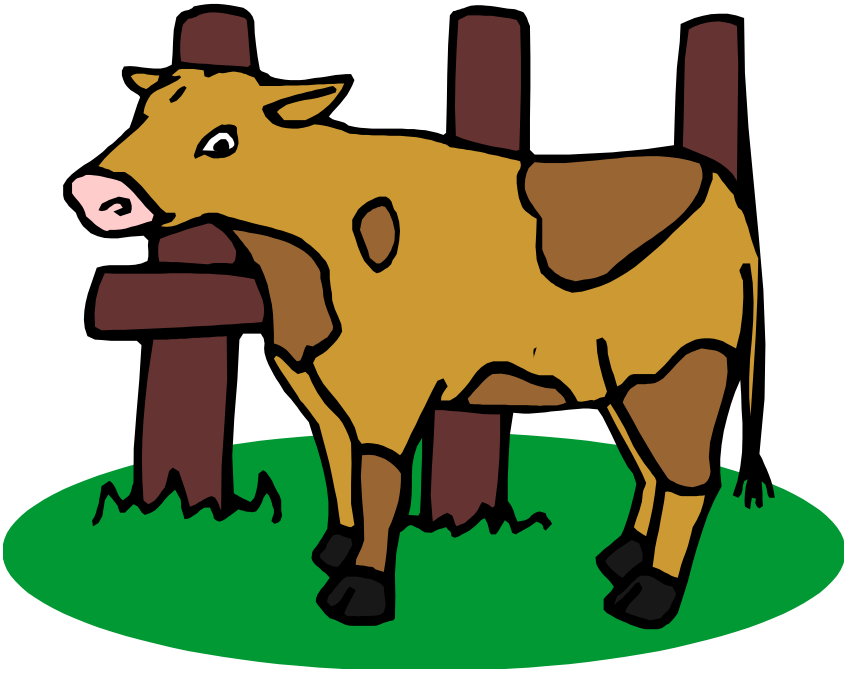
Show the child the puzzle pieces in a random order and say,

Can you try to join the pieces together to make this picture? Let me know when you are done.

While you administer this item observe how persistent /engaged the child is in trying to answer the questions, and score according to the scoring rubric.

Scoring

Puzzle completion			
a) Number of puzzle pieces fit together (0, 2, 3, 4, 5)			No response
Persistence / Engagement			
a) Child stays concentrated on the task at hand; not easily distracted	Yes	No	No response
b) Child is motivated to complete task; does not want to stop the task.	Yes	No	No response



Item 9. Friends

Materials: Nothing

Can you tell me the names of some of your friends you like to play with?

You can prompt ONCE by saying,

Can you think of any other friends?

Scoring

a) Number of friends named (0-10)		No response

Item 10. emotional awareness/regulation (socio-emotional)

Materials: None

Now I have some questions about feelings. Think for a moment and tell me what makes you feel sad or want to cry?

If needed ask clarifying question to understand better child's response. Then ask:

What do you do to feel better when you are feeling sad?

Continue and ask:

What else do you do to feel better when you are feeling sad?

Mark whether the child gives an appropriate response and say:

Now tell me what kinds of things make you feel happy?"

Appropriate answers for regulating emotions convey that child understands concept and can identify a coping mechanism. Some examples could be: talking/being with friend/adult, playing with something, seeking an adult to help, think of something that makes me smile, punch s pillow, take a deep breath etc.

Scoring

a) Child identifies something that makes them sad	Appropriate response	Inappropriate response	No response
b) Child gives one response on dealing with sad feeling	Appropriate response	Inappropriate response	No response
c) Child gives another response on dealing with sad feeling	Appropriate response	Inappropriate response	No response
d) Child identifies something that makes them happy	Appropriate response	Inappropriate response	No response

Appendix D Samples of Teacher Questionnaire

This short survey is designed to find out how confident you feel as an early years practitioner on entry to the research. It should only take around 10 minutes to complete.

Your answers will be confidential and anonymous, and only used by the research team for research purposes. We will always report as a group and never name individual teachers or schools. At a later stage in the programme - on one of the training days - we will give you more information about how we plan to use the survey responses, and formally ask for your consent to use your answers. Until this happens, the survey data will be stored securely and not used. You will have the right to withdraw your consent at any time.

	None /not at all		Very little		Some influence		Quite a bit		A great deal /very much
1. How much can you do to help **typically developing** children make good progress in their learning?	1	2	3	4	5	6	7	8	9
2. How much can you do to help **children with learning ability delay** make good progress in their learning?	1	2	3	4	5	6	7	8	9
3. To what extent can you craft good **questions** for your children?	1	2	3	4	5	6	7	8	9
4. How much can you **support families** to help their children do well in their learning and development?	1	2	3	4	5	6	7	8	9
5. How much can you do to get children to **believe they can do well** in their learning and development?	1	2	3	4	5	6	7	8	9
6. To what extent can you use a variety of **assessment strategies**?	1	2	3	4	5	6	7	8	9
7. How much can you do to **manage challenging behaviour**?	1	2	3	4	5	6	7	8	9
8. How much can you do to **promote collaborative working** within your year group team?	1	2	3	4	5	6	7	8	9
9. To what extent can you **provide an alternative explanation** or example, when children are confused?	1	2	3	4	5	6	7	8	9
10. How much can you do to help your children **value learning**?	1	2	3	4	5	6	7	8	9
11. How much can you do to **influence decisions** that are made in your school?	1	2	3	4	5	6	7	8	9
12. How much can you do to get children to **follow classroom rules**?	1	2	3	4	5	6	7	8	9
13. How much can you do to **engage other early years staff in changes** to practice?	1	2	3	4	5	6	7	8	9
14. How well can you **implement alternative strategies** in your classroom?	1	2	3	4	5	6	7	8	9
15. How much can you do to **calm a child** who is disruptive or noisy?	1	2	3	4	5	6	7	8	9
16. How much can you **express your views freely** on important school matters?	1	2	3	4	5	6	7	8	9
17. How well can you establish an **effective classroom routine** with each cohort of children?	1	2	3	4	5	6	7	8	9

18. How much can you do to **motivate children** who show low interest in play and activities?	1 2 3 4 5 6 7 8 9

Your name _____

Your school _____

Date of completion _____

Open-ended Questionnire

School name:

Teacher name:

Role (Assistant teacher or senior teacher):

1. What were the main messages you got from the professional development training?
2. What do you think was the most useful aspect of this professional training for teachers and why? (Please illustrate with an example)
3. What did you find most challenging in the teacher professional development training? (e.g., content, theory, practice, pedagogy)
4. How has this training influenced you as a practitioner? (think in terms of your studies, interests/sports, future plans or theory of knowledge)
5. Please give specific examples of changes you have made in your daily teaching practice since participating in teacher professional development training.
6. What factors supported you in implementing what you learned in this training? (Recognition from other teachers, access to online learning; parental support, participation of other colleagues in the training.)
7. Describe the impact of the changes you made in your teaching practice:
8. What difficulties did you encounter when practicing the content of this teacher professional development training in the kindergarten?

9. How would you suggest improving this training?
10. What aspects of this teacher professional development training can be improved? Why? (e.g. content, materials, training time)

Appendix E Some Statistical Outputs from Mplus and SPSS

E1. The Results of Multilevel Modelling regarding Classroom Quality

E1.1 The Results of Multilevel Modelling regarding ECERS-E

Model 2 – Ancova Model Output

```
MODEL FIT INFORMATION

Number of Free Parameters                       9

Loglikelihood

          H0 Value                          -55.760
          H0 Scaling Correction Factor       0.8746
            for MLR
          H1 Value                          -55.760
          H1 Scaling Correction Factor       0.8746
            for MLR

Information Criteria

          Akaike (AIC)                      129.521
          Bayesian (BIC)                    152.506
          Sample-Size Adjusted BIC          124.091
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             15.615
          Degrees of Freedom                     6
          P-Value                           0.0160

MODEL FIT INFORMATION

Number of Free Parameters                       9

Loglikelihood

          H0 Value                          -55.760
          H0 Scaling Correction Factor       0.8746
            for MLR
          H1 Value                          -55.760
          H1 Scaling Correction Factor       0.8746
            for MLR

Information Criteria

          Akaike (AIC)                      129.521
          Bayesian (BIC)                    152.506
          Sample-Size Adjusted BIC          124.091
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR
```

```
RMSEA (Root Mean Square Error Of Approximation)

          Estimate                            0.000

CFI/TLI

          CFI                                 1.000
          TLI                                 1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                              15.615
          Degrees of Freedom                     6
          P-Value                           0.0160

SRMR (Standardized Root Mean Square Residual)

          Value for Within                    0.000
          Value for Between                   0.000

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTECER           0.148      0.076      1.956      0.050
```

Model 2 – Intercept model output

```
MODEL FIT INFORMATION

Number of Free Parameters                       8

Loglikelihood

          H0 Value                          -38.259
          H0 Scaling Correction Factor        0.8919
            for MLR
          H1 Value                          -38.259
          H1 Scaling Correction Factor        0.8919
            for MLR

Information Criteria

          Akaike (AIC)                       92.518
          Bayesian (BIC)                    112.949
          Sample-Size Adjusted BIC           87.692
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                            0.000

CFI/TLI

          CFI                                 1.000
          TLI                                 1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                              51.837
          Degrees of Freedom                     5
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                    0.001
          Value for Between                   0.000
```

```
MODEL RESULTS

                                                    Two-Tailed
                  Estimate       S.E.  Est./S.E.    P-Value

Within Level

 Variances
    POSTECERS          0.108      0.017      6.263      0.000

Between Level

 POSTECERS  ON
    DISTRICT          -0.429      0.127     -3.389      0.001
    GROUP              1.042      0.103     10.129      0.000
    TYPE               0.514      0.095      5.441      0.000
    CITY               0.153      0.112      1.372      0.170
    LOCATION          -0.205      0.110     -1.867      0.062

 Intercepts
    POSTECERS          2.838      0.111     25.533      0.000

 Residual Variances
    POSTECERS          0.031      0.012      2.493      0.013

R-SQUARE

Within Level

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTECER           0.928      0.032     28.646      0.000
```

Model 3 –Full model

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                          -31.180
          H0 Scaling Correction Factor       0.9223
            for MLR
          H1 Value                          -31.181
          H1 Scaling Correction Factor       0.9223
            for MLR

Information Criteria

          Akaike (AIC)                       90.361
          Bayesian (BIC)                    126.115
          Sample-Size Adjusted BIC           81.914
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             66.269
          Degrees of Freedom                    11
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.000
          Value for Between                  0.000
```

```
MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTECERS  ON
    PREECERS           0.349      0.121      2.896      0.004
    STAGE             -0.085      0.041     -2.080      0.038
    SENITEAQUA         0.175      0.048      3.613      0.000
    GRADE             -0.104      0.086     -1.212      0.226
    TCRATIO            0.002      0.016      0.151      0.880
    STDEGREE           0.042      0.076      0.546      0.585

 Residual Variances
    POSTECERS          0.090      0.014      6.595      0.000

Between Level

 POSTECERS  ON
    TYPE               0.469      0.093      5.032      0.000
    GROUP              1.066      0.098     10.877      0.000
    DISTRICT          -0.425      0.118     -3.610      0.000
    CITY               0.149      0.116      1.284      0.199
    LOCATION          -0.212      0.110     -1.918      0.055

 Intercepts
    POSTECERS          2.799      0.397      7.058      0.000

 Residual Variances
    POSTECERS          0.033      0.013      2.598      0.009

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTECER           0.146      0.083      1.764      0.078

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTECER           0.923      0.032     28.704      0.000
```

Model 4 Within-level Interaction

```
MODEL FIT INFORMATION

Number of Free Parameters                       11

Loglikelihood

          H0 Value                          -34.027
          H0 Scaling Correction Factor       0.8822
            for MLR
          H1 Value                          -34.027
          H1 Scaling Correction Factor       0.8822
            for MLR

Information Criteria

          Akaike (AIC)                       90.054
          Bayesian (BIC)                    118.146
          Sample-Size Adjusted BIC           83.417
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.
```

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.000

CFI/TLI

CFI	1.000
TLI	1.000

Chi-Square Test of Model Fit for the Baseline Model

Value	63.059
Degrees of Freedom	8
P-Value	0.0000

SRMR (Standardized Root Mean Square Residual)

Value for Within	0.000
Value for Between	0.000

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Within Level				
POSTECERS ON				
PREECERS	0.267	0.105	2.540	0.011
STAGE	-0.089	0.040	-2.211	0.027
SENITEAQUA	0.168	0.052	3.230	0.001
Residual Variances				
POSTECERS	0.091	0.013	7.158	0.000
Between Level				
POSTECERS ON				
GROUP	0.967	0.149	6.473	0.000
TYPE	0.376	0.117	3.218	0.001
DISTRICT	-0.466	0.127	-3.670	0.000
GT	0.120	0.208	0.574	0.566
GD	0.133	0.249	0.532	0.594
Intercepts				
POSTECERS	2.835	0.108	26.150	0.000
Residual Variances				
POSTECERS	0.044	0.014	3.140	0.002

Model 5 Cross-level Interaction

MODEL FIT INFORMATION

Number of Free Parameters 13

Information Criteria

Deviance (DIC)	70.795
Estimated Number of Parameters (pD)	37.665

MODEL RESULTS

	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%	Significance
Within Level						
POSTECERS ON						
PREECERS	0.280	0.093	0.000	0.090	0.450	*
Residual Variances						
POSTECERS	0.081	0.019	0.000	0.056	0.131	*
Between Level						
BELTA1J ON						
GROUP	0.165	0.321	0.250	-0.545	0.855	
BELTA2J ON						
GROUP	-0.090	0.112	0.157	-0.336	0.123	
POSTECERS ON						
GROUP	1.038	0.140	0.000	0.734	1.315	*
DISTRICT	-0.413	0.168	0.013	-0.720	-0.052	*
TYPE	0.460	0.150	0.003	0.156	0.749	*
Intercepts						
POSTECERS	2.818	0.105	0.000	2.619	2.999	*
BELTA1J	-0.086	0.219	0.313	-0.517	0.404	
BELTA2J	-0.037	0.087	0.320	-0.219	0.109	
Residual Variances						
POSTECERS	0.070	0.040	0.000	0.024	0.180	*
BELTA1J	0.083	0.176	0.000	0.005	0.650	*
BELTA2J	0.042	0.031	0.000	0.008	0.132	*

E1.2 The Results of Multilevel Modelling regarding ECERS-E Subscales

Model 6 – Main Effects on ECERS-E Literacy

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                          -66.089
          H0 Scaling Correction Factor       0.8417
            for MLR
          H1 Value                          -66.090
          H1 Scaling Correction Factor       0.8417
            for MLR

Information Criteria

          Akaike (AIC)                      160.179
          Bayesian (BIC)                    195.933
          Sample-Size Adjusted BIC          151.732
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                            1.0000
          Scaling Correction Factor          1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             68.437
          Degrees of Freedom                    11
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.001
          Value for Between                  0.000


MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTLITE   ON
    PRELITE            0.176      0.090      1.952      0.051
    STAGE              0.040      0.057      0.700      0.484
    SENITEAQUA         0.013      0.137      0.096      0.924
    GRADE              0.030      0.106      0.282      0.778
    STDEGREE           0.077      0.109      0.712      0.477
    TCRATIO            0.025      0.023      1.098      0.272

 Residual Variances
    POSTLITE           0.211      0.032      6.634      0.000

Between Level

 POSTLITE   ON
    TYPE               0.479      0.135      3.539      0.000
    GROUP              1.386      0.122     11.351      0.000
    DISTRICT          -0.725      0.163     -4.443      0.000
    CITY               0.121      0.139      0.872      0.383
    LOCATION          -0.412      0.125     -3.294      0.001

 Intercepts
    POSTLITE           3.270      0.477      6.859      0.000

 Residual Variances
    POSTLITE           0.029      0.015      2.027      0.043

R-SQUARE

Within Level

    Observed                                    Two-Tailed
    Variable       Estimate       S.E.  Est./S.E.    P-Value

    POSTLITE          0.061      0.033      1.821      0.069

Between Level

    Observed                                    Two-Tailed
    Variable       Estimate       S.E.  Est./S.E.    P-Value

    POSTLITE          0.959      0.024     39.486      0.000
```

Model 6 – Main Effects on ECERS-E Math

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                          -105.941
          H0 Scaling Correction Factor        0.9309
            for MLR
          H1 Value                          -105.941
          H1 Scaling Correction Factor        0.9309
            for MLR

Information Criteria

          Akaike (AIC)                       239.882
          Bayesian (BIC)                     275.636
          Sample-Size Adjusted BIC           231.435
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             41.299
          Degrees of Freedom                    11
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.001
          Value for Between                  0.001

MODEL RESULTS

                                                    Two-Tailed
                  Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTMAT    ON
    PREMATHS           0.222      0.094      2.358      0.018
    STAGE             -0.211      0.113     -1.864      0.062
    SENITEAQUA         0.219      0.251      0.871      0.384
    GRADE             -0.239      0.187     -1.275      0.202
    STDEGREE           0.290      0.131      2.211      0.027
    TCRATIO            0.041      0.056      0.728      0.467

 Residual Variances
    POSTMAT            0.481      0.061      7.904      0.000

Between Level

 POSTMAT    ON
    TYPE               0.539      0.189      2.849      0.004
    GROUP              1.268      0.194      6.545      0.000
    DISTRICT          -0.167      0.232     -0.722      0.470
    CITY               0.352      0.196      1.794      0.073
    LOCATION           0.041      0.185      0.222      0.825

 Intercepts
    POSTMAT            2.225      0.486      4.578      0.000

 Residual Variances
    POSTMAT            0.077      0.065      1.189      0.234

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTMAT            0.124      0.073      1.703      0.089

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTMAT            0.871      0.102      8.519      0.000
```

Model 6 – Main Effects on ECERS-E Science

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                          -90.234
          H0 Scaling Correction Factor       1.0029
            for MLR
          H1 Value                          -90.234
          H1 Scaling Correction Factor       1.0029
            for MLR

Information Criteria

          Akaike (AIC)                      208.468
          Bayesian (BIC)                    244.222
          Sample-Size Adjusted BIC          200.021
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             42.898
          Degrees of Freedom                    11
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.000
          Value for Between                  0.000

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTSCIE   ON
    PRESCIEN           0.122      0.108      1.130      0.258
    STAGE             -0.089      0.064     -1.391      0.164
    SENITEAQUA         0.099      0.204      0.484      0.628
    GRADE              0.166      0.152      1.092      0.275
    STDEGREE          -0.354      0.127     -2.780      0.005
    TCRATIO           -0.085      0.035     -2.443      0.015

 Residual Variances
    POSTSCIE           0.285      0.046      6.178      0.000

Between Level

 POSTSCIE   ON
    TYPE               0.829      0.209      3.966      0.000
    GROUP              1.150      0.212      5.419      0.000
    DISTRICT          -0.528      0.233     -2.269      0.023
    CITY               0.282      0.234      1.204      0.228
    LOCATION          -0.417      0.214     -1.948      0.051

 Intercepts
    POSTSCIE           3.879      0.546      7.103      0.000

 Residual Variances
    POSTSCIE           0.179      0.068      2.635      0.008

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSCIE           0.177      0.057      3.106      0.002

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSCIE           0.769      0.095      8.113      0.000
```

Model 6 – Main Effects on ECERS-E Diversity

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                          -22.143
          H0 Scaling Correction Factor       0.9788
            for MLR
          H1 Value                          -22.144
          H1 Scaling Correction Factor       0.9788
            for MLR

Information Criteria

          Akaike (AIC)                       72.285
          Bayesian (BIC)                    108.040
          Sample-Size Adjusted BIC           63.839
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             37.262
          Degrees of Freedom                    11
          P-Value                           0.0001

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.002
          Value for Between                  0.003

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTDIVE   ON
    PREDIVER           0.155      0.129      1.204      0.229
    STAGE             -0.050      0.032     -1.560      0.119
    SENITEAQUA         0.259      0.088      2.944      0.003
    GRADE             -0.060      0.084     -0.719      0.472
    STDEGREE           0.019      0.083      0.230      0.818
    TCRATIO            0.016      0.020      0.816      0.414

 Residual Variances
    POSTDIVE           0.088      0.013      6.591      0.000

Between Level

 POSTDIVE   ON
    TYPE               0.095      0.077      1.235      0.217
    GROUP              0.424      0.069      6.164      0.000
    DISTRICT          -0.293      0.070     -4.175      0.000
    CITY              -0.194      0.095     -2.050      0.040
    LOCATION          -0.034      0.080     -0.428      0.669

 Intercepts
    POSTDIVE           1.997      0.303      6.598      0.000

 Residual Variances
    POSTDIVE           0.005      0.009      0.586      0.558

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTDIVE           0.083      0.052      1.602      0.109

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTDIVE           0.927      0.107      8.699      0.000
```

Model 7 – Moderation Effects on ECERS-E Literacy

```
MODEL FIT INFORMATION

Number of Free Parameters                       17

Loglikelihood

          H0 Value                          -61.753
          H0 Scaling Correction Factor       0.8526
            for MLR
          H1 Value                          -61.760
          H1 Scaling Correction Factor       0.8526
            for MLR

Information Criteria

          Akaike (AIC)                      157.507
          Bayesian (BIC)                    200.923
          Sample-Size Adjusted BIC          147.250
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             79.363
          Degrees of Freedom                    14
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.004
          Value for Between                  0.001

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTLITE   ON
    PRELITE            0.176      0.090      1.949      0.051
    STAGE              0.044      0.057      0.774      0.439
    SENITEAQUA        -0.046      0.127     -0.365      0.715
    GRADE              0.027      0.107      0.252      0.801
    STDEGREE           0.103      0.102      1.012      0.312
    TCRATIO            0.027      0.024      1.144      0.253

 Residual Variances
    POSTLITE           0.211      0.031      6.722      0.000

Between Level

 POSTLITE   ON
    TYPE               0.220      0.148      1.487      0.137
    GROUP              1.340      0.239      5.598      0.000
    DISTRICT          -0.373      0.131     -2.839      0.005
    CITY               0.130      0.117      1.118      0.264
    LOCATION          -0.553      0.140     -3.946      0.000
    TG                 0.519      0.213      2.432      0.015
    DG                -0.818      0.235     -3.479      0.001
    LG                 0.044      0.229      0.191      0.848

 Intercepts
    POSTLITE           3.244      0.465      6.977      0.000

 Residual Variances
    POSTLITE           0.004      0.011      0.365      0.715

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTLITE           0.064      0.033      1.949      0.051

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTLITE           0.995      0.015     66.608      0.000
```

Model 8 – Within-level Moderation Effects on ECERS-E Math

```
MODEL FIT INFORMATION

Number of Free Parameters                       16

Loglikelihood

          H0 Value                        -104.298
          H0 Scaling Correction Factor       0.9182
            for MLR
          H1 Value                        -104.299
          H1 Scaling Correction Factor       0.9182
            for MLR

Information Criteria

          Akaike (AIC)                     240.597
          Bayesian (BIC)                   281.459
          Sample-Size Adjusted BIC         230.943
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             45.835
          Degrees of Freedom                    13
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.001
          Value for Between                  0.001

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTMAT    ON
    PREMATHS           0.232      0.094      2.454      0.014
    STAGE             -0.222      0.112     -1.993      0.046
    SENITEAQUA         0.331      0.257      1.288      0.198
    GRADE             -0.246      0.189     -1.307      0.191
    STDEGREE           0.308      0.139      2.220      0.026
    TCRATIO            0.041      0.056      0.734      0.463

 Residual Variances
    POSTMAT            0.483      0.061      7.861      0.000

Between Level

 POSTMAT    ON
    TYPE               0.507      0.226      2.242      0.025
    GROUP              1.075      0.243      4.430      0.000
    DISTRICT          -0.490      0.200     -2.450      0.014
    CITY               0.317      0.195      1.625      0.104
    LOCATION           0.153      0.173      0.885      0.376
    TG                -0.025      0.412     -0.061      0.951
    DG                 0.775      0.449      1.726      0.084

 Intercepts
    POSTMAT            2.232      0.533      4.186      0.000

 Residual Variances
    POSTMAT            0.049      0.052      0.940      0.347
R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTMAT            0.137      0.076      1.803      0.071

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTMAT            0.918      0.083     11.063      0.000
```

Model 9 – Cross-level Moderation Effects on ECERS-E Math

MODEL FIT INFORMATION

Number of Free Parameters 18

Information Criteria

Deviance (DIC) 239.016
Estimated Number of Parameters (pD) 29.065

MODEL RESULTS

	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%	Significance
Within Level						
POSTMAT ON						
STAGE	-0.202	0.097	0.016	-0.400	-0.016	*
SENITEAQUA	0.171	0.303	0.284	-0.441	0.775	
GRADE	-0.190	0.176	0.136	-0.536	0.178	
TCRATIO	0.038	0.056	0.252	-0.074	0.146	
Residual Variances						
POSTMAT	0.545	0.102	0.000	0.394	0.784	*
Between Level						
BELTA1J ON						
GROUP	-0.111	0.268	0.350	-0.596	0.468	
BELTA2J ON						
GROUP	-0.196	0.329	0.287	-0.871	0.457	
POSTMAT ON						
TYPE	0.548	0.377	0.073	-0.183	1.273	
GROUP	1.931	1.228	0.046	-0.325	4.511	
DISTRICT	-0.173	0.364	0.308	-0.873	0.524	
CITY	0.356	0.362	0.147	-0.327	1.081	
LOCATION	0.043	0.289	0.436	-0.557	0.595	
Intercepts						
POSTMAT	1.980	1.190	0.074	-0.396	3.863	
BELTA1J	0.225	0.189	0.101	-0.150	0.624	
BELTA2J	0.330	0.306	0.125	-0.170	0.894	
Residual Variances						
POSTMAT	0.123	0.154	0.000	0.009	0.580	*
BELTA1J	0.038	0.084	0.000	0.001	0.306	*
BELTA2J	0.009	0.011	0.000	0.001	0.041	*

Model 10 – Within-level Moderation Effects on ECERS-E Science

```
MODEL FIT INFORMATION

Number of Free Parameters                       17

Loglikelihood

          H0 Value                          -87.772
          H0 Scaling Correction Factor       0.9659
            for MLR
          H1 Value                          -87.772
          H1 Scaling Correction Factor       0.9659
            for MLR

Information Criteria

          Akaike (AIC)                      209.544
          Bayesian (BIC)                    252.960
          Sample-Size Adjusted BIC          199.287
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             50.296
          Degrees of Freedom                    14
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.000
          Value for Between                  0.000
MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTSCIE   ON
    PRESCIEN           0.122      0.108      1.130      0.259
    STAGE             -0.091      0.063     -1.452      0.146
    SENITEAQUA         0.134      0.207      0.644      0.519
    GRADE              0.165      0.152      1.083      0.279
    STDEGREE          -0.354      0.126     -2.819      0.005
    TCRATIO           -0.085      0.035     -2.435      0.015

 Residual Variances
    POSTSCIE           0.285      0.046      6.186      0.000

Between Level

 POSTSCIE   ON
    TYPE               0.430      0.321      1.339      0.181
    GROUP              0.965      0.321      3.008      0.003
    DISTRICT           0.193      0.323      0.599      0.549
    CITY               0.177      0.243      0.729      0.466
    LOCATION          -0.198      0.225     -0.880      0.379
    TG                 0.451      0.446      1.013      0.311
    DG                -0.612      0.410     -1.492      0.136
    LG                -1.217      0.450     -2.705      0.007

 Intercepts
    POSTSCIE           3.931      0.588      6.686      0.000

 Residual Variances
    POSTSCIE           0.133      0.052      2.559      0.010

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSCIE           0.178      0.056      3.166      0.002

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSCIE           0.829      0.079     10.467      0.000
```

Model 11 – Cross-level Moderation Effects on ECERS-E Science

MODEL FIT INFORMATION

Number of Free Parameters 18

Information Criteria

Deviance (DIC)	190.341
Estimated Number of Parameters (pD)	36.655

MODEL RESULTS

	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%	Significance
Within Level						
POSTSCIE ON						
PRESCIEN	0.118	0.088	0.080	-0.051	0.294	
STAGE	-0.079	0.073	0.146	-0.232	0.056	
SENITEAQUA	0.120	0.227	0.308	-0.332	0.544	
GRADE	0.224	0.136	0.010	0.028	0.564	*
Residual Variances						
POSTSCIE	0.290	0.060	0.000	0.192	0.431	*
Between Level						
BELTA1J ON						
GROUP	-0.512	0.214	0.022	-0.910	-0.020	*
BELTA2J ON						
GROUP	-0.015	0.131	0.456	-0.226	0.308	
POSTSCIE ON						
TYPE	0.777	0.389	0.032	-0.035	1.591	
GROUP	3.062	0.789	0.000	1.249	4.425	*
DISTRICT	-0.464	0.419	0.114	-1.330	0.368	
CITY	0.320	0.407	0.184	-0.666	1.126	
LOCATION	-0.431	0.276	0.064	-0.899	0.176	
Intercepts						
POSTSCIE	2.453	0.576	0.000	1.256	3.508	*
BELTA1J	-0.013	0.113	0.446	-0.204	0.225	
BELTA2J	-0.070	0.099	0.200	-0.314	0.089	
Residual Variances						
POSTSCIE	0.182	0.155	0.000	0.033	0.573	*
BELTA1J	0.010	0.010	0.000	0.002	0.041	*
BELTA2J	0.019	0.027	0.000	0.002	0.098	*

R-SQUARE

Within-Level R-Square Averaged Across Clusters

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTSCIE	0.215	0.055	0.000	0.117	0.325

Between Level

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTSCIE	0.886	0.106	0.000	0.573	0.982

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
BELTA1J	0.764	0.233	0.000	0.023	0.955
BELTA2J	0.053	0.121	0.000	0.000	0.434

Model 12 – Cross-level Moderation Effects on ECERS-E Diversity

MODEL RESULTS

	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%	Significance
Within Level						
POSTDIVE ON						
PREDIVER	0.134	0.124	0.127	-0.131	0.360	
STAGE	-0.068	0.040	0.045	-0.143	0.014	
GRADE	-0.048	0.083	0.305	-0.211	0.117	
STDEGREE	0.048	0.074	0.285	-0.128	0.153	
TCRATIO	0.015	0.025	0.268	-0.030	0.065	
Residual Variances						
POSTDIVE	0.100	0.017	0.000	0.071	0.137	*
Between Level						
BELTA1J ON						
GROUP	-0.162	0.294	0.278	-0.766	0.461	
POSTDIVE ON						
TYPE	0.093	0.124	0.248	-0.163	0.343	
GROUP	0.446	0.096	0.000	0.248	0.635	*
DISTRICT	-0.313	0.119	0.015	-0.529	-0.047	*
CITY	-0.199	0.120	0.043	-0.449	0.029	
LOCATION	-0.032	0.102	0.338	-0.246	0.173	
Intercepts						
POSTDIVE	1.854	0.267	0.000	1.502	2.473	*
BELTA1J	0.365	0.210	0.055	-0.074	0.741	
Residual Variances						
POSTDIVE	0.019	0.022	0.000	0.002	0.076	*
BELTA1J	0.085	0.196	0.000	0.010	0.604	*

R-SQUARE

Within-Level R-Square Averaged Across Clusters

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTDIVE	0.125	0.040	0.000	0.061	0.214

Between Level

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTDIVE	0.711	0.178	0.000	0.307	0.948

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
BELTA1J	0.064	0.139	0.000	0.000	0.513

Model 13 – Cross-level Moderation Effects on ECERS-E Diversity

```
MODEL FIT INFORMATION

Number of Free Parameters                       16

Loglikelihood

          H0 Value                          -20.322
          H0 Scaling Correction Factor       0.9449
            for MLR
          H1 Value                          -20.333
          H1 Scaling Correction Factor       0.9449
            for MLR

Information Criteria

          Akaike (AIC)                       72.645
          Bayesian (BIC)                    113.507
          Sample-Size Adjusted BIC           62.991
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             44.475
          Degrees of Freedom                    13
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.005
          Value for Between                  0.006

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTDIVE   ON
    PREDIVER           0.158      0.130      1.218      0.223
    STAGE             -0.048      0.032     -1.497      0.134
    SENITEAQUA         0.238      0.085      2.808      0.005
    GRADE             -0.064      0.083     -0.762      0.446
    STDEGREE           0.029      0.085      0.344      0.731
    TCRATIO            0.017      0.020      0.855      0.392

 Residual Variances
    POSTDIVE           0.089      0.014      6.407      0.000

Between Level

 POSTDIVE   ON
    TYPE               0.085      0.062      1.381      0.167
    GROUP              0.326      0.076      4.321      0.000
    DISTRICT          -0.318      0.086     -3.675      0.000
    CITY              -0.342      0.145     -2.370      0.018
    LOCATION          -0.057      0.072     -0.795      0.426
    DI                 0.022      0.149      0.151      0.880
    CI                 0.281      0.158      1.784      0.074

 Intercepts
    POSTDIVE           2.038      0.308      6.624      0.000

 Residual Variances
    POSTDIVE           0.001      0.007      0.114      0.909
```

E1.3 The Results of Multilevel Modelling regarding SSTEW

Model 14 - Ancova Model

```
MODEL FIT INFORMATION

Number of Free Parameters                       9

Loglikelihood

          H0 Value                          -87.000
          H0 Scaling Correction Factor       0.8712
            for MLR
          H1 Value                          -87.000
          H1 Scaling Correction Factor       0.8712
            for MLR

Information Criteria

          Akaike (AIC)                      191.999
          Bayesian (BIC)                    214.984
          Sample-Size Adjusted BIC          186.569
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                              8.034
          Degrees of Freedom                     6
          P-Value                           0.2356

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.000
          Value for Between                  0.000

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTSSTEW  ON
    STAGE            -0.041      0.053     -0.777      0.437
    SENITEAQUA        0.361      0.138      2.617      0.009
    STDEGREE         -0.064      0.122     -0.521      0.603
    TCRATIO           0.031      0.026      1.172      0.241
    GRADE            -0.010      0.096     -0.109      0.913
    PRESSTEW          0.088      0.084      1.049      0.294

 Residual Variances
    POSTSSTEW         0.206      0.050      4.139      0.000

Between Level

 Means
    POSTSSTEW         4.297      0.585      7.342      0.000

 Variances
    POSTSSTEW         0.453      0.086      5.257      0.000
```

Model 14 - Intercept Model

```
MODEL FIT INFORMATION

Number of Free Parameters                        8

Loglikelihood

          H0 Value                         -69.982
          H0 Scaling Correction Factor       1.1963
            for MLR
          H1 Value                         -69.983
          H1 Scaling Correction Factor       1.1963
            for MLR

Information Criteria

          Akaike (AIC)                     155.965
          Bayesian (BIC)                   176.396
          Sample-Size Adjusted BIC         151.138
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             32.158
          Degrees of Freedom                     5
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.001
          Value for Between                  0.001
```

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Within Level				
Variances				
POSTSSTEW	0.225	0.053	4.249	0.000
Between Level				
POSTSSTEW ON				
DISTRICT	-0.431	0.151	-2.846	0.004
CITY	0.187	0.199	0.937	0.349
GROUP	0.959	0.142	6.752	0.000
TYPE	0.734	0.183	4.011	0.000
LOCATION	-0.056	0.132	-0.424	0.672
Intercepts				
POSTSSTEW	3.196	0.249	12.827	0.000
Residual Variances				
POSTSSTEW	0.037	0.031	1.184	0.236

Model 14 - Full Model

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                          -67.546
          H0 Scaling Correction Factor       1.0138
            for MLR
          H1 Value                          -67.547
          H1 Scaling Correction Factor       1.0138
            for MLR

Information Criteria

          Akaike (AIC)                      163.093
          Bayesian (BIC)                    198.847
          Sample-Size Adjusted BIC          154.646
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                            1.0000
          Scaling Correction Factor          1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             45.507
          Degrees of Freedom                    11
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.000
          Value for Between                  0.001

MODEL RESULTS

                                                    Two-Tailed
                  Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTSSTEW  ON
    STAGE           -0.022      0.052     -0.428      0.668
    SENITEAQUA       0.303      0.131      2.316      0.021
    STDEGREE        -0.018      0.114     -0.161      0.872
    TCRATIO          0.033      0.028      1.195      0.232
    GRADE           -0.018      0.094     -0.193      0.847
    PRESSTEW         0.094      0.084      1.116      0.265

 Residual Variances
    POSTSSTEW        0.207      0.050      4.114      0.000

Between Level

 POSTSSTEW  ON
    DISTRICT        -0.448      0.166     -2.703      0.007
    CITY             0.153      0.211      0.725      0.468
    GROUP            0.969      0.137      7.070      0.000
    TYPE             0.706      0.188      3.762      0.000
    LOCATION        -0.056      0.133     -0.420      0.674

 Intercepts
    POSTSSTEW        3.357      0.590      5.691      0.000

 Residual Variances
    POSTSSTEW        0.045      0.029      1.573      0.116

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSSTE           0.055      0.040      1.388      0.165

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSSTE           0.898      0.072     12.391      0.000
```

Model 15 – Within-level Interaction Model

```
MODEL FIT INFORMATION

Number of Free Parameters                       16

Loglikelihood

          H0 Value                          -67.408
          H0 Scaling Correction Factor       0.9801
            for MLR
          H1 Value                          -67.409
          H1 Scaling Correction Factor       0.9801
            for MLR

Information Criteria

          Akaike (AIC)                      166.817
          Bayesian (BIC)                    207.679
          Sample-Size Adjusted BIC          157.163
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             47.616
          Degrees of Freedom                    13
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.000
          Value for Between                  0.001

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTSSTEW  ON
    PRESSTEW          0.085      0.081      1.056      0.291
    STAGE            -0.053      0.051     -1.053      0.293
    SENITEAQUA        0.339      0.139      2.446      0.014
    STDEGREE         -0.025      0.108     -0.234      0.815
    TCRATIO           0.013      0.021      0.629      0.530
    GRADE             0.005      0.089      0.051      0.959

 Residual Variances
    POSTSSTEW         0.207      0.051      4.081      0.000

Between Level

 POSTSSTEW  ON
    GROUP             0.909      0.223      4.070      0.000
    TYPE              0.606      0.216      2.810      0.005
    DISTRICT         -0.415      0.168     -2.470      0.014
    CITY              0.162      0.207      0.784      0.433
    LOCATION         -0.064      0.138     -0.467      0.640
    GT                0.137      0.240      0.570      0.569
    GD               -0.003      0.318     -0.009      0.993

 Intercepts
    POSTSSTEW         3.092      0.651      4.753      0.000

 Residual Variances
    POSTSSTEW         0.045      0.028      1.575      0.115

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSSTE           0.059      0.039      1.484      0.138

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSSTE           0.899      0.073     12.359      0.000
```

Model 16 – Cross-level Interaction Model

MODEL FIT INFORMATION

Number of Free Parameters 16

Information Criteria

Deviance (DIC)	150.090
Estimated Number of Parameters (pD)	24.962

MODEL RESULTS

	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%	Significance
Within Level						
POSTSSTEW ON						
PRESSTEW	0.085	0.119	0.240	-0.218	0.268	
STAGE	-0.053	0.061	0.155	-0.177	0.056	
STDEGREE	-0.052	0.096	0.225	-0.254	0.127	
TCRATIO	0.014	0.023	0.260	-0.026	0.060	
GRADE	-0.027	0.102	0.390	-0.231	0.169	
Residual Variances						
POSTSSTEW	0.225	0.041	0.000	0.169	0.316	*
Between Level						
BELTA1J ON						
GROUP	-0.136	0.682	0.410	-1.498	1.217	
POSTSSTEW ON						
GROUP	1.016	0.199	0.000	0.663	1.462	*
TYPE	0.639	0.225	0.000	0.224	1.055	*
DISTRICT	-0.412	0.239	0.025	-0.986	-0.005	*
CITY	0.183	0.231	0.260	-0.290	0.582	
LOCATION	-0.103	0.171	0.280	-0.414	0.281	
Intercepts						
POSTSSTEW	3.261	0.364	0.000	2.253	3.801	*
BELTA1J	0.504	0.442	0.175	-0.401	1.166	
Residual Variances						
POSTSSTEW	0.113	0.063	0.000	0.054	0.306	*
BELTA1J	0.380	0.525	0.000	0.048	1.861	*

R-SQUARE

Within-Level R-Square Averaged Across Clusters

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTSSTEW	0.111	0.037	0.000	0.051	0.193

Between Level

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTSSTEW	0.666	0.116	0.000	0.374	0.827

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
BELTA1J	0.067	0.129	0.000	0.000	0.454

E1.4 The Results of Multilevel Modelling regarding SSTEW Subscales

Model 17 – Main Effects on SSTEW-Build TCI

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                          -98.690
          H0 Scaling Correction Factor       0.8992
            for MLR
          H1 Value                          -98.691
          H1 Scaling Correction Factor       0.8992
            for MLR

Information Criteria

          Akaike (AIC)                      225.380
          Bayesian (BIC)                    261.135
          Sample-Size Adjusted BIC          216.934
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                            1.0000
          Scaling Correction Factor          1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             46.065
          Degrees of Freedom                    11
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.001
          Value for Between                  0.002

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTBTCT   ON
    PREBTCT            0.101      0.066      1.535      0.125
    STAGE             -0.123      0.075     -1.628      0.104
    SENITEAQUA         0.652      0.201      3.238      0.001
    STDEGREE           0.179      0.161      1.111      0.267
    TCRATIO           -0.011      0.025     -0.422      0.673
    GRADE             -0.014      0.144     -0.098      0.922

 Residual Variances
    POSTBTCT           0.437      0.074      5.893      0.000

Between Level

 POSTBTCT   ON
    GROUP              1.254      0.173      7.265      0.000
    TYPE               0.334      0.182      1.831      0.067
    DISTRICT          -0.153      0.222     -0.689      0.491
    CITY               0.144      0.190      0.755      0.450
    LOCATION          -0.093      0.151     -0.618      0.537

 Intercepts
    POSTBTCT           3.591      0.853      4.207      0.000

 Residual Variances
    POSTBTCT           0.034      0.054      0.627      0.530



R-SQUARE

Within Level

    Observed                                            Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTBTCT           0.118      0.062      1.902      0.057

Between Level

    Observed                                            Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTBTCT           0.931      0.112      8.318      0.000
```

Model 17 – Main Effects on SSTEW-SE Wellbg

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                        -134.422
          H0 Scaling Correction Factor      1.0177
            for MLR
          H1 Value                        -134.422
          H1 Scaling Correction Factor      1.0177
            for MLR

Information Criteria

          Akaike (AIC)                     296.844
          Bayesian (BIC)                   332.598
          Sample-Size Adjusted BIC         288.397
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                             0.000*
          Degrees of Freedom                    0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                          0.000

CFI/TLI

          CFI                               1.000
          TLI                               1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                            28.734
          Degrees of Freedom                   11
          P-Value                          0.0025

SRMR (Standardized Root Mean Square Residual)

          Value for Within                  0.001
          Value for Between                 0.001

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTSEWE   ON
    PRESEWE            0.258      0.089      2.910      0.004
    STAGE             -0.086      0.113     -0.765      0.444
    SENITEAQUA         0.081      0.369      0.220      0.826
    STDEGREE           0.209      0.188      1.113      0.266
    TCRATIO            0.028      0.043      0.640      0.522
    GRADE             -0.039      0.178     -0.220      0.826

 Residual Variances
    POSTSEWE           0.888      0.156      5.701      0.000

Between Level

 POSTSEWE   ON
    GROUP              1.195      0.257      4.646      0.000
    TYPE               0.680      0.380      1.788      0.074
    DISTRICT          -0.725      0.299     -2.422      0.015
    CITY               0.287      0.429      0.669      0.503
    LOCATION          -0.093      0.253     -0.367      0.714

 Intercepts
    POSTSEWE           2.130      1.169      1.822      0.068

 Residual Variances
    POSTSEWE           0.123      0.107      1.153      0.249


R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSEWE           0.075      0.039      1.925      0.054

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSEWE           0.827      0.151      5.480      0.000
```

Model 17 – Main Effects on SSTEW-Lang-Comm

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                        -103.640
          H0 Scaling Correction Factor       0.9724
            for MLR
          H1 Value                        -103.640
          H1 Scaling Correction Factor       0.9724
            for MLR

Information Criteria

          Akaike (AIC)                     235.279
          Bayesian (BIC)                   271.033
          Sample-Size Adjusted BIC         226.832
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                             0.000*
          Degrees of Freedom                    0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                          0.000

CFI/TLI

          CFI                               1.000
          TLI                               1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                            36.399
          Degrees of Freedom                   11
          P-Value                          0.0001

SRMR (Standardized Root Mean Square Residual)

          Value for Within                  0.001
          Value for Between                 0.001

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTCOMM   ON
    PRECOMM           -0.041      0.093     -0.435      0.664
    STAGE             -0.004      0.054     -0.075      0.940
    SENITEAQUA         0.380      0.200      1.900      0.057
    STDEGREE          -0.389      0.203     -1.920      0.055
    TCRATIO           -0.013      0.032     -0.412      0.680
    GRADE             -0.011      0.123     -0.086      0.932

 Residual Variances
    POSTCOMM           0.464      0.093      4.965      0.000

Between Level

 POSTCOMM   ON
    GROUP              0.961      0.175      5.488      0.000
    TYPE               0.948      0.250      3.788      0.000
    DISTRICT          -0.371      0.194     -1.918      0.055
    CITY               0.152      0.306      0.497      0.619
    LOCATION          -0.023      0.179     -0.128      0.898

 Intercepts
    POSTCOMM           5.726      1.028      5.568      0.000

 Residual Variances
    POSTCOMM           0.066      0.052      1.261      0.207

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTCOMM           0.088      0.069      1.261      0.207

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTCOMM           0.880      0.106      8.338      0.000
```

Model 17 – Main Effects on SSTEW-Learn-Crit

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                          -84.962
          H0 Scaling Correction Factor       0.9912
            for MLR
          H1 Value                          -84.978
          H1 Scaling Correction Factor       0.9912
            for MLR

Information Criteria

          Akaike (AIC)                      197.925
          Bayesian (BIC)                    233.679
          Sample-Size Adjusted BIC          189.478
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                            1.0000
          Scaling Correction Factor          1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             67.397
          Degrees of Freedom                    11
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.005
          Value for Between                  0.005

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTCRIT   ON
    PRECRIT            0.136      0.114      1.186      0.235
    STAGE             -0.086      0.069     -1.235      0.217
    SENITEAQUA         0.610      0.163      3.735      0.000
    STDEGREE          -0.081      0.161     -0.502      0.616
    TCRATIO            0.055      0.026      2.089      0.037
    GRADE              0.187      0.135      1.383      0.167

 Residual Variances
    POSTCRIT           0.349      0.058      6.070      0.000

Between Level

 POSTCRIT   ON
    GROUP              1.014      0.134      7.588      0.000
    TYPE               0.913      0.147      6.217      0.000
    DISTRICT          -0.452      0.163     -2.772      0.006
    CITY               0.331      0.156      2.124      0.034
    LOCATION          -0.178      0.145     -1.226      0.220

 Intercepts
    POSTCRIT           2.163      0.605      3.574      0.000

 Residual Variances
    POSTCRIT           0.001      0.030      0.027      0.979

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTCRIT           0.162      0.065      2.490      0.013

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTCRIT           0.998      0.060     16.610      0.000
```

Model 17 – Main Effects on SSTEW-Assessing

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                          -78.091
          H0 Scaling Correction Factor       0.9705
            for MLR
          H1 Value                          -78.091
          H1 Scaling Correction Factor       0.9705
            for MLR

Information Criteria

          Akaike (AIC)                      184.181
          Bayesian (BIC)                    219.936
          Sample-Size Adjusted BIC          175.735
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                            1.0000
          Scaling Correction Factor          1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             31.407
          Degrees of Freedom                    11
          P-Value                           0.0009

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.004
          Value for Between                  0.004

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTASSESS ON
    PREASSES           0.047      0.062      0.767      0.443
    STAGE              0.047      0.081      0.588      0.556
    SENITEAQUA        -0.214      0.135     -1.580      0.114
    STDEGREE           0.041      0.170      0.242      0.809
    TCRATIO           -0.003      0.027     -0.117      0.907
    GRADE             -0.047      0.158     -0.298      0.765

 Residual Variances
    POSTASSESS         0.302      0.055      5.535      0.000

Between Level

 POSTASSESS ON
    GROUP              0.466      0.111      4.213      0.000
    TYPE               0.512      0.153      3.343      0.001
    DISTRICT          -0.387      0.145     -2.675      0.007
    CITY              -0.067      0.138     -0.484      0.628
    LOCATION           0.063      0.106      0.594      0.553

 Intercepts
    POSTASSESS         1.493      0.750      1.991      0.046

 Residual Variances
    POSTASSESS         0.001      0.029      0.041      0.967

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTASSE           0.020      0.027      0.728      0.467

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTASSE           0.992      0.198      5.009      0.000
```

Model 18 – Within-level Moderation Effects on SSTEW-Build TCI

```
MODEL FIT INFORMATION

Number of Free Parameters                       15

Loglikelihood

          H0 Value                          -98.689
          H0 Scaling Correction Factor       0.9024
            for MLR
          H1 Value                          -98.690
          H1 Scaling Correction Factor       0.9024
            for MLR

Information Criteria

          Akaike (AIC)                      227.378
          Bayesian (BIC)                    265.686
          Sample-Size Adjusted BIC          218.328
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             46.107
          Degrees of Freedom                    12
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.001
          Value for Between                  0.002

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTBTCT   ON
    PREBTCT            0.101      0.066      1.533      0.125
    STAGE             -0.123      0.075     -1.630      0.103
    SENITEAQUA         0.654      0.197      3.319      0.001
    STDEGREE           0.179      0.162      1.109      0.268
    TCRATIO           -0.011      0.026     -0.423      0.672
    GRADE             -0.014      0.144     -0.098      0.922

 Residual Variances
    POSTBTCT           0.437      0.074      5.893      0.000

Between Level

 POSTBTCT   ON
    GROUP              1.246      0.211      5.913      0.000
    TYPE               0.325      0.238      1.368      0.171
    DISTRICT          -0.153      0.219     -0.698      0.485
    CITY               0.143      0.186      0.769      0.442
    LOCATION          -0.093      0.151     -0.619      0.536
    GT                 0.016      0.310      0.052      0.959

 Intercepts
    POSTBTCT           3.596      0.843      4.265      0.000

 Residual Variances
    POSTBTCT           0.034      0.054      0.624      0.532


R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTBTCT           0.119      0.061      1.939      0.052

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTBTCT           0.931      0.112      8.281      0.000
```

Model 19 – Within-level Moderation Effects on SSTEW-Build TCI

MODEL FIT INFORMATION

Number of Free Parameters 16

Information Criteria

Deviance (DIC)	214.189
Estimated Number of Parameters (pD)	15.876

MODEL RESULTS

	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%	Significance
Within Level						
POSTBTCT ON						
PREBTCT	0.110	0.089	0.097	-0.086	0.285	
STAGE	-0.132	0.088	0.050	-0.306	0.049	
STDEGREE	0.163	0.151	0.180	-0.129	0.433	
TCRATIO	-0.008	0.035	0.400	-0.074	0.061	
GRADE	-0.023	0.141	0.440	-0.303	0.225	
Residual Variances						
POSTBTCT	0.497	0.084	0.000	0.347	0.671	*
Between Level						
BELTA1J ON						
GROUP	-0.005	0.595	0.495	-1.139	1.254	
POSTBTCT ON						
GROUP	1.284	0.211	0.000	0.836	1.638	*
TYPE	0.327	0.293	0.138	-0.276	0.873	
DISTRICT	-0.169	0.283	0.255	-0.702	0.447	
CITY	0.100	0.288	0.368	-0.455	0.748	
LOCATION	-0.062	0.243	0.365	-0.570	0.379	
Intercepts						
POSTBTCT	3.495	0.653	0.000	2.572	4.938	*
BELTA1J	0.771	0.423	0.047	-0.129	1.527	
Residual Variances						
POSTBTCT	0.134	0.112	0.000	0.031	0.430	*
BELTA1J	0.281	0.738	0.000	0.039	2.020	*

R-SQUARE

Within-Level R-Square Averaged Across Clusters

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTBTCT	0.133	0.043	0.000	0.064	0.231

Between Level

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTBTCT	0.657	0.146	0.000	0.350	0.899

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
BELTA1J	0.058	0.124	0.000	0.000	0.429

Model 20 – Cross-level Moderation Effects on SSTEW-SE Wellbg

MODEL FIT INFORMATION

Number of Free Parameters 16

Information Criteria

Deviance (DIC)	278.812
Estimated Number of Parameters (pD)	13.852

MODEL RESULTS

	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%	Significance
Within Level						
POSTSEWE ON						
STAGE	-0.072	0.125	0.285	-0.338	0.164	
SENITEAQUA	0.041	0.405	0.465	-0.758	0.794	
STDEGREE	0.159	0.223	0.285	-0.279	0.524	
TCRATIO	0.023	0.051	0.330	-0.078	0.126	
GRADE	0.046	0.208	0.425	-0.375	0.405	
Residual Variances						
POSTSEWE	0.979	0.177	0.000	0.680	1.366	*
Between Level						
BELTA1J ON						
GROUP	-0.279	0.261	0.142	-0.760	0.250	
POSTSEWE ON						
GROUP	1.221	0.323	0.000	0.569	1.759	*
TYPE	0.701	0.454	0.078	-0.207	1.506	
DISTRICT	-0.729	0.423	0.045	-1.539	0.158	
CITY	0.238	0.435	0.260	-0.570	1.195	
LOCATION	-0.069	0.365	0.410	-0.805	0.665	
Intercepts						
POSTSEWE	2.087	0.965	0.000	0.763	4.178	*
BELTA1J	0.458	0.192	0.015	0.041	0.801	*
Residual Variances						
POSTSEWE	0.342	0.280	0.000	0.073	1.113	*
BELTA1J	0.090	0.118	0.000	0.004	0.448	*

R-SQUARE

Within-Level R-Square Averaged Across Clusters

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTSEWE	0.134	0.040	0.000	0.061	0.223

Between Level

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTSEWE	0.532	0.158	0.000	0.244	0.835

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
BELTA1J	0.113	0.219	0.000	0.000	0.715

Model 21 – Within-level Moderation Effects on SSTEW-SE Wellbg

```
MODEL FIT INFORMATION

Number of Free Parameters                       15

Loglikelihood

          H0 Value                          -134.367
          H0 Scaling Correction Factor        1.0125
            for MLR
          H1 Value                          -134.368
          H1 Scaling Correction Factor        1.0125
            for MLR

Information Criteria

          Akaike (AIC)                       298.735
          Bayesian (BIC)                     337.043
          Sample-Size Adjusted BIC           289.685
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                               0.000*
          Degrees of Freedom                      0
          P-Value                            1.0000
          Scaling Correction Factor          1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                            0.000

CFI/TLI

          CFI                                 1.000
          TLI                                 1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                              29.111
          Degrees of Freedom                     12
          P-Value                            0.0038

SRMR (Standardized Root Mean Square Residual)

          Value for Within                    0.001
          Value for Between                   0.001

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTSEWE   ON
    PRESEWE            0.257      0.089      2.888      0.004
    STAGE             -0.088      0.113     -0.780      0.435
    SENITEAQUA         0.105      0.396      0.265      0.791
    STDEGREE           0.210      0.190      1.104      0.270
    TCRATIO            0.025      0.047      0.532      0.595
    GRADE             -0.038      0.178     -0.212      0.832

 Residual Variances
    POSTSEWE           0.889      0.156      5.707      0.000

Between Level

 POSTSEWE   ON
    GROUP              1.143      0.349      3.274      0.001
    TYPE               0.672      0.370      1.819      0.069
    DISTRICT          -0.809      0.364     -2.226      0.026
    CITY               0.276      0.419      0.658      0.511
    LOCATION          -0.064      0.277     -0.230      0.818
    GD                 0.192      0.588      0.327      0.743

 Intercepts
    POSTSEWE           2.187      1.154      1.894      0.058

 Residual Variances
    POSTSEWE           0.121      0.103      1.182      0.237


R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSEWE           0.074      0.039      1.888      0.059

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTSEWE           0.830      0.144      5.769      0.000
```

Model 22 – With-level moderation effects on SSTEW-Lang Comm

```
MODEL FIT INFORMATION

Number of Free Parameters                       15

Loglikelihood

          H0 Value                        -103.574
          H0 Scaling Correction Factor       0.9714
            for MLR
          H1 Value                        -103.575
          H1 Scaling Correction Factor       0.9714
            for MLR

Information Criteria

          Akaike (AIC)                     237.149
          Bayesian (BIC)                   275.457
          Sample-Size Adjusted BIC         228.099
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           1.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             36.673
          Degrees of Freedom                    12
          P-Value                           0.0003

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.001
          Value for Between                  0.001


MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTCOMM   ON
    PRECOMM          -0.041      0.095     -0.436      0.663
    STAGE            -0.005      0.053     -0.094      0.925
    SENITEAQUA        0.391      0.200      1.955      0.051
    STDEGREE         -0.387      0.206     -1.877      0.061
    TCRATIO          -0.014      0.033     -0.436      0.662
    GRADE            -0.010      0.123     -0.081      0.935

 Residual Variances
    POSTCOMM          0.464      0.094      4.945      0.000

Between Level

 POSTCOMM   ON
    GROUP             0.898      0.307      2.923      0.003
    TYPE              0.878      0.286      3.074      0.002
    DISTRICT         -0.373      0.192     -1.942      0.052
    CITY              0.145      0.300      0.483      0.629
    LOCATION         -0.023      0.177     -0.129      0.898
    GT                0.129      0.365      0.354      0.723

 Intercepts
    POSTCOMM          5.769      1.002      5.757      0.000

 Residual Variances
    POSTCOMM          0.064      0.049      1.305      0.192


R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTCOMM           0.088      0.069      1.289      0.197

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTCOMM           0.883      0.100      8.848      0.000
```

Model 23 – With-level moderation effects on SSTEW-Learn Crit

```
MODEL FIT INFORMATION

Number of Free Parameters                       17

Loglikelihood

          H0 Value                          -84.293
          H0 Scaling Correction Factor       0.9431
            for MLR
          H1 Value                          -83.924
          H1 Scaling Correction Factor       0.9431
            for MLR

Information Criteria

          Akaike (AIC)                      202.585
          Bayesian (BIC)                    246.001
          Sample-Size Adjusted BIC          192.329
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.738*
          Degrees of Freedom                     0
          P-Value                           0.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                0.988
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                             75.944
          Degrees of Freedom                    14
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.036
          Value for Between                  0.018


MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTCRIT   ON
    PRECRIT            0.135      0.119      1.135      0.256
    STAGE             -0.076      0.068     -1.105      0.269
    SENITEAQUA         0.604      0.162      3.730      0.000
    STDEGREE          -0.185      0.160     -1.159      0.246
    TCRATIO            0.052      0.030      1.729      0.084
    GRADE              0.147      0.137      1.074      0.283

 Residual Variances
    POSTCRIT           0.344      0.056      6.105      0.000

Between Level

 POSTCRIT   ON
    GROUP              0.798      0.258      3.096      0.002
    TYPE               0.932      0.233      3.998      0.000
    DISTRICT          -0.552      0.183     -3.019      0.003
    CITY               0.091      0.309      0.294      0.769
    LOCATION          -0.173      0.134     -1.295      0.195
    GT                 0.029      0.252      0.114      0.909
    GD                 0.159      0.304      0.523      0.601
    CD                 0.414      0.350      1.181      0.237

 Intercepts
    POSTCRIT           2.764      0.604      4.578      0.000

 Residual Variances
    POSTCRIT           0.002      0.029      0.054      0.957


R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTCRIT           0.162      0.072      2.254      0.024

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTCRIT           0.997      0.055     18.190      0.000
```

Model 24 – Cross-level moderation effects on SSTEW-Learn Crit

MODEL FIT INFORMATION

Number of Free Parameters 18

Information Criteria

Deviance (DIC)	201.459
Estimated Number of Parameters (pD)	25.450

MODEL RESULTS

	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%	Significance
Within Level						
POSTCRIT ON						
PRECRIT	0.122	0.122	0.155	-0.121	0.369	
STAGE	-0.063	0.081	0.211	-0.215	0.103	
STDEGREE	-0.212	0.188	0.177	-0.524	0.154	
GRADE	0.155	0.138	0.128	-0.120	0.428	
Residual Variances						
POSTCRIT	0.381	0.070	0.000	0.273	0.550	*
Between Level						
BELTA1J ON						
GROUP	0.179	0.712	0.377	-1.162	1.694	
BELTA2J ON						
GROUP	-0.060	0.076	0.243	-0.168	0.135	
POSTCRIT ON						
GROUP	1.912	1.235	0.119	-1.171	3.652	
TYPE	0.908	0.309	0.002	0.325	1.544	*
DISTRICT	-0.471	0.314	0.048	-1.167	0.093	
CITY	0.284	0.287	0.146	-0.323	0.845	
LOCATION	-0.166	0.229	0.213	-0.629	0.282	
Intercepts						
POSTCRIT	2.289	1.555	0.049	-0.195	5.419	
BELTA1J	0.607	0.472	0.088	-0.391	1.484	
BELTA2J	0.081	0.066	0.138	-0.076	0.186	
Residual Variances						
POSTCRIT	0.053	0.078	0.000	0.003	0.286	*
BELTA1J	0.284	0.788	0.000	0.008	2.665	*
BELTA2J	0.000	0.000	0.000	0.000	0.001	*

R-SQUARE

Within-Level R-Square Averaged Across Clusters

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTCRIT	0.171	0.049	0.000	0.083	0.272

Between Level

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
POSTCRIT	0.924	0.119	0.000	0.543	0.996

Variable	Estimate	Posterior S.D.	One-Tailed P-Value	95% C.I. Lower 2.5%	Upper 2.5%
BELTA1J	0.084	0.203	0.000	0.000	0.767
BELTA2J	0.722	0.320	0.000	0.004	0.987

Model 25 – Within-level moderation effects on SSTEW-Assessing

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Within Level				
POSTASSESS ON				
PREASSES	0.046	0.061	0.764	0.445
STAGE	0.044	0.081	0.544	0.586
SENITEAQUA	-0.175	0.123	-1.430	0.153
STDEGREE	0.055	0.174	0.315	0.753
TCRATIO	-0.007	0.031	-0.211	0.833
GRADE	-0.049	0.158	-0.309	0.757
Residual Variances				
POSTASSESS	0.281	0.047	5.930	0.000
Between Level				
POSTASSESS ON				
GROUP	0.196	0.144	1.356	0.175
TYPE	0.152	0.122	1.246	0.213
DISTRICT	-0.299	0.120	-2.503	0.012
CITY	-0.090	0.122	-0.742	0.458
LOCATION	0.029	0.083	0.347	0.729
GT	0.676	0.147	4.611	0.000
GD	-0.221	0.245	-0.904	0.366
Intercepts				
POSTASSESS	1.641	0.796	2.062	0.039
Residual Variances				
POSTASSESS	0.000	0.072	0.006	0.995

R-SQUARE

Within Level

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
POSTASSE	0.019	0.029	0.641	0.521

Between Level

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
POSTASSE	0.997	0.440	2.267	0.023

E1.5 The Results of Multilevel Modelling regarding Child Development

Model 25 – Main effects on child literacy

```
MODEL FIT INFORMATION

Number of Free Parameters                       13

Loglikelihood

          H0 Value                       -2289.349
          H0 Scaling Correction Factor       1.0092
            for MLR
          H1 Value                       -2289.348
          H1 Scaling Correction Factor       1.0092
            for MLR

Information Criteria

          Akaike (AIC)                    4604.697
          Bayesian (BIC)                  4660.655
          Sample-Size Adjusted BIC        4619.388
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                             0.000*
          Degrees of Freedom                    0
          P-Value                           0.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                          0.000

CFI/TLI

          CFI                               1.000
          TLI                               1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                           275.637
          Degrees of Freedom                   10
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                  0.000
          Value for Between                 0.001

MODEL RESULTS

                                                    Two-Tailed
                  Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTLITE   ON
    PRETLITE          0.662      0.034     19.746      0.000
    CHIAGE            0.514      0.198      2.600      0.009
    GENDER            0.096      1.302      0.074      0.941

 Residual Variances
    POSTLITE        202.505     15.457     13.101      0.000

Between Level

 POSTLITE   ON
    INTERVEN         11.057      3.535      3.128      0.002
    DIFECERS        -10.762      2.730     -3.943      0.000
    DIFSSTEW          1.932      1.708      1.131      0.258
    SENITEAQUA        9.433      3.954      2.386      0.017
    STDEGREE          0.322      2.563      0.126      0.900
    TCRATIO           1.030      0.504      2.043      0.041
    STAGE            -0.317      1.287     -0.246      0.805

 Intercepts
    POSTLITE         54.671      4.407     12.405      0.000

 Residual Variances
    POSTLITE         92.161     17.154      5.372      0.000

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTLITE           0.390      0.032     12.085      0.000

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTLITE           0.321      0.094      3.426      0.001
```

Model 25 – Main effects on child numeracy

```
MODEL FIT INFORMATION

Number of Free Parameters                       13

Loglikelihood

          H0 Value                       -2284.781
          H0 Scaling Correction Factor       1.0250
            for MLR
          H1 Value                       -2284.781
          H1 Scaling Correction Factor       1.0250
            for MLR

Information Criteria

          Akaike (AIC)                    4595.562
          Bayesian (BIC)                  4651.520
          Sample-Size Adjusted BIC        4610.253
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                             0.000*
          Degrees of Freedom                    0
          P-Value                           0.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                          0.000

CFI/TLI

          CFI                               1.000
          TLI                               1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                           319.354
          Degrees of Freedom                   10
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                  0.000
          Value for Between                 0.000

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTMATH   ON
    PRENUM             0.636      0.036     17.514      0.000
    CHIAGE             0.642      0.211      3.046      0.002
    GENDER             2.643      1.205      2.193      0.028

 Residual Variances
    POSTMATH         189.750     11.405     16.637      0.000

Between Level

 POSTMATH   ON
    INTERVEN          14.072      4.632      3.038      0.002
    DIFECERS          -9.996      3.181     -3.142      0.002
    DIFSSTEW            0.221     1.926      0.115      0.909
    SENITEAQUA          7.912     4.642      1.705      0.088
    STDEGREE            4.493     3.062      1.467      0.142
    TCRATIO             0.722     0.657      1.098      0.272
    STAGE               0.266     1.418      0.188      0.851

 Intercepts
    POSTMATH           58.169      4.875     11.932      0.000

 Residual Variances
    POSTMATH          124.987     20.437      6.116      0.000

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTMATH           0.462      0.031     14.765      0.000

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTMATH           0.249      0.089      2.817      0.005
```

Model 25 – Main effects on child executive function

```
MODEL FIT INFORMATION

Number of Free Parameters                       13

Loglikelihood

          H0 Value                          -2268.522
          H0 Scaling Correction Factor          0.9709
            for MLR
          H1 Value                          -2268.518
          H1 Scaling Correction Factor          0.9709
            for MLR

Information Criteria

          Akaike (AIC)                       4563.044
          Bayesian (BIC)                     4619.001
          Sample-Size Adjusted BIC           4577.734
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                                 0.007*
          Degrees of Freedom                        0
          P-Value                               0.0000
          Scaling Correction Factor             1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                              0.000

CFI/TLI

          CFI                                   1.000
          TLI                                   1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                               111.617
          Degrees of Freedom                       10
          P-Value                               0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                      0.001
          Value for Between                     0.006

MODEL RESULTS

                                                    Two-Tailed
                  Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTEF     ON
    PREEF          0.284      0.033      8.655      0.000
    CHIAGE         0.686      0.205      3.349      0.001
    GENDER        -1.127      1.180     -0.955      0.339

 Residual Variances
    POSTEF       218.365     15.467     14.118      0.000

Between Level

 POSTEF     ON
    INTERVEN       6.775      2.645      2.561      0.010
    DIFECERS      -4.328      1.820     -2.378      0.017
    DIFSSTEW       2.701      1.075      2.512      0.012
    SENITEAQUA     2.658      2.454      1.083      0.279
    STDEGREE       0.058      1.632      0.036      0.972
    TCRATIO        0.272      0.316      0.861      0.389
    STAGE          0.543      0.975      0.557      0.578

 Intercepts
    POSTEF        56.451      3.259     17.319      0.000

 Residual Variances
    POSTEF        19.175      7.516      2.551      0.011

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTEF             0.148      0.025      5.933      0.000

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTEF             0.446      0.154      2.907      0.004
```

E1.6 Moderation Results of Multilevel Modelling regarding Child Development

Model 26 –Within-level moderation on child literacy

```
MODEL FIT INFORMATION

Number of Free Parameters                       16

Loglikelihood

          H0 Value                       -2288.101
          H0 Scaling Correction Factor       0.9731
            for MLR
          H1 Value                       -2288.101
          H1 Scaling Correction Factor       0.9731
            for MLR

Information Criteria

          Akaike (AIC)                    4608.203
          Bayesian (BIC)                  4677.074
          Sample-Size Adjusted BIC        4626.284
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                             0.000*
          Degrees of Freedom                    0
          P-Value                           0.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                          0.000

CFI/TLI

          CFI                               1.000
          TLI                               1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                           292.283
          Degrees of Freedom                   13
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                  0.000
          Value for Between                 0.001

MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTLITE   ON
    PRETLITE           0.662      0.034     19.745      0.000
    CHIAGE             0.514      0.198      2.600      0.009
    GENDER             0.081      1.304      0.062      0.951

 Residual Variances
    POSTLITE         202.489     15.455     13.102      0.000

Between Level

 POSTLITE   ON
    DIFECERS         -10.121      3.924     -2.579      0.010
    SENITEAQUA         7.427      4.709      1.577      0.115
    TCRATIO            1.765      0.812      2.174      0.030
    INTERVEN          34.489     16.444      2.097      0.036
    DIFSSTEW           2.029      1.702      1.192      0.233
    STDEGREE           0.441      2.527      0.174      0.862
    STAGE             -0.122      1.240     -0.099      0.921
    ID                -1.477      4.900     -0.301      0.763
    IQ                 4.890      6.358      0.769      0.442
    IC                -1.467      1.043     -1.407      0.159

 Intercepts
    POSTLITE          54.630      4.679     11.674      0.000

 Residual Variances
    POSTLITE          88.905     16.960      5.242      0.000

R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTLITE           0.390      0.032     12.082      0.000

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTLITE           0.345      0.088      3.901      0.000
```

Model 27 –Cross-level moderation on child literacy

```
MODEL FIT INFORMATION

Number of Free Parameters                       15

Loglikelihood

          H0 Value                       -2288.484
          H0 Scaling Correction Factor       1.0078
            for MLR

Information Criteria

          Akaike (AIC)                    4606.969
          Bayesian (BIC)                  4671.535
          Sample-Size Adjusted BIC        4623.919
            (n* = (n + 2) / 24)


MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTLITE   ON
    PRETLITE           0.663      0.033     19.810      0.000
    GENDER             0.097      1.311      0.074      0.941

 Residual Variances
    POSTLITE         194.735     16.327     11.927      0.000

Between Level

 BELTA1J    ON
    INTERVEN           0.124      0.405      0.307      0.759

 POSTLITE   ON
    DIFECERS         -10.762      2.729     -3.944      0.000
    SENITEAQUA         9.433      3.954      2.386      0.017
    TCRATIO            1.030      0.504      2.043      0.041
    INTERVEN          11.057      3.535      3.128      0.002
    DIFSSTEW           1.932      1.708      1.131      0.258
    STDEGREE           0.321      2.563      0.125      0.900
    STAGE             -0.317      1.287     -0.246      0.805

 Intercepts
    POSTLITE          54.674      4.402     12.421      0.000
    BELTA1J            0.502      0.316      1.587      0.113

 Residual Variances
    POSTLITE          93.196     16.860      5.528      0.000
    BELTA1J            0.564      0.547      1.029      0.303
```

Model 28 –Within-level moderation on child numeracy

```
MODEL FIT INFORMATION

Number of Free Parameters                       14

Loglikelihood

          H0 Value                       -2284.232
          H0 Scaling Correction Factor       0.9964
            for MLR
          H1 Value                       -2284.231
          H1 Scaling Correction Factor       0.9964
            for MLR

Information Criteria

          Akaike (AIC)                    4596.463
          Bayesian (BIC)                  4656.725
          Sample-Size Adjusted BIC        4612.284
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              0.000*
          Degrees of Freedom                     0
          P-Value                           0.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.000

CFI/TLI

          CFI                                1.000
          TLI                                1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                            333.070
          Degrees of Freedom                    11
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                   0.000
          Value for Between                  0.000


MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTMATH   ON
    PRENUM             0.636      0.036     17.514      0.000
    CHIAGE             0.642      0.211      3.046      0.002
    GENDER             2.646      1.205      2.196      0.028

 Residual Variances
    POSTMATH         189.734     11.404     16.637      0.000

Between Level

 POSTMATH   ON
    INTERVEN          11.781      4.726      2.493      0.013
    DIFECERS         -13.459      4.192     -3.211      0.001
    DIFSSTEW           0.217      1.873      0.116      0.908
    SENITEAQUA         7.812      4.723      1.654      0.098
    STDEGREE           4.527      2.996      1.511      0.131
    TCRATIO            0.710      0.652      1.090      0.276
    STAGE              0.135      1.368      0.098      0.922
    DN                 5.682      4.604      1.234      0.217

 Intercepts
    POSTMATH          56.921      5.021     11.336      0.000

 Residual Variances
    POSTMATH         123.219     19.983      6.166      0.000


R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTMATH           0.462      0.031     14.764      0.000

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTMATH           0.260      0.088      2.956      0.003
```

Model 29 –Cross-level moderation on child numeracy

```
MODEL FIT INFORMATION

Number of Free Parameters                       15

Loglikelihood

          H0 Value                       -2284.741
          H0 Scaling Correction Factor       1.0344
            for MLR

Information Criteria

          Akaike (AIC)                    4599.482
          Bayesian (BIC)                  4664.049
          Sample-Size Adjusted BIC        4616.433
            (n* = (n + 2) / 24)


MODEL RESULTS

                                                    Two-Tailed
                   Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTMATH   ON
    PRENUM            0.636      0.037     17.368      0.000
    CHIAGE            0.642      0.209      3.068      0.002

 Residual Variances
    POSTMATH        189.682     13.202     14.368      0.000

Between Level

 BELTA2J    ON
    INTERVEN         -0.730      2.425     -0.301      0.763

 POSTMATH   ON
    INTERVEN         14.439      4.917      2.936      0.003
    DIFECERS        -10.001      3.219     -3.107      0.002
    DIFSSTEW          0.222      1.941      0.115      0.909
    SENITEAQUA        7.915      4.648      1.703      0.089
    STDEGREE          4.486      3.058      1.467      0.142
    TCRATIO           0.721      0.653      1.105      0.269
    STAGE             0.267      1.419      0.188      0.851

 Intercepts
    POSTMATH         57.974      4.905     11.821      0.000
    BELTA2J           3.014      1.484      2.031      0.042

 Residual Variances
    POSTMATH        124.960     20.405      6.124      0.000
    BELTA2J           0.096     21.648      0.004      0.996
```

Model 30 – Within-level moderation on child executive function

```
MODEL FIT INFORMATION

Number of Free Parameters                       15

Loglikelihood

          H0 Value                       -2267.952
          H0 Scaling Correction Factor       0.9791
            for MLR
          H1 Value                       -2267.949
          H1 Scaling Correction Factor       0.9791
            for MLR

Information Criteria

          Akaike (AIC)                    4565.905
          Bayesian (BIC)                  4630.471
          Sample-Size Adjusted BIC        4582.855
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                             0.007*
          Degrees of Freedom                    0
          P-Value                           0.0000
          Scaling Correction Factor         1.0000
            for MLR

*   The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used
    for chi-square difference testing in the regular way.  MLM, MLR and WLSM
    chi-square difference testing is described on the Mplus website.  MLMV, WLSMV,
    and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                          0.000

CFI/TLI

          CFI                               1.000
          TLI                               1.000

Chi-Square Test of Model Fit for the Baseline Model

          Value                           111.431
          Degrees of Freedom                   12
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value for Within                  0.001
          Value for Between                 0.005


MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTEF     ON
    PREEF             0.284      0.033      8.655      0.000
    CHIAGE            0.686      0.205      3.350      0.001
    GENDER           -1.135      1.180     -0.962      0.336

 Residual Variances
    POSTEF          218.395     15.465     14.122      0.000

Between Level

 POSTEF     ON
    INTERVEN          6.436      2.962      2.173      0.030
    DIFECERS         -4.979      2.590     -1.923      0.055
    DIFSSTEW          1.778      1.350      1.317      0.188
    SENITEAQUA        2.469      2.418      1.021      0.307
    STDEGREE          0.117      1.629      0.072      0.943
    TCRATIO           0.240      0.319      0.752      0.452
    STAGE             0.438      0.970      0.451      0.652
    IE                0.677      3.414      0.198      0.843
    IS                2.260      2.183      1.035      0.300

 Intercepts
    POSTEF           56.021      3.408     16.437      0.000

 Residual Variances
    POSTEF           18.452      7.431      2.483      0.013


R-SQUARE

Within Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTEF             0.148      0.025      5.933      0.000

Between Level

    Observed                                        Two-Tailed
    Variable        Estimate       S.E.  Est./S.E.    P-Value

    POSTEF             0.466      0.153      3.042      0.002
```

Model 31 – Cross-level moderation on child executive function

```
MODEL FIT INFORMATION

Number of Free Parameters                       15

Loglikelihood

          H0 Value                          -2267.068
          H0 Scaling Correction Factor          0.9752
            for MLR

Information Criteria

          Akaike (AIC)                       4564.137
          Bayesian (BIC)                     4628.703
          Sample-Size Adjusted BIC           4581.087
            (n* = (n + 2) / 24)


MODEL RESULTS

                                                    Two-Tailed
                    Estimate       S.E.  Est./S.E.    P-Value

Within Level

 POSTEF     ON
    PREEF             0.287      0.033      8.710      0.000
    GENDER           -1.186      1.169     -1.014      0.310

 Residual Variances
    POSTEF          215.281     16.217     13.275      0.000

Between Level

 BELTA1J    ON
    INTERVEN         -0.619      0.389     -1.589      0.112

 POSTEF     ON
    INTERVEN          6.775      2.645      2.561      0.010
    DIFECERS         -4.328      1.820     -2.379      0.017
    DIFSSTEW          2.702      1.075      2.514      0.012
    SENITEAQUA        2.658      2.454      1.083      0.279
    STDEGREE          0.058      1.632      0.036      0.972
    TCRATIO           0.272      0.316      0.861      0.389
    STAGE             0.542      0.974      0.557      0.578

 Intercepts
    POSTEF           56.482      3.271     17.266      0.000
    BELTA1J           0.980      0.260      3.764      0.000

 Residual Variances
    POSTEF           19.040      7.716      2.468      0.014
    BELTA1J           0.156      0.452      0.345      0.730
```

Appendix MLM Models

Appendix F Results of Correlational Analysis for MLM Models

F1 The Impacts of PD on Classroom Quality

F1.1 Correlations for variables in analysing the impacts of PD on classroom quality measured by ECERS-E.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 Post-test ECERS-E Literacy	–	.88***	.88***	.86***	.52**	.07	.71***	-.24	-.10	-.05	.07	.43*	.10	.89***	.26	-.29	.04	-.17
2 Post-test ECERS-E Numeracy	.22*	–	.83***	.79***	.52**	.27	.68***	-.20	.09	.10	.13	.51*	.18	.85***	.41*	-.08	.02	.04
3 Post-test ECERS-E Science	.11	.07	–	.78***	.53**	.09	.85***	-.26	.07	-.11	-.03	.50*	.28	.79***	.35	-.16	.04	-.23
4 Post-test ECERS-E Diversity	.22*	.17	.23*	–	.53**	.18	.75***	.17	.18	-.10	.28	.32	.19	.78***	.32	-.27	-.22	-.02
5 Pre-test ECERS-E Literacy	.22*	.11	-.05	.20	–	.27	.65***	.19	.21	-.05	.06	.56**	.42*	.44*	.07	-.49*	.24	.33
6 Pre-test ECERS-E Math	.23*	.14	.16	.11	.29**	–	.22	.47*	.08	.18	.52**	.33	.34	-.03	.05	-.45*	.37	.32
7 Pre-test ECERS-E Science	.11	.11	.25*	.04	.14	.32**	–	-.01	.39	-.01	.30	.48*	.45*	.53**	.43*	-.35	-.15	-.02
8 Pre-test ECERS-E Diversity	.02	-.11	.06	.15	.01	.07	.11	–	.27	-.11	.51**	-.26	.43*	-.25	-.05	-.25	-.24	.22
9 Teacher degree	-.03	.09	-.32**	-.10	-.16	-.05	-.23*	-.11	–	.56**	.61**	.27	.19	-.23	.73***	.31	-.51*	.14
10 Teacher Qualification	.01	-.02	.07	.19	-.05	-.07	.02	-.06	.01	–	.58**	.41*	-.31	-.25	.69***	.27	-.06	-.02
11 Teacher age	.16	-.20	-.14	-.06	.12	.26*	.07	-.01	.11	.31**	–	.09	.23	-.22	.57**	-.13	-.38	.03
12 Grade	.09	-.13	.17	-.01	.15	.36***	.45***	.42***	-.10	.13	.23*	–	.01	.36	.36	-.19	.43*	.36
13 Child-teacher ratio	.14	.06	-.11	-.01	.30**	.25*	.30**	-.09	-.19	-.01	.09	.21	–	.09	.11	-.18	-.17	.17
14 Intervention	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.17	-.09	.01	.01
15 School type	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.46*	-.53**	-.17
16 District level	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-.45*	-.28
17 City level	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.18
18 School location	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Notes: Classroom-level correlations are presented under the diagonal, kindergarten-level correlations are presented above the diagonal.
*p < .05, **p < .01, ***p < .001

F1.2 Correlations for variables in analysing the impacts of PD on classroom quality measured by SSTEW.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Post-test Build-TCI	–	.91***	.93***	.93***	.83***	.26	.30	.28	.34	.38	.06	-.03	.13	.60*	.01	.88***	.40	-.05	-.03	-.06
2 Post-test SE-welbg	.37***	–	.92***	.90***	.86***	.42*	.38	.49*	.58**	.45*	.15	-.04	.26	.66***	.14	.76***	.31	-.30	.07	.03
3 Post-test Lang-Comm	.43***	.43***	–	.90***	.83***	.29	.42*	.44*	.44*	.41*	.14	.20	.29	.68***	-.03	.79***	.51*	-.06	-.06	-.07
4 Post-test Learn-Crit	.36***	.33**	.38***	–	.89***	.32	.37	.37	.44*	.41*	.19	.08	.27	.68***	.23	.80***	.55**	-.13	-.02	-.09
5 Post-test Assessing	.16	.12	.16	.06	–	.32	.37	.37	.44*	.41*	.19	.08	.27	.68***	.23	.74***	.55**	-.19	-.21	.08
6 Pre-test Build-TCI	.14	.04	.16	-.05	-.14	–	.50*	.58**	.74***	.54**	.67***	.13	.48*	.55**	.46*	.16	.34	-.13	-.25	.62**
7 Pre-test SE-welbg	.25*	.26*	.12	.13	.05	.17	–	.65***	.54**	.40	.21	.26	.56**	.50*	.52**	.28	.34	-.08	-.33	.22
8 Pre-test Lang-Comm	.07	-.15	.01	-.05	-.15	.35***	.38***	–	.69***	.76***	.52**	-.03	.67***	.43*	.47*	.13	.40	-.16	-.50*	.15
9 Post-test Learn-Crit	.12	.02	.17	.16	.02	.06	.24*	.27**	–	.66***	.60**	.25	.65***	.49*	.22	.11	.37	-.42	-.16	.37
10 Pre-test Assessing	.02	-.04	.08	-.04	.04	.10	.05	.40***	.31**	–	.63***	.05	.79***	.23	.24	.10	.51*	-.10	-.63***	.01
11 Teacher degree	.03	.02	-.26*	-.18	-.01	-.09	.04	.04	-.01	-.02	–	.35	.63***	.30	.23	-.23	.72***	.31	-.50*	.13
12 Teacher Qualification	.26*	.03	.15	.31**	-.07	.01	.11	.06	-.01	.09	.05	–	.50*	.30	-.30	-.21	.59**	.23	-.06	-.01
13 Teacher age	-.07	-.05	.05	.01	.01	-.08	.01	.01	.05	.05	-.11	.31**	–	.37	.28	-.20	.58**	-.12	-.40	.05
14 Grade	-.02	-.09	.02	.22*	-.04	.07	-.16	-.04	.20	.09	-.09	.14	.22*	–	.27	.45*	.45*	-.08	.18	.45*
15 Child-teacher ratio	-.01	.05	.10	.17	.03	.07	-.06	-.13	-.11	.01	-.22*	.01	.08	.20	–	.10	.12	-.18	-.18	.18
16 Intervention	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.17	-.09	.01	.01
17 School type	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.46*	-.53**	.17
18 District level	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-.45*	-.28
19 City level	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.18
20 School location	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Notes: Classroom-level correlations are presented under the diagonal, kindergarten-level correlations are presented above the diagonal. Build-TCI = Building trust, confidence, independence; SE-welbg = social and emotional well-being; Lang-Comm = Supporting and extending language and communication; Learn-Crit = Supporting learning and critical thinking; Assessing = Assessing learning and language.
*p < .05, **p < .01, ***p < .001

F2 The Impacts of PD on Child Development

F2.1 Correlations for variables in analysing the impacts of PD on classroom quality measured by SSTEW.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 Post-test Literacy	–	.96***	.79***	.81***	.96***	.97***	.77***	.90***	.96***	.28**	.11	-.27**	.08	.18	-.05	.34***	.17
2 Post-test Numeracy	.58***	–	.69***	.80***	.97***	.98***	.73***	.89***	.92***	.19	.16	-.18	.04	.16	.13	.27**	.22*
3 Post-test Social-emotion	.34***	.18***	–	.75***	.71***	.73***	.81***	.73***	.78***	.33**	.03	-.16	.25*	.20	-.17	.44***	.38***
4 Post-test Executive function	.30***	.33***	.17***	–	.74***	.80***	.60***	.79***	.72***	.41***	.45***	.09	.47***	.12	-.07	.23*	.19
5 Pre-test Literacy	.66***	.50***	.30***	.27***	–	.97***	.78***	.94***	.92***	.18	-.04	-.30**	-.05	.19	.09	.29**	.17
6 Pre-test Numeracy	.56***	.70***	.17***	.31***	.56***	–	.76***	.90***	.93***	.22*	.11	-.13	.09	.27**	.10	.28**	.19
7 Pre-test Social-emotion	.35***	.28***	.40***	.25***	.45***	.28***	–	.80***	.82***	.08	-.20	-.34***	-.13	.30**	.11	.30**	.23*
8 Pre-test Executive function	.39***	.40***	.18***	.39***	.43***	.45***	.32***	–	.85***	.17	-.04	-.30**	-.06	.17	.02	.26**	.12
9 Age	.27***	.33***	.13**	.24***	.27***	.31***	.23***	.24***	–	.29**	-.01	-.31**	.01	.18	-.07	.20	.17
10 Gender	.02	.13**	-.14**	-.04	.02	.08	-.09*	-.02	.02	–	.21*	.12	.66***	.08	-.30**	-.28**	-.07
11 Intervention	–	–	–	–	–	–	–	–	–	–	–	.71***	.58***	-.07	-.14	.05	-.11
12 Diff-ECERS-E	–	–	–	–	–	–	–	–	–	–	–	–	.54***	.05	-.01	-.18	-.21*
13 Diff-SSTEW	–	–	–	–	–	–	–	–	–	–	–	–	–	.05	-.09	-.02	-.06
14 Teacher qualification	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.10	-.06	.34***
15 Teacher degree	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-.02	.26*
16 Child-to-teacher ratio	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.13
17 Teacher age	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Notes: Child-level correlations are presented under the diagonal, classroom-level correlations are presented above the diagonal. Diff-ECERS-E = post-test ECERS-E – pre-test ECERS-E, Diff SSTEW = post-test SSTEW – pre-test SSTEW.
*p < .05, **p < .01, ***p < .001