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Promoting Teaching and Learning Through Research-Informed Professional Development: The Leadership for Learning Programme in Australia and China

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Abstract: The fragmented provision of training for early childhood educators has highlighted the imperative need for research-informed professional development (PD) programmes to enhance educator professionalism. This study evaluates the effectiveness of a research-informed in-service PD programme—"Leadership for Learning"—through cluster randomised controlled trials in Australia and China. In Australia, the study involved 83 early-years services, and 1346 4–5-year-old children. In China, the study adapted the PD programme both educationally and culturally, involving 24 preschools, 95 classrooms, 202 educators, and 547 children aged 3–5 years. The comparative findings revealed that the PD programme significantly improved scores on the ECERS-E and SSTEW classroom quality rating scales in both Australia and China. Regarding children's outcomes, the Australian PD programme significantly enhanced children's numeracy development, social–emotional development, and expressive language, but not vocabulary, while the Chinese adaptation improved literacy development but not numeracy. This study has important implications for the implementation of PD programmes and cross-cultural educational research, highlighting the need for context-specific adaptations to maximise the effectiveness of PD interventions.

Keywords: in-service professional development; cross-cultural adaptations; early childhood education and care; intervention; early childhood educator; preschool quality

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1. Introduction

The landscape of early childhood education and care (ECEC) is often characterised by the fragmented provision of training for educators. With low levels of professional development compared to other sectors of education and concerns about the variability in the overall quality of care and education, these challenges have brought to the forefront the imperative need for research-informed professional development (PD) programmes to enhance educator professionalism, process quality, and, ultimately, child development. This paper presents a comparative study of the implementation of a research-informed PD programme—"Leadership for Learning"—in two distinct educational contexts—Australia and China—which aimed to foster effective early learning.

Central to our investigation is the hypothesis that research-informed professional development, when properly infused with cultural sensitivity and customised to align with local educational needs, can significantly enhance educator effectiveness and children's developmental outcomes. This study examines the original implementation of the programme in Australia and its subsequent adaptation in China, providing a unique lens through which to assess the programme's impact on teaching and learning practices across these culturally and educationally diverse environments and workforces. Therefore, this research aims

to not only explore the effectiveness of professional development initiatives in these two contexts, but also to offer broader insights into the global challenges and opportunities of providing research-informed PD within ECEC when initial training is fragmented.

1.1. Global Workforce in Early Childhood Education and Care (ECEC)

Decades of research have demonstrated that the early establishment of brain networks has long-lasting impacts on child development, and children's early development predicts their academic growth in high school and college attendance [1,2]. Supported by the research evidence, there has been increased attention given to improving the quality of the ECEC workforce for better child wellbeing [3,4]. Quality in ECEC is linked to the structure of programmes and children's daily experiences within the programmes, while the latter has been demonstrated to directly influence child outcomes [5]. Therefore, preschool educators are tasked with providing the sensitive and responsive interactions that young children need for positive development.

However, the preparation of early educators varies considerably, leaving many educators without adequate training to engage in this highly skilled work [6]. Most ECEC educators are not required to have a bachelor's degree before working with young children [7], despite preschool educators' qualifications having been identified as an important factor in determining the quality of ECEC. Moreover, the majority of educators in the ECEC workforce face similar issues, such as low wages, lower educational degrees than other sectors of education, lack of benefits, and high-level job demands [8,9]. Preschool educators have been found to be incompetent in many areas, including knowledge of child development [10], communication with families [11], planning, implementation and evaluation of curricula [12], teaching with a child-oriented approach [13], evaluation of learning processes [4], mentoring and supervision [14], and working with culturally and linguistically diverse children [15]. This highlights the need for providing continuous in-service training opportunities to prepare preservice educators and support in-service preschool educators' professional knowledge and competencies in arranging learning environments and planning, implementing, and assessing learning processes for better child outcomes [3,14,15].

1.2. Quality Improvement Through Professional Development

Professional development (PD) refers to the training activities that develop an individual's skills, knowledge, expertise, and other characteristics as an educator [16]. Ongoing PD has the potential to fill in gaps in educators' knowledge and skills and, through this, change the quality of outcomes for children. Research in the last decades has witnessed the development of diverse effective PD programmes for improving educators' interaction quality and curriculum implementation, such as My Tools for Teachers (TfT) [17] and Teaching Partner [18] in America, Leadership for Learning [19] and Quality Teaching Rounds [20] in Australia, and Un Buen Comienzo (UBC) [21] in Chile. Evidence suggests that training in early childhood curricula and practices is positively related to educators' sensitivity and the use of enriching language in their interactions with young children [19,22]. According to the model of change [23], educator training changes latent and observable educator outcomes through its components of who (i.e., characteristics of learners and context), what (i.e., content area and focus domains), and how (i.e., PD strategies and delivery modes). PD training can equip educators with professional knowledge, skills, attitudes, beliefs, and expectations. The improved educator outcomes can enhance classroom quality through continuous reflection and enactment, subsequently promoting students' learning.

Although many PD programmes have been shown to effectively enhance classroom quality and improve child outcomes, PD for preschool educators still encounters numerous methodological and practical challenges. For instance, many PD programmes are limited in scale and conducted at a single site, which constrains the ability to consistently demonstrate positive outcomes. Even when larger experimental studies or multisite evaluations are conducted to examine the effects of PD, they are often criticised for their lack of replication

or inconsistency in producing positive outcomes [24]. Therefore, it is crucial to consider the scalability of research-proven PD programmes, as these programmes rarely reach a significant number of educators and students. As Elliot and Mihalic (2004) emphasised, the new frontier in intervention study is replicating and disseminating effective programmes [25]. In this regard, the current research aims to adapt a research-informed professional development programme—"Leadership for Learning (LfL)" from Australia and China and to compare its impacts.

1.3. The "Leadership for Learning" Programme

The "Leadership for Learning (LfL)" PD programme, developed by Siraj et al. (2018; 2023), addresses core principles of early childhood education, with a focus on the pivotal role of educators in intentional and relational teaching [26]. This programme was designed in response to previous research that identified weaknesses using the classroom quality rating scales ECERS-E and SSTEW in Australia, the UK, and other global contexts. The PD programme aims to enhance process quality—specifically in curricula and interactions—and to promote child development by empowering educators to improve their competencies and take on leadership roles in professional development within preschools and in collaboration with children's families.

This programme is structured into three phases. Phase 1 consists of two full-day intensive face-to-face sessions that introduce key aspects of quality in ECEC, supported by evidence. Phase 2 includes five fortnightly half-day sessions that focus on building professional competence and addressing curriculum content areas such as literacy, numeracy, self-regulation, science, and planning for concept development and critical thinking. During this phase, educators are encouraged to apply their learning in practice and provide feedback in subsequent sessions. Phase 3 involves ongoing online support, and a half-day, face-to-face session to address feedback from Phase 2 [26]. The programme's effectiveness was evaluated through a cluster randomised controlled trial [19,26]. The findings demonstrated significant improvements in curricular and pedagogical quality among participating educators, along with notable advancements in children's language and numeracy skills.

Given the lack of research-informed PD programmes tailored for Chinese preschool educators and the demonstrated effectiveness of LfL PD, this study further adapts the programme for implementation in China, exploring its impacts on classroom quality and child development. Recent guidelines for programme adaptation [27] emphasise the importance of balancing programme fidelity with necessary modifications to enhance outcomes. Bernal et al. (2009) defined cultural adaptation as "the systematic modification of an evidence-based treatment (EBT) or intervention protocol to consider language, culture, and context in such a way that it is compatible with the receiver's cultural patterns, meanings, and values" [28] (p. 362). Researchers commonly use three approaches for cross-national delivery of educational resources: (1) Adoption: Prioritizes achieving linguistic equivalence in translations; (2) Adaptation: Involves thorough translation and psychometric work to accommodate diverse linguistic and cultural contexts; (3) Assembly: Focuses on developing entirely new tools that are both linguistically and culturally relevant [29]. The choice of approach depends on the degree of contextual divergence between the target country and the original setting. In this study, these three approaches informed the translation and adaptation of the LfL PD programme to ensure its cultural and educational relevance within the Chinese context. Based on these guidelines, the following adaptations were made [30]:

- Adoption and adaptation: We translated the slides and videotapes from the original PD programme into Chinese, ensuring linguistic equivalence and cultural relevance.
- Assembly: We collaborated with Chinese experts in literacy, numeracy, science, self-regulation, and assessment to refine the Chinese version of the slides and to provide video recordings of one training session for each domain.

- Adaptation: We removed the online discussion component and incorporated follow-up mentoring to deliver individualised guidance directly within each classroom.
- Assembly: We added a new training session on diversity, addressing the limited awareness of gender and racial equality in Chinese kindergartens.
- Adaptation: We included preschool directors and curriculum coordinators in the PD sessions alongside educators to foster a collaborative learning community.

These adaptations were made to ensure that the LfL PD programme is not merely translated but also culturally and contextually tailored to address the unique needs of Chinese early childhood educators. This research is guided by the following research questions:

1. What is the impact of "Leadership for Learning" on classroom quality in Australia and China?
2. What is the impact of the adapted "Leadership for Learning" on child outcomes in Australia and China?

2. Materials and Methods

This comparative study examines two cluster randomised controlled trials (RCTs) conducted in Australia and China to investigate the impacts of the LfL PD programme on classroom quality and child development, exploring both the effects and the contextual nuances between the two countries.

In Australia, the selection process involved 90 ECEC centres in New South Wales, chosen to ensure broad representation across various dimensions, including government quality ratings, geography, service types, and socioeconomic areas. Following recruitment, 93 classrooms were randomly selected from these centres. Classroom quality assessments were conducted both before and after the implementation of the PD programme, specifically in 2015 and 2016. Baseline assessments were performed to establish initial conditions, after which the centres were randomly allocated into two groups: an intervention group of 45 centres, which participated in the PD programme, and a control group of the same size, which continued their standard practices.

In China, the study employed stratified random sampling to select 24 centres from 6 districts in Shenzhen, ensuring diversity in government quality ratings, service types, and family socioeconomic statuses. From each centre, two classrooms for K1 (serving 3- to 4-year-old children) and two for K2 (serving 4- to 5-year-old children) were randomly chosen, resulting in a total of 96 classrooms. These centres were matched based on criteria such as location (urban/suburban), operational type (private/public), and administrative classification (province/city/district), and then randomly divided into intervention and control groups. The intervention group consisted of 48 classrooms from 12 centres, which received tailored LfL training, while the control group of equal size adhered to their usual teaching methodologies. This phase of the RCT ran from October 2020 through July 2021, with pretests conducted in October and November 2020, a 7-month intervention period, and post-tests conducted in June and July 2021.

The PD training and assessments were conducted onsite in preschools or training hubs for both studies. Data collection took place during the baseline phase (prior to the implementation of the LfL programmes) and after their implementation, with the aim of evaluating programme impacts. To access classroom quality, the ECERS-E and the SSTEW scales were employed. For measuring child development, the International Development and Early Learning Assessment (IDELA) was used in Shenzhen, China, to evaluate areas such as literacy, numeracy, and executive functions. Conversely, in NSW, Australia, children's language and numeracy skills were assessed using the Differential Ability Scales (DAS—II) [31].

Evaluators, blinded to the centres' group assignment (intervention or control), conducted baseline assessments of children at the start of the intervention year, followed by post-intervention assessments and evaluations of classroom quality after the 7-month programme. This method, applied across two distinct geographic and cultural contexts,

provided valuable comparative insights into the LfL PD programme's effectiveness in enhancing classroom environments and supporting child developmental outcomes.

2.1. Participants

Table 1 summarises the datasets used in both countries. In Australia, a total of 90 ECEC centres were selected, encompassing both metropolitan (n = 45) and regional (n = 45) areas around a central metropolitan hub and two regional hubs. The selection process aimed to achieve a geographical balance (42 regional, 49 metropolitan) as well as a variety of National Quality Standard (NQS) ratings. These included 25 centres working towards standards, 27 meeting them, 37 exceeding, and 2 not yet rated. Following baseline evaluations, the centres were randomly allocated to either the intervention or control groups. However, 7 centres originally designated for the intervention group (17%) withdrew from the study due to logistical issues, leaving 38 ECEC centres in the intervention group, as shown in Table 1. For the child assessments, consent forms were distributed to the primary caregivers of all children in each classroom. With the consent obtained, assessments were conducted on a total of 1346 children aged 4 to 5 years, with an average cluster size of 14 children per classroom.

Table 1. Sample information.

Variables	Intervention	Control
	New South Wales, Australia	
Number of centres	38	45
Number of classrooms	39	54
Number of children	624	677
Geographic location	18 regional, 20 metro	18 regional, 27 metro
Government quality ratings	9 WT, 9 M, 19 E, 1 UR	12 WT, 14 M, 18 E, 1 UR
	Shenzhen, China	
Number of centres	12	12
Number of classrooms	48	48
Number of children	288	288
Geographic location	24 regional, 24 metro	24 regional, 24 metro
Government quality ratings	16 PL, 20 CL, 12 DL	16 PL, 16 CL, 16 DL

Note. In terms of government quality ratings, we refer to National Quality Standard (NQS) in New South Wales, Australia, and Guangdong Province Kindergarten Grade Assessment and Management Measures (Trial) in Shenzhen, China. In Australia, ratings refer to working towards (WT), meeting (M), exceeding (EX), or unrated (UR) against NQS at the time of recruitment. In China, ratings refer to province-level (PL), city-level (CL), and district-level (DL) at the time of recruitment.

In Shenzhen, China, 96 classrooms from 24 centres participated in this study. The distribution of these groups, as detailed in Table 1, was evenly spread across geographic locations (48 regional, 48 metropolitan) and government quality evaluations (32 at PL level, 36 at CL level, and 28 at DL level). However, one classroom from the control group withdrew from the study due to educator resignations. For child evaluations, six children from each classroom were selected using a random sampling process. Educators provided a list of children, from which researchers randomly selected 3 boys and 3 girls, resulting in 578 children participating in the baseline assessment. By the post-test phase, 29 children had transferred to other centres, leaving 547 children (272 boys and 275 girls) available for the final analysis.

Before conducting those studies, ethical approval was obtained from the Institutional Review Boards (IRBs) of the authors' institutions, ensuring adherence to local regulations and ethical standards. Informed consent was obtained from all participants, including teachers, parents, and principals, who were fully informed about the study's purpose, procedures, potential risks, and benefits. To address ethical concerns regarding fairness, participants in the control group were provided with the training intervention after the post-test, ensuring they had the opportunity to benefit from the study's findings.

2.2. Intervention

The PD programme, designed to enhance the quality of staff interactions and promote relational and intentional pedagogy with children, was informed by preassessment classroom quality metrics using ECERS-E and SSTEW scales in both Australia and China. This approach emphasised pedagogical practices and high-quality interactions known to positively influence children's outcomes [32]. Baseline assessments revealed areas requiring improvement. In Australia, ECEC educators' performance in literacy, mathematics, science, diversity, and support for critical thinking was found to be of minimal quality, underscoring the need to strengthen their knowledge and application of effective ECEC practices in these domains. The intervention was implemented over three phases spanning seven months, providing opportunities for observation, discussion, practice, and reflection on effective pedagogical qualities. Phase one was two-day, intensive, face-to-face training. It introduced the characteristics of pedagogical quality and engagement strategies through intensive training. Phase two continued with five 4 h face-to-face sessions, delivered every 2 weeks. This phase focused on content knowledge and strategies for quality improvement. The final phase leveraged an online model to sustain engagement and build a community of practice among educators.

Similarly, in China, the baseline assessments revealed minimal scores in supporting learning and critical thinking, as well as deficiencies in literacy, mathematics, science, and diversity education [33]. These findings mirrored those in Australian, highlighting the global relevance of the identified pedagogical weaknesses [19]. Such evidence informed the adaptation of the Australian PD content to the Chinese context. The tailored PD programme in China also followed a three-phase structure over 7 months, starting with two days of intensive training on quality teaching and interaction strategies, followed by six specialised sessions on domain-specific knowledge, and concluding with biweekly onsite mentoring for two months to assist educators in applying the learned concepts. This integrated approach across two diverse settings offered a comprehensive comparative analysis, exploring the effectiveness of the PD programme in enhancing pedagogical quality and classroom interactions.

2.3. Measures

Measures were selected to evaluate the impact of the intervention on two key fronts: the quality of the environment created by educators, which was the direct focus of the PD, and the developmental outcomes for children, which the PD aimed to influence indirectly through changes in educators' practices. At the classroom level, primary outcomes were measured using standardised quality rating scales, ECERS-E and SSTEW. For children, a range of assessments was employed to evaluate critical areas critical of readiness, including literacy and numeracy.

2.3.1. Quality Ratings

To evaluate the impact of the PD programme on educators' classroom practices, quality assessments were carried out by thoroughly trained evaluators who observed each preschool classroom for a full day in the participating ECEC centres. Observers were required to meet a strict interrater reliability criteria, achieving a minimum of 80% agreement within a 1-point margin on item ratings with a highly trained observer. For all data collection phases, including baseline and outcome assessments, the research team remained blinded to the centres' assignment to either the intervention or control groups.

The Early Childhood Environment Rating Scale-Extension (ECERS-E) [34] was used to assess curricular, environmental, and pedagogical quality within ECEC settings [35]. This instrument includes 15 items, grouped into four subscales: literacy, mathematics, science and environment, and diversity. Each item is scored on a 7-point scale, ranging from 1 (indicating inadequate practice) to 7 (signifying excellent practice), based on the observer's detailed evaluation of the quality indicators during a full day of classroom observation. The ECERS-E is recognised for its strong reliability and its ability to predict

children's developmental progress upon school entry [35]. Subscale scores are calculated as the average of item scores within each subscale, and these subscale scores are further averaged to yield an overall scale score.

The Sustained Shared Thinking and Emotional Wellbeing Scale (SSTEW) [36] was employed to assess pedagogical approaches that foster sustained shared thinking and support the emotional wellbeing of children under the age of five. The scale consists of 14 items, organised into 5 key subscales: (1) establishing trust, (2) building confidence and fostering independence, (3) promoting social and emotional wellbeing, (4) enriching language and communication, and (5) stimulating learning and critical thought while evaluating learning and linguistic development. Similar to ECERS-E, SSTEW items are rated on a 7-point scale, with 1 reflecting inadequate quality and 7 indicating excellent quality. The SSTEW is validated for its reliability and its capability to predict outcomes in child development effectively [12]. Average item scores within each subscale are aggregated to calculate subscale scores, which are subsequently combined to produce an overall scale score.

2.3.2. Child Assessments

Fieldworkers with extensive training, who were blinded to the environmental evaluations and group assignments, conducted child assessments in a quiet space within the child's ECEC centre. The training for assessors included an intensive one-day workshop covering assessment methodologies, hands-on observation supervised by specialists, constructive feedback on their administration techniques, and ongoing quality assurance reviews of collected data to ensure methodological rigor.

Differential Ability Scales (DAS-II) [31]: In the Australian context, children's language and numeracy skills were assessed using the DAS-II [31]. For language skills, the Verbal Comprehension subtest, which consists of 42 tasks, engages children in object identification and manipulation based on verbal prompts. This subtest concludes either upon its completion or when the child fails to meet performance threshold at specific stopping points designated by the test's protocol. For numeracy skills, the Early Number Concepts subscale of DAS-II, comprising 33 tasks, evaluates children's abilities in counting, recognising numbers and quantities, executing simple arithmetic operations, and understanding numerical concepts. The methodology for administering these sections mirrors that of the Verbal Comprehension subtest. The entire assessment process for each child, divided over two sessions, ranges from 40 to 50 min. Designed for children from 2.5 to 17 years of age, the DAS-II is validated for its high reliability—measured through internal consistency and test–retest reliability—and its validity, both concurrent and predictive, for children with typical and atypical development trajectories [31].

International Development and Early Learning Assessment (IDELA): In China, the official Chinese version of the IDELA was used to evaluate children's language and numeracy abilities. Developed by Save the Children, IDELA is a comprehensive tool designed to evaluate literacy, numeracy, socioemotional skills, and executive functioning in young children aged between 3 and 6. Each IDELA subscale is scored on a scale from 0 to 100, enabling a nuanced analysis of children's abilities across multiple domains. For emergent literacy (EL), IDELA incorporates 24 items across 6 subtasks: emergent writing, expressive vocabulary, recognition of initial word sounds, letter identification, listening comprehension, and print awareness. Similarly, the emergent numeracy (EN) subscale evaluates children using 6 subtasks comprising 27 items, which include classifying and sorting by length and quantity, number comparison, object counting, numeral recognition, shape identification, and basic arithmetic operations. IDELA has been widely validated for use in in low- and middle-income countries, demonstrating strong effectiveness and reliability (Halpin et al., 2019). Its reliability is further affirmed within the Chinese context, where it has achieved a Cronbach's alpha of 0.858, indicating a high level of internal consistency and reliability in measuring early learning and development [30].

2.4. Data Analysis

To evaluate the effectiveness of the PD intervention on classroom quality ratings, linear regression models were employed. The analysis began with an intention-to-treat approach, which included the entire sample while adjusting for potential confounding variables such as geographic location, service type, government quality ratings, area-level socioeconomic status (SES), and baseline quality ratings. To more accurately analyse the PD's effectiveness, the analysis was then refined to focus on centres that met a predefined threshold of participation, thereby adhering more closely to the protocol, in a per-protocol analysis.

For assessing the PD programme's impacts on children's developmental outcomes, mixed-effects linear regression models were utilised. These models incorporated a random effect for each childcare centre cluster, effectively accounting for the intracluster correlation arising from repeated individual assessments over time and the clustering of individuals within centres. The analysis was conducted on both complete case datasets and datasets subjected to multiple imputations to address missing data effectively, ensuring a comprehensive and coherent examination of the PD intervention's effects.

3. Results

3.1. The PD Effects on Classroom Quality in Australia and China

As shown in Table 2, the baseline analysis indicates that educators demonstrated minimal quality, as measured by using ECERS-E (M(SD) intervention = 3.17 (1.03), M(SD) control = 3.09 (0.94)), and minimal to good quality, as measured by using SSTEW (M(SD) intervention = 4.00 (1.21), M(SD) control = 3.96 (1.25)). For the subscales of ECERS-E, results indicate inadequate quality in science (M(SD) intervention = 2.87 (1.17), M(SD) control = 2.83 (1.20)) and diversity (M(SD) intervention = 2.74 (1.27), M(SD) control = 2.65 (1.02)). Regarding the subscales of SSTEW, educators performed at good quality levels in building trust, confidence, and independence (M(SD) intervention = 5.03 (1.14), M(SD) control = 4.89 (1.30)) but demonstrated minimal quality in supporting learning and critical thinking (M(SD) intervention = 3.08 (1.40), M(SD) control = 2.98 (1.38)) and assessing learning (M(SD) intervention = 3.28 (1.50), M(SD) control = 3.40 (1.48)).

Table 2. Baseline and follow-up ratings by group in Australia.

	Baseline			Post-Test				
Sub/Scale	**Intervention M(SD)**	**Control M(SD)**	**Mean Diff**	**Intervention M(SD)**	**Control M(SD)**	**Mean Diff**	**Hedges'g**	**95%CI**
ECERS-E	3.17 (1.03)	3.09 (0.94)	0.08	4.03 (1.25)	3.19 (1.12)	0.84 ***	0.70	[0.26, 1.15]
Literacy	3.89 (1.05)	3.81 (1.12)	0.08	4.76 (1.21)	3.79 (1.17)	0.97 ***	0.81	[0.36, 1.26]
Mathematics	2.87 (1.17)	2.83 (1.20)	0.04	4.31 (1.66)	3.24 (1.57)	1.07 ***	0.66	[0.21, 1.10]
Science	3.19 (1.36)	3.08 (1.18)	0.11	4.08 (1.64)	3.19 (1.24)	0.89 **	0.61	[0.17, 1.06]
Diversity	2.74 (1.27)	2.65 (1.02)	0.09	2.99 (1.04)	2.54 (1.01)	0.45	0.44	[0.00, 0.87]
SSTEW	4.00 (1.21)	3.96 (1.25)	0.04	4.90 (1.36)	3.83 (1.28)	1.07 ***	0.80	[0.36, 1.25]
Building T,C,I	5.03 (1.14)	4.89 (1.30)	0.14	5.56 (1.25)	4.47 (1.44)	1.09 ***	0.80	[0.35, 1.24]
Soc-Emo W-B	4.10 (1.70)	4.09 (1.70)	0.01	5.15 (1.66)	4.06 (1.60)	1.09 ***	0.66	[0.22, 1.11]
Lang-Comm	4.49 (1.24)	4.44 (1.34)	0.05	5.43 (1.32)	4.16 (1.53)	1.27 ***	0.87	[0.42, 1.33]
Learn-Critical	3.08 (1.40)	2.98 (1.38)	0.1	4.25 (1.61)	3.03 (1.31)	1.22 ***	0.83	[0.38, 1.28]
Assessing	3.28 (1.50)	3.40 (1.48)	−0.12	4.10 (1.66)	3.41 (1.37)	0.69 *	0.45	[0.02, 0.89]

Note. ECERS-E = average of ECERS-E subscale scores for a given room. SSTEW = average of SSTEW subscale scores for a given room. A score of 1 is considered inadequate, 3 as basic, 5 as good and 7 as excellent quality. Build TCI = Building Trust, Confidence and Independence. SE Wellbg = Social-Emotional Wellbeing. Lang-Comm = Supporting and Extending Language and Communication. Learn-Crit = Supporting Learning and Critical Thinking. Assessing = Assessing Learning and Language. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

In terms of the impacts of the intervention on classroom quality, Table 2 shows no significant differences between the intervention and control group in the baseline analysis of classroom quality as measured by using ECERS-E and SSTEW. However, significant differences were observed in the post-test results for overall and subscales scores of ECERS-E

and SSTEW. The intervention group shows significant improvement in the overall scores for the ECERS-E (mean difference = 0.84, $p < 0.001$, Hedges'g = 0.70, 95% CI [0.26, 1.15]) and SSTEW (mean difference = 1.07, $p < 0.001$, Hedges'g = 0.80, 95% CI [0.36, 1.25]). For the ECERS-E subscales, the most notable improvement was in literacy (mean difference = 0.97, $p < 0.001$), with the largest effect size (Hedges'g = 0.81, 95% CI [0.36, 1.26]). The smallest effect size was observed in diversity (Hedges'g = 0.44, 95% CI [0.36, 1.26]). Among the SSTEW subscales, the largest effect size was identified in supporting language and communication (Hedges'g = 0.87, 95% CI [0.42, 1.33]), while the smallest effect size was observed in assessing learning (Hedges'g = 0.45, 95% CI [0.02, 0.89]).

As shown in Table 3, the baseline analysis indicates that educators demonstrated minimal quality in overall classroom quality, as measured by using ECERS-E (M(SD) intervention = 3.03 (0.50), M(SD) control = 2.84 (0.45)) and SSTEW (M(SD) intervention = 3.97 (0.52), M(SD) control = 3.84 (0.67)). Among the ECERS-E subscales, results indicate inadequate quality in diversity (M(SD) intervention = 1.69 (0.43), M(SD) control = 1.80 (0.40)) and in science for the control group (M(SD) control = 2.76 (0.97)). Regarding the SSTEW subscales, educators demonstrated inadequate quality in assessing learning (M(SD) intervention = 2.22 (0.80), M(SD) control = 2.11 (0.89)). However, the baseline score for supporting language and communication (M(SD) intervention = 4.72 (0.87), M(SD) control = 4.61 (0.93)) was relatively higher compared to other subscales.

Table 3. Baseline and follow-up ratings by group in China.

	Baseline			Post-Test				
Sub/Scale	**Intervention M(SD)**	**Control M(SD)**	**Mean diff**	**Intervention M(SD)**	**Control M(SD)**	**Mean Diff**	**Hedges'g**	**95%CI**
ECERS-E	3.03 (0.50)	2.84 (0.45)	0.19	4.02 (0.84)	2.85 (0.37)	1.17 ***	1.79	[1.31, 2.26]
Literacy	3.74 (0.57)	3.54 (0.56)	0.2	4.91 (0.69)	3.39 (0.52)	1.52 ***	2.46	[1.93, 3.00]
Mathematics	3.23 (0.78)	3.26 (0.96)	−0.03	4.60 (0.87)	3.28 (0.70)	1.32 ***	1.66	[1.19, 2.12]
Science	3.46 (1.07)	2.76 (0.97)	0.7 ***	4.26 (0.82)	2.87 (0.70)	1.39 ***	1.81	[1.33, 2.28]
Diversity	1.69 (0.43)	1.80 (0.40)	−0.11	2.32 (0.36)	1.87 (0.38)	0.45 ***	1.21	[0.77, 1.64]
SSTEW	3.97 (0.52)	3.84 (0.67)	0.13	4.51 (0.60)	3.39 (0.55)	1.12 ***	1.93	[1.44, 2.42]
Building T,C,I	4.72 (1.01)	4.56 (1.09)	0.16	5.51 (0.76)	4.24 (0.71)	1.27 ***	1.71	[1.24, 2.18]
Soc-Emo W-B	4.31 (0.88)	4.11 (1.45)	0.2	4.73 (1.07)	3.38 (1.09)	1.35 ***	1.24	[0.80, 1.68]
Lang-Comm	4.72 (0.87)	4.61 (0.93)	0.11	5.60 (0.79)	4.42 (0.78)	1.18 ***	1.49	[1.04, 1.95]
Learn-Critical	3.90 (0.70)	3.82 (0.72)	0.08	4.54 (0.78)	3.32 (0.71)	1.22 ***	1.62	[1.16, 2.08]
Assessing	2.22 (0.80)	2.11 (0.89)	0.11	2.18 (0.73)	1.60 (0.44)	0.58 ***	0.95	[0.53, 1.38]

Note. ECERS-E = average of ECERS-E subscale scores for a given room. SSTEW = average of SSTEW subscale scores for a given room. A score of 1 is considered inadequate, 3 as basic, 5 as good and 7 as excellent quality. Build TCI = Building Trust, Confidence and Independence. SE Wellbg = Social-Emotional Wellbeing. Lang-Comm = Supporting and Extending Language and Communication. Learn-Crit = Supporting Learning and Critical Thinking. Assessing = Assessing Learning and Language. *** $p < 0.001$.

Regarding the impacts of the intervention on classroom quality, Table 3 shows no significant differences between the intervention and control group for classroom quality, as measured by using ECERS-E and SSTEW, except for the ECERS-E science subscale (M(SD) intervention = 3.46 (1.07), M(SD) control = 2.76 (0.97)). However, significant differences were observed in the post-test results for both overall scores and subscale scores of ECERS-E and SSTEW. The intervention group shows significant improvement in the overall scores of ECERS-E (mean difference = 1.17, $p < 0.001$, Hedges'g = 1.79, 95% CI [1.31, 2.26]) and SSTEW (mean difference = 1.12, $p < 0.001$, Hedges'g = 1.93, 95% CI [1.44, 2.42]). For the subscales, the largest improvement was observed in literacy (mean difference = 1.52, $p < 0.001$), with the largest effect size (Hedges'g = 2.46, 95% CI [1.93, 3.00]). The smallest effect size was noted in diversity (Hedges'g = 1.21, 95% CI [0.77, 1.64]). Among the SSTEW subscales, the largest effect size was observed in building trust confidence and independence (Hedges'g = 1.71, 95% CI [1.24, 2.81]), while the smallest effect size was identified in assessing learning (Hedges'g = 0.95, 95% CI [0.53, 1.83]).

3.2. The PD Impacts on Child Development in Australia and China

Table 4 shows the results of the regression analysis of the impacts of PD intervention on children's numeracy development in Australia. It shows that the intervention significantly improved children's numeracy skills (B = 0.045, $p < 0.01$, 95% CI (+0.017, +0.073)). This result suggests that children in the intervention group experienced a 0.045-unit increase in numeracy scores compared to those in the control group. Additionally, children in the control group and younger children tended to achieve lower numeracy scores following the PD programme.

Table 4. Results of the regression model of difference between pre- and post-intervention Preschool Early Numeracy Scale scores in Australia.

		Beta	95% CI	*p*-Value
Group	Control	Reference level		
	Intervention	+0.045	(+0.017, +0.073)	0.002 **
Age difference		+0.266	(+0.009, +0.523)	0.042 *
Sex	Male	Reference level		
	Female	−0.011	(−0.033, +0.010)	0.303
Mother's education	Less than high school	Reference level		
	High school	−0.016	(−0.055, +0.022)	0.406
	Diploma	−0.028	(−0.071, +0.015)	0.206
	University or higher	−0.038	(−0.077, +0.001)	0.059
Income band	Low	Reference level		
	Middle	−0.006	(−0.034, +0.022)	0.680
	High	−0.014	(−0.046, +0.017)	0.359
First language	English	Reference level		
	Other language	−0.013	(−0.055, +0.029)	0.535
Aboriginal status	No	Reference level		
	Yes	+0.023	(−0.036, +0.082)	0.451

Note: CI = confidence interval; statically significant *p*-values: * = $p < 0.05$, ** = $p < 0.01$.

Table 5 shows the impacts of PD on children's language development, including verbal comprehension and expressive vocabulary, in Australia. The results indicate that PD intervention did not have a significant impact on children's verbal comprehension development (B = 0.618, 95% CI (−0.241, 1.477), $p > 0.05$) or expressive vocabulary development (B = 0.064, 95% CI (−0.595, 0.723), $p > 0.05$). Furthermore, age, gender, mother's education, income band, first language, and aboriginal status did not significantly influence the comparisons between the control and intervention groups regarding children's verbal comprehension.

Table 5. Results of the regression model of difference between pre- and post-intervention EYT Expressive Vocabulary and DAS Verbal Comprehension scores in Australia.

		Expressive Vocabulary			DAS Verbal Comprehension		
		Beta	95% CI	*p*-Value	Beta	95% CI	*p*-Value
Group	Control	Reference level					
Group	Intervention	+0.064	(−0.595, +0.723)	0.847	+0.618	(−0.241, +1.477)	0.156
Age difference		+3.490	(−2.440, +9.420)	0.248	+2.279	(−5.500, +10.058)	0.565
Sex	Male	Reference level					
	Female	+0.166	(−0.315, +0.646)	0.499	−0.535	(−1.172, +0.103)	0.100
Mother's education	Less than high school	Reference level					
	High school	−0.250	(−1.108, +0.609)	0.568	+0.149	(−0.985, +1.283)	0.797
	Diploma	−0.699	(−1.643, +0.245)	0.146	−0.541	(−1.795, +0.712)	0.397
	University or higher	−0.227	(−1.097, +0.643)	0.609	+0.132	(−1.019, +1.283)	0.822
Income band	Low	Reference level					
	Middle	+0.493	(−0.134, +1.119)	0.123	−0.463	(−1.296, +0.370)	0.276
	High	−0.235	(−0.921, +0.451)	0.502	−0.891	(−1.802, +0.020)	0.055
First language	English	Reference level					

Table 5. *Cont.*

		Expressive Vocabulary			DAS Verbal Comprehension		
		Beta	**95% CI**	***p*-Value**	**Beta**	**95% CI**	***p*-Value**
Aboriginal status	Other language	−0.148	(−1.079, +0.782)	0.754	+0.452	(−0.777, +1.681)	0.471
	No	Reference level					
	Yes	+0.479	(−0.853, +1.812)	0.480	−0.328	(−2.061, +1.404)	0.710

Note: CI = confidence interval; statically significant *p*-values.

Table 6 shows the impacts of PD intervention on children's numeracy and literacy development in China. The results indicate that the PD intervention did not have a significant effect on children's numeracy development (B = 0.005, 95% CI (−0.022, +0.003), $p > 0.05$). However, children from the urban areas demonstrated higher early numeracy scores (B = 0.300, 95% CI (+0.001, +0.058), $p < 0.05$) following the PD programme.

Table 6. Results of the regression model of difference between pre- and post-intervention literacy and numeracy scores in China.

		Numeracy			Literacy		
		Beta	**95% CI**	***p*-Value**	**Beta**	**95% CI**	***p*-Value**
Group	Control	Reference level					
	Intervention	+0.005	(−0.022, +0.003)	0.738	+0.029	(+0.003, +0.055)	0.032 *
Age difference		−0.028	(−0.005, +0.001)	0.008 **	+0.001	(−0.002, +0.002)	0.639
Sex	Female	Reference level					
	Male	+0.182	(−0.008, +0.044)	0.172	−0.002	(−0.027, +0.241)	0.897
Educator degree	Associate degree or below	Reference level					
	Bachelor's degree or above	−0.011	(−0.042, +0.200)	0.486	−0.027	(−0.056, +0.003)	0.077
Location	Suburban	Reference level					
	Urban	+0.300	(+0.001, +0.058)	0.043 *	−0.009	(−0.036, +0.189)	0.541
Governmental quality assessment	District level	Reference level					
	City level	−0.024	(−0.061, +0.137)	0.754	+0.003	(−0.325, +0.394)	0.852
	Province level	0.001	(−0.418, 0.200)	0.486	0.010	(−0.225, +0.429)	0.540

Note: CI = confidence interval. statically significant *p*-values: * = $p < 0.05$, ** = $p < 0.01$.

Regarding literacy development, the PD intervention had a significant positive impact (B = 0.029, 95% CI (+0.003, +0.055), $p < 0.05$), indicating a meaningful difference between the control and intervention groups. Children's age, gender, educator education, location, and governmental quality rating of preschools did not significantly influence the comparisons between the control and intervention groups regarding children's verbal comprehension.

4. Discussion

The findings indicated that the LfL PD programme effectively enhances process quality, as measured by using ECERS-E and SSTEW, in both Australia and China. Classrooms in the intervention group demonstrated significantly higher scores in literacy, numeracy, science, and diversity instruction. Furthermore, these classrooms excelled in fostering children's language and communication, critical thinking, and independence during interactions. In terms of child development, the LfL PD programme positively influenced children's numeracy skills in Australia and literacy skills in China. These findings will be further explored and discussed in the following sections.

4.1. Effect of Research-Informed PD on Process Quality

The results suggest that the PD programme had a significant positive impact on ECERS-E and SSTEW scores in both Australia and China, which is consistent with previous research on the effectiveness of in-service PD in improving the quality of teacher–child

interactions [23]. This outcome supports the well-established relationship between educators' knowledge and the quality of their interactions. Specifically, ECERS-E assesses domain-specific instructional quality in literacy, numeracy, science, and diversity, while SSTEW evaluates the support and extension of language and communication, as well as the assessment of learning and language. Since these domains were comprehensively addressed in the PD content, it is reasonable to conclude that the programme contributed to enhanced instructional quality in these areas. Moreover, findings by Kulgemeyer and Riese (2018) highlight that educators' content knowledge and pedagogical content knowledge are strong predictors of teaching quality, as they enable educators to implement appropriate instructional strategies and select relevant content for children's learning [37].

In addition, existing research underscores the effectiveness of observation rubrics in peer support and self-assessment, which can substantially enhance educators' practices and improve children's learning outcomes [38]. Observation rubrics are widely employed in ECEC settings to refine instructional practices [38–40]. By using rating scales, educators engage in self-reflection, systematically identifying strengths and areas for improvement to enhance their instructional methodologies. These tools provide a concrete and objective framework for evaluating teaching practices and facilitating constructive peer feedback. This approach aligns with adult learning theory, which posits that adults benefit from realistic, goal-oriented learning experiences and formative evaluations that encourage self-directed learning.

Furthermore, the results indicate that the effect size of the PD programme on process quality was stronger in China than in Australia, suggesting the effectiveness of the programme's adaptation to the Chinese context. This difference may be attributed to China's collective learning culture, which emphasises continuous, collaborative, and reflective sharing of knowledge and practices among educators. Unlike the participants in Australia, each participating preschool in China included four classrooms and at least eight educators in the adapted PD programme. Educators from the same preschool, along with their curriculum coordinator, attended the PD training sessions together, fostering a cohesive learning community. This arrangement aligns with the Chinese tradition of collaborative learning practices, such as joint lesson planning and lesson observations [41]. Additionally, the follow-up onsite mentoring process likely contributed to the stronger effect size in China. Individualised mentoring sessions tailored the PD content to educators' diverse needs and specific knowledge of the curriculum and children. These factors collectively underscore the effectiveness of the adapted PD programme in the Chinese educational setting.

4.2. Effect of Research-Informed PD on Child Outcomes

This research found that the PD programme significantly enhanced children's numeracy development in Australia. Children in the intervention classrooms exhibited higher proficiency in classifying and sorting, comparison, counting, number identification, shape recognition, and simple arithmetic. These findings align with prior research indicating that in-service PD positively affects child outcomes [23]. During the PD intervention, educators improved their content knowledge of early mathematics concepts, such as comparison, counting, number identification, and shapes, as well as their pedagogical knowledge on how to effectively interact with young children to foster numeracy learning. These enhancements in educators' knowledge and practices procedurally and conceptually contributed to children's numeracy attainment [42].

However, the results also revealed that the PD intervention did not significantly impact children's vocabulary development in Australia. While language skills can be improved through rich, complex conversations with children, vocabulary development remains a challenging area to influence [43]. This finding is consistent with previous research showing that most interventions focusing on language and literacy development tend to impact alphabet knowledge and phonemic awareness rather than vocabulary development [44]. Notably, vocabulary development was more effectively enhanced when PD programmes specifically targeted classroom language practices or children's vocabulary acquisition, such as through explicit vocabulary instruction or dialogical reading programmes [45].

The LfL PD programme primarily concentrated on environmental print, emergent writing, adult reading with young children, and communication skills. This suggests that more specific strategies and intensive training focused on vocabulary development should be incorporated into future PD interventions to improve their effectiveness in enhancing children's vocabulary skills.

Regarding the impacts of the adapted PD programme in China, this research found that children in the intervention classrooms exhibited higher levels of literacy skills than those in the control group. These findings highlight that professional development for educators focusing on literacy instruction and teacher–child interactions can effectively enhance children's literacy development [22,43]. Specifically, the PD programme improved the quality of literacy instruction, creating opportunities for children to engage in shared book reading and mark-making activities with educators, which in turn strengthened their emergent writing, word identification, story comprehension, and print awareness.

In contrast, the adapted PD programme did not show significant impacts on children's numeracy skills, a result that diverges from the findings in Australia. This discrepancy underscores the importance of contextual differences in children's mathematical learning. While many mathematical concepts, such as the use of Arabic numerals, are universal, the language and cultural context in which children learn mathematics can significantly influence their acquisition of mathematical competence [46]. Linguistic equivalence in the PD content between Australia and China may not sufficiently address the nuances of mathematical learning in the Chinese context. Therefore, the lack of significant improvement in numeracy skills suggests that the adapted PD programme may not have adequately considered the unique linguistic and cultural factors affecting mathematics education in China.

5. Conclusions

This research represents a cross-national and cross-cultural investigation that adapted the LfL PD programme from Australia to the Chinese context and compared its effects. While prior studies have often focused on the challenges of validating rating scales across different languages or contexts [29], this research took a broader approach by adapting a PD programme to account for the social and cultural dimensions of PD design, delivery, communication, and knowledge structuring for learners from diverse cultural backgrounds. By doing so, this research extends current discussions on cross-national studies. Additionally, the effective adaptation of Siraj et al.'s (2018) work provided a rigorous test of its cross-national transportability, offering insights for larger-scale and cross-national studies aimed to enhance children's learning outcomes [26].

Despite the promising findings, several limitations must be considered. Firstly, the two PD programmes were conducted at different times, which may limit the direct comparability of the effects between China and Australia. Temporal differences could have influenced the outcomes due to external factors such as educational policies, societal changes, and economic conditions. Secondly, the educational context in China differs significantly from that in Australia, including variations in class size, educators' preservice training, and curriculum frameworks. These contextual differences could introduce additional variables that affect the PD programme's impact, making it challenging to attribute changes solely to the PD intervention.

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