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From Awareness to Action: Strengthening Teacher Competencies for Least Restrictive and Inclusive Early Learning through Professional Development

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ABSTRACT

The key goal of this research was to determine how effectively a professional development (PD) program could be used to enhance the skills of early childhood educators in the implementation of inclusive education through the lens of Universal Design for Learning (UDL). The authors of the paper chose the quasi-experimental design for their study. The participants were 220 early childhood teachers who were randomly divided into the intervention group or control group. The authors used pretest and posttest competency assessments as well as teacher self-efficacy measures and classroom observations for data collection. The findings were also subjected to statistical analysis, including descriptive statistics, independent-samples t-tests, Analysis of Covariance (ANCOVA), and multilevel modeling. Consequently, those teachers who received the intervention exhibited a statistically significant improvement in their teaching effectiveness and the implementation of inclusive practices compared to those teachers from the control group. Moreover, a dose–response relationship was detected, which suggested that an increased participation in the PD sessions resulted in higher levels of competencies. The findings of this study point to the importance of ongoing, locally relevant PD as a way of enhancing teachers' confidence and skills in the use of inclusive strategies. It is suggested that technology, in-service coaching, and collaborative models be used to secure the long-term effects of PD on the practice of inclusive education. The present research is a rich source of information for policymakers, educators, and researchers, who are looking to have their students taught in an inclusive manner in early childhood settings.

Keywords: *Teacher Competencies, Least Restrictive Environment (LRE), Universal Design for Learning (UDL), Inclusive Education, Professional Development*

INTRODUCTION

Inclusive education has been made one of the main objectives of global educational reform. The system outlines the main principles of equal access, participation, and achievement, and tries to unite all learners regardless of their ability or social background. The concept of the Least Restrictive Environment (LRE) is

the basis of this idea and thus it supports the notion that children with disabilities should be taught with other children as far as it is suitable. The impact of such a concept is very sensitive in the domain of the first stage of the child's education program, where teachers, through this principle, are reforming their teaching methods, handling diversities, and providing equal learning for all kids (UNESCO, 2020). Nevertheless, the inclusive concept has been registered in both national and international legislations, and teacher proficiency is its main condition - a teacher's know-how, skills, and character traits that help a teacher to apply inclusive principles and make their effectiveness felt in the classroom (Kleiner & Lipsky, 2022; Smith & Jones, 2021).

Evidence from studies, worldwide, indicates that the teachers are usually in favor of inclusive education from the theoretical point of view, but they are hesitant to carry it out in practice. The difference between knowledge and deeds in this case is because teachers have had a very small share of professional preparation, and the institutions that are supposed to support them have not done it sufficiently. Besides this, there have been only a few scattered and irregular professional development (PD) sessions available to them (Griful-Freixenet et al., 2021). Teachers in early childhood settings face additional challenges, as inclusion at this stage requires flexible play-based pedagogy, individualized scaffolding, and social–emotional supports rather than rigid academic instruction (Bruns, 2024). Therefore, effective instructional staff development should not be considered as one-time training, but as a continuous, collaborative process that empowers educators to self-evaluate, change, and create in various learning contexts (Lindner, 2023; Rao et al., 2021).

As a developing country, Pakistan has seen increased attention towards inclusive education policies over the last few years. This is evidenced by support from the National Education Policy (2018) and various programs aligned with Sustainable Development Goal 4 (SDG 4). However, besides these advances in policy, the actual implementation is still lagging far behind. Often, teachers in early childhood have no methodological exposure to inclusion since they have not been front-loaded in evidence-based practices. At the same time, most professional development leaves teachers only prepared in the delivery of the content rather than in skill areas (Han & Lei, 2024). Also, school systems are structurally void of collaborative setups like mentoring relationships and resource provisions that can lead to the habituation of inclusive practices in less prioritized areas (Echeita et al., 2022). Hence, while having learned theoretically what inclusion means, teachers are frequently doubting their capacity to alter teaching frameworks, effectively using technology or applying adaptive pedagogies for the benefit of heterogeneous students (Katz & Sokal, 2023).

Wide adoption of digital instruments could reinvigorate efforts to maintain pedagogical skills at a high level. Personal development through technology may help teachers to become more self-critical practitioners, open more channels for seeing different methods of instruction, and allow teaching personnel to reach each other regardless of their locales (Bray et al., 2024). Digital avenues and community-building through social media have rapidly turned into an informal way of professional development where teachers can exchange material, talk over problems, and figure out collectively new plans for an inclusive approach implementation (Vie, 2018; Veytia Bucheli et al., 2024). When tech innovations are well-planned with the support of inclusive structures like Universal Design for Learning (UDL), teachers will be able to create even more learner-centered and inherently least restrictive educational settings in which the main idea of free and equal access to education is truly practiced (CAST, 2024). Subsequently, by properly organizing, continuously running, and technologically supporting teacher development early childhood educators might experience the awareness thus becoming the actors to enable inclusion in their classrooms (Rusconi & Squillaci, 2023).

Least Restrictive Environment (LRE) has been primarily associated with Special Education Law which provides that the decision on pupils' placement must guarantee interaction with non-disabled peers to the highest extent possible and the rest of the needs should be fulfilled with the help of supplementary aids and services (IDEA jurisprudence, in U.S. contexts). With the time passing by, the discussion about LRE has gone far beyond heading towards different locations for learning to access and engagement issues, i.e., the idea that children should not only be there physically but also actively involved in the curriculum, interaction with peers, and the life of the class (Kleiner & Lipsky, 2022; UNESCO, 2020). Those students who get their first schooling in a preschool context are a little difficult to place in an environment that fits the description of LRE. This is since young kids need much more scaffolding, social and emotional support, as well as an adaptive play-based approach to teaching.

Along with the concept of LRE, teacher competency issues have become more profound and dependent upon the usage of adaptive expertise, inclusive pedagogy, and reflective practice. Teachers in inclusive ECE must blend child development knowledge, classroom management, differentiation skills, and collaboration with specialists. Yet multiple studies show that many early childhood teachers lack confidence or training in designing modifications, scaffolds, or collaborative support for learners with diverse needs (Smith & Jones, 2021; Veytia Bucheli et al., 2024). Professional development emerges repeatedly in literature as the key lever for building those competencies, especially when sustained, context-embedded, and collaborative.

In Pakistan, inclusive education policies have made strides over the past decade, but implementation often lags. Many early childhood educators receive only superficial exposure to inclusive concepts without structured PD to build concrete competencies. Institutional constraints large classes, resource shortages, limited support from leadership compound the difficulty of translating awareness into classroom practice. Thus, there is a compelling need to explore PD models suited to strengthening teacher competencies in least restrictive and inclusive early learning settings in the Pakistani context (Alsraisri & Amjad, 2025).

While there is substantial literature documenting inclusive principles, LRE, and teacher PD in general education settings, gaps remain in the early childhood domain and in low- and middle-income contexts like Pakistan. First, most existing studies address awareness or attitude toward inclusion; fewer examine the transition to instructional competence how teachers enact inclusive practices in real early learning classrooms. Second, research often treats PD as a one-time workshop; fewer studies rigorously evaluate ongoing, embedded PD models that explicitly target competencies for LRE. Third, comparative studies that examine how institutional support, teacher beliefs, and PD design interact in fostering or hindering implementation are limited. Finally, evaluations that link PD in early childhood to measures of inclusion and participation (rather than just knowledge gains) are especially rare. Addressing these gaps can inform more effective PD structures tailored to early learning and inclusion in contexts like Pakistan (Almulla et al., 2025).

Although awareness of inclusion and least restrictive environments has increased among ECE teachers in Pakistan, many still struggle to convert that awareness into effective classroom practice. Often, teachers show signs of confusion regarding the adaptation of the curriculum, the scaffolding of peer interaction, or the use of support in such a way that learners with disabilities can participate meaningfully (Alahmari et al., 2025). Professional development programs are generally episodic, and teachers perceive them as disconnected from classroom realities, and these programs also do not focus on the specific skills required for inclusive early learning. Consequently, many children who might flourish in general classrooms are still segregated or under-participated. So, the main issue is: In what ways can professional development be planned and carried out to engineer teacher competencies that facilitate the least restrictive, inclusive early learning environments? This research is aimed at discovering the features of PD, the needs of teachers, the

enablers and barriers of the institution, and the practical ways to move from awareness to action in Pakistani ECE settings.

1. To evaluate the actual level of competency of early childhood teachers and their perception of the degree of their readiness for inclusive practices in line with least restrictive environments.
2. To unearth gaps in the professional development of pedagogical skills, collaborative skills, and adaptive support skills for inclusive early learning, through which to provide the corresponding PD needs.
3. To create and implement a pilot PD model centered on competency-building for LRE in ECE classrooms.
4. To assess the way institutional support (leadership, resources, collaborative structures) influences the effectiveness of PD in bringing about the transition of awareness into action?
5. To come up with evidence-based suggestions that would facilitate the decision-making process for policy makers, teacher educators, and school administrators in scaling up inclusive PD in early childhood settings.

The significance of the research extends to various levels. On a theoretical level, the research is instrumental in overcoming the 'knowing doing' divided into the domain of inclusion by positioning the development of teacher competence as the main lever for achieving least restrictive conditions, particularly at the early learning stage. On a practical level, the results of the study will be a resource for the design of PD programs that not only raise awareness but also train instructional skills that are actionable and conducive to educational inclusion. This is very important, especially in resource-constrained contexts that have a diverse range of learner needs. Moreover, for institutional leaders and policy makers, the insights from the study will serve as a guide in the structuring of support systems, the allocation of resources, and the motivation system for maintaining inclusive practices. At the level of children and communities, stronger teacher capacity will directly contribute to improved participation, belonging, and learning outcomes for children with varied abilities in mainstream early childhood settings in Pakistan and similar contexts.

LITERATURE REVIEW

This review synthesizes empirical and theoretical literature on three interrelated themes: the least restrictive environment (LRE) as a guiding principle for early childhood inclusion, teacher competencies and professional development (PD) required to translate inclusive awareness into practice, and the role of digital and social technologies in supporting teacher learning and inclusive pedagogy. The goal is to identify what is known about building teacher capacity for LRE in early childhood education (ECE), the barriers that impede implementation particularly in low- and middle-income contexts such as Pakistan and evidence-informed PD strategies that move educators from awareness to sustained practice (UNESCO, 2020).

Conceptualizing Least Restrictive Environment (LRE) in Early Childhood

The idea of least restrictive environment (LRE) comes from special-education policies which, basically, have been the source of children with disabilities rights to be educated along with other children in general classrooms whenever it is suitable. This concept in the very first years of life has been changed to emphasize rather participation and access than the simple physical placing. At present, the research is defining LRE as a place where a child can be fully engaged with the help of individualized support, interaction with peers, and practices suitable for the child's level of development. This method includes the use of an inclusive curriculum that is open and accessible to all students in the mainstream ECE classrooms (UNESCO, 2020).

Teacher Competencies Required for Inclusive Early Learning

Inclusive education requires that teachers have many teaching, assessment, and cooperation skills in their toolkits. Some of the main skills that a teacher should have are deep understanding of child development, ability to modify instruction, use of formative assessment, and skillful management of different student behaviors. Moreover, teachers need to have good attitudes toward inclusion, be open to change, and collaborate with families and experts so that every child can take part. Research-based studies have pointed out that the development of competences in these areas leads to a significant improvement in the quality of inclusive education and better learner outcomes (Rao et al., 2021; Griful-Freixenet et al., 2021).

The "Awareness–Action" Gap

Studies have consistently shown that teachers know what inclusive education is about, but they fail to implement and practice these principles in their classrooms. As a matter of fact, teachers usually endorse and accept the idea of inclusion in educational settings, however, they come across problems such as insufficient training, shortage of resources and restrictions imposed by the administration. The gap between "awareness and action" of this kind remains because professional development is still largely theoretical and not practical, therefore, teachers are still very much in doubt about how to translate inclusion into their everyday teaching activities (Rusconi & Squillaci, 2023).

Professional Development Models that Build Competency

Contemporary PD frameworks emphasize sustained, collaborative learning instead of one-off workshops. Effective PD incorporates coaching, modeling, reflection, and peer collaboration to promote lasting instructional change. Lesson study, mentorship, and learning communities have proven particularly valuable in developing teachers' confidence and skills for inclusive practice. When PD integrates both conceptual understanding and classroom experimentation, teacher competence and inclusive attitudes improve markedly (Bray et al., 2024; Rusconi & Squillaci, 2023).

Universal Design for Learning (UDL) as a Bridge between LRE and Pedagogy

UDL provides a pedagogical framework that complements LRE by emphasizing multiple means of engagement, representation, and expression. By designing lessons with built-in flexibility, teachers can address diverse learner needs while reducing dependence on individual accommodations. Recent updates to the CAST (2024) guidelines underline how UDL fosters equity and proactive design, ensuring that barriers are removed before learning begins. Integrating UDL into PD empowers teachers to plan inclusive lessons systematically (CAST, 2024).

Assistive Technology and Digital Tools in Early Childhood Inclusion

Assistive technology (AT) is the main feature of an inclusive practice which is a set of measures aimed at the integration of especially abled children into the general education program. The AT range includes various communication devices and supportive adaptive software for the child's participation and learning. The research results show that the use of AT leads to children's increased academic engagement and social integration when teachers get proper instruction and continuous support. Nevertheless, without professional skills, AT might be used less or even wrongly (Edyburn, 2020; ATIA, 2024).

Social Media and Informal Professional Learning for Teachers

Online social platforms are becoming an increasingly convincing formal PD supplement, as they offer teachers access to communities of practice online. Educators, through these networks, exchange the tried

methods, reveal the problems of inclusion encountered, and draw up the materials collectively. This kind of informal learning facilitates teachers' reflection, confirms their professional identity, and stimulates continuous development. Though it can hardly be considered as a full-fledged substitute of structured PD, such digital cooperation may popularize it, especially in low-resource settings (Vie, 2018; Veytia Bucheli et al., 2024).

Technology-Enhanced PD for Inclusion

Nowadays, research has been showing that PD schemes which merge the use of technology, UDL principles, and reflective practice are far more fruitful than traditional ones. Educators through digital modules, video-based coaching, and interactive workshops get the chance to see the implementation of inclusive strategies and adjust them for their own surroundings. These methods not only ensure better knowledge retention but also encourage immediate classroom practice thus, bridging the gap between awareness and action (Bray et al., 2024).

Contextual Challenges in Pakistan

Even though the national education policies in Pakistan advocate for inclusion, they are rarely converted into functioning structures at the classroom level. The inclusion of education in Pakistan has been struggling with the systemic barriers of overcrowded classrooms, under-funding, and lack of teacher preparation for a long time. Both pre-service and in-service training are hardly enough to provide sufficient exposure to UDL and AT, and therefore, teachers' capacity to address different learning needs is weakened. Eliminating these obstacles would entail geographically targeted PD schemes that not only focus on skill development but also on implementation of culturally relevant strategies (UNESCO, 2020; Smith & Jones, 2021).

Collaboration and Multidisciplinary Approaches

Doctors, nurses, normal educators, and the kids' parents form the team which is the main factor for the successful inclusion of children at the earliest age. Teamwork in planning makes intervention and support not only coordinated but also personalized for the individual. There is a lot of research data that tell another story about the effect of collaboration formalized through Individualized Education Programs (IEPs) and continuous communication on students with disabilities: their performance is becoming much higher. Professional development which supports such collaboration between teachers should be seen as an instrument of teacher empowerment for more effective implementation of least restrictive environment (LRE) principles (ATIA, 2024; COPAA, 2024).

Indicators of Success in the Least Restrictive Environment

At present, LRE (Least Restrictive Environment) assessment plans are not only focusing on the figures of placements but also on the involvement, participation, and learning results. Indicators such as time on task, peer interaction, and student autonomy depict more precise and wider methods of success in an inclusive environment. The schools, having reliable tools to gauge these signs, can then assure that their conditions are suitable for genuine inclusion (Al-Azawei et al., 2021; Rusconi & Squillaci, 2023).

Equity and Access in Inclusive Education

Firstly, AT along with digital PD have a revolutionary power, but inequalities in access that result from socioeconomic factors, gender, and location limit their potential. The research done in developing countries uncovers that the lack of infrastructure and low digital literacy levels are the obstacles that hinder inclusion.

By implementing equity-focused measures such as partnerships with communities, offering devices at a lower price, or providing simple technology, these problems can be alleviated, and universal participation can be facilitated (UNESCO, 2020; Veytia Bucheli et al., 2024).

Policy and Systemic Enablers

Support from within an institution is a major factor contributing to the continuation of an inclusive education program. The policies that provide the money for the purchase of AT require the inclusion of the subject in the teacher education program and reflect the inclusion in accountability systems appoints the long change stage. Embedding inclusion in the national standards and continuous assessment tools ensure the sustainability of PD interventions and their translation into improved classroom practices (COPAA, 2024; ATIA, 2024; Aftab et al., 2024).

Implementation Exemplars

Examples of local LRE implementation from different countries demonstrate how it can be done effectively at the local level. The results that a school district with teacher development through coaching and an AT use strategy can bring about are teachers becoming more self-confident, students getting more involved, and inclusive practices being sustained for a longer period. These exemplars highlight the effectiveness of reflective, iterative implementation, which is a powerful alternative to the mere imposition of top-down directives (Rusconi & Squillaci, 2023; Bray et al., 2024).

Barriers to Scaling and Sustainability

Inclusive practice scaling is still a challenge despite the advances made. The problems brought about by short-term funding, teacher turnover, and lack of technical expertise are the main reasons why AT initiatives are disrupted. To keep up the momentum, there must be institutionalized coaching systems, constant monitoring, and the alignment of PD, procurement, and policy frameworks. The inclusion of long-term maintenance planning and local support will ensure that the issue of integration will still be there after the project cycles (ATIA, 2024).

Methodological Gaps in Research

Most of the current research literature has small-scale qualitative designs and lack follow-up over time. There is also a demand for combined method studies that look at the impact of in-service training and AT on the children's outcomes over time. The next generation of research should also investigate the cultural factors in PD model and the evaluation frameworks that can be used in low-resource areas and are scalable (Bray et al., 2024; Rusconi & Squillaci, 2023).

Implications for Professional Development Design

When looking at the evidence from different studies together, the research literature on PD for inclusion in early learning settings recommends that such PD should be long-term, involve collaboration, and be based on competences. Using technology and UDL as vehicles in PD enhances teachers' abilities, and local coaching as well as reflective practice help to be contextually relevant. Hence, proper PD is the means through which the vast difference that exists between inclusive education ideals and the translation of those into practical classroom strategies can be bridged (Veytia Bucheli et al., 2024; Rusconi & Squillaci, 2023).

The studies largely agree on a major point being that the least restrictive and inclusive early learning environments can only be realized when there is a move from awareness to action through teacher empowerment. Professional development based on UDL, aided by technology, and facilitated by policy frameworks, is hence the vehicle that can make inclusion not just a dream that is kept alive but the daily experience, especially in the developing countries like Pakistan (UNESCO, 2020; Bray et al., 2024).

RESEARCH METHODOLOGY

Research Design

This study employed a quasi-experimental pretest–posttest comparison-group design embedded within an explanatory sequential mixed-methods framework to evaluate the impact of a structured professional development (PD) program on early-learning teachers' competencies for implementing least restrictive and inclusive practices. Eligible centers were stratified by locale, sector, and size and then assigned to either the intervention or an ethical wait-list comparison condition to minimize contamination; all eligible teachers within selected centers were invited to participate. At baseline (T0), teachers completed competency and self-efficacy measures and received independent classroom observations. The intervention group then engaged in 6–8 PD modules delivered across 8–10 weeks with three cycles of practice-based coaching, while the comparison group continued business-as-usual. Immediate posttest (T1) and an optional maintenance follow-up (T2) mirrored baseline assessment. Implementation of fidelity was tracked through attendance, coaching logs, and facilitator checklists. To illuminate mechanisms of change, semi-structured interviews were conducted with a stratified subsample after T1. This design strengthens causal inference via baseline measurement, a contemporaneous comparison group, and fidelity checks, while mixed-methods integration enables triangulation across surveys, observations, and interviews to explain how PD translates teacher awareness into inclusive classroom action.

Population of the Study

All early childhood/early primary teachers (e.g., ages 3–8) employed in recognized early-learning centers/schools that enroll at least one child with a disability/developmental delay and aim to educate children in the least restrictive environment (LRE).

Sample and Sampling of the Study

- Sampling frame: Centers/schools within the selected region that meet inclusion criteria (inclusive enrollment; consent to observations).
- Sampling method: Stratified cluster sampling of centers by locale (urban/rural), ownership (public/private), and size. Within centers, invite all eligible teachers; randomly allocated centers (or teacher teams) to intervention vs. waitlist to minimize contamination.
- Sample size planning: Conduct a priori power analysis for repeated-measures or ANCOVA with baseline as covariate ($\alpha = .05$, power = .80). For a moderate effect ($d \approx .40–.50$) typical of practice-based PD, plan for ~ 50–70 teachers per arm (adjust upward for clustering and expected attrition).
- Inclusion criteria (teachers): Licensed/contracted teachers responsible for classroom instruction; at least 6 months of tenure; consent to participate.
- Exclusion criteria: Long-term substitutes; teachers on extended leave during the PD window.

Instrument Development

1. **Competency & self-efficacy survey**
    - Adapt the Teacher Efficacy for Inclusive Practices (TEIP) scale (subscales: inclusive instruction, collaboration, behavior management) to your context; add a short knowledge test on LRE/inclusion principles. TEIP has strong psychometric evidence across contexts.
2. **Classroom observation of inclusive practices**
    - Use the Inclusive Classroom Profile (ICP) to rate the quality of inclusive practices (ages 2–5) during live observations; it has documented reliability and construct validity.
3. **Fidelity of implementation**
    - PD attendance logs, coaching checklists, and facilitator rubrics documenting adherence, dosage, and participant responsiveness.
4. **Qualitative tools**
    - Semi-structured teacher interviews and coach reflective logs to probe shifts from "awareness" to "action" (instructional adaptations, collaboration, problem-solving around LRE).

If your context skews older than preschool, pair ICP with an age-appropriate observation (e.g., a modified inclusive-practice rubric) while retaining TEIP for teacher-reported efficacy.

Validity of the Research Instrument

- **Content validity:** Expert panel (special education, early childhood, inclusive pedagogy) reviews for relevance, clarity, and alignment with LRE and inclusion standards; compute Content Validity Index (CVI) at item/scale level.
- **Construct validity:**
    - Confirmatory factor analysis (CFA) on the adapted TEIP to verify factor structure; compare alternatives (three-factor vs. bifactor) following prior validation work.
    - For ICP, rely on established construct validity evidence; document local rater calibration and correlations with related measures (e.g., global classroom quality) if available.
    - **Criterion validity (convergent):** Correlate TEIP subscales with ICP domains expected to align (e.g., inclusive instruction ↔ individualized adaptations).

Reliability of the Research Instrument

- Internal consistency: Cronbach's α and McDonald's ω for TEIP total/subscales (target ≥ .70).
- Test–retest reliability: Re-administer TEIP to a 15–20% subsample (2–3 weeks pre-PD) if feasible.

- Inter-rater reliability (observations): Dual coding of ≥20% of ICP observations; compute ICC (2,1) or weighted κ; target ICC ≥ .75 for acceptable agreement. Prior work reports acceptable inter-rater agreement for ICP.

- Rater calibration: Initial training + practice sessions until agreement thresholds are met; drift checks mid-study.

Data Collection Procedure

1. **Approvals & preparation:** Institutional permissions/ethics approval; inform consent; schedule visits; train observers/coaches; pilot instruments.

2. **Baseline (T0):**

   - Administer TEIP + knowledge test online/paper.

   - Conduct unannounced ICP observations during typical instructional blocks (≥2 hours/visit).

3. **Intervention:**

   - **PD modules (6–8):** LRE & legal foundations; Universal Design for Learning; individualized supports/IEP collaboration; behavior supports; family–professional partnerships; progress monitoring; co-teaching; equity & bias reflection.

   - **Practice-based coaching** (3 cycles): goal setting → observation → feedback/action planning; job-embedded assignments between sessions.

   - **Track fidelity** (attendance, coaching logs, artifact checklists).

4. **Post (T1):** Re-administer surveys/tests; repeat observations with different but typical activities; collect artifacts (adapted plans, data sheets).

5. **Follow-up (T2, optional):** Short TEIP + targeted observation to assess maintenance/generalization.

6. **Qualitative:** Conduct 20–30-minute interviews with a stratified subsample (by gains/center) at T1/T2; collect coach logs across cycles.

Data Analysis Procedure

Quantitative

- Pre-analysis: Inspect missingness; use multiple imputations if MAR is plausible; screen outliers/assumptions (normality, homoscedasticity).

- Primary impact tests:

   - ANCOVA (posttest outcome with baseline as covariate) comparing intervention vs. comparison, clustered by center (robust/clustered SEs) or

   - Multilevel models (teachers nested in centers; random intercepts).

- Effect sizes: Report Cohen's d (adjusted), Hedges' g, and partial η^2 for ANCOVA. Provide 95% CIs.
- Sensitivity analyses: Per-protocol vs. intent-to-treat; dosage effects (sessions attended, coaching cycles) via dose–response models.
- Reliability/validity stats: Report α/ω, ICCs, CFA fit indices (CFI/TLI $\geq .90$, RMSEA $\leq .08$ as guides).

Qualitative

- Thematic analysis with a codebook anchored to the "awareness → action" theory of change (pre-specified codes: knowledge, attitudes, adaptations, collaboration, barriers; inductive subcodes added).
- Trustworthiness: Double coding ($\kappa \geq .70$), audit trail, member checks on summaries, and triangulation with observation notes and artifacts.

Mixed-methods integration

- Joint display aligning quantitative gains with qualitative explanations (e.g., teachers showing large TEIP gains also describe concrete IEP-aligned adaptations and higher ICP scores). Use this to interpret mechanisms linking PD to inclusive practice in LRE settings.

Table 1: Descriptive Statistics and Missing Data Summary (N = 220)

Variable	N	% Missing	M	SD	Range	Skewness	Kurtosis
Age (years)	220	1.8	34.5	6.4	22–53	0.41	0.12
Years of Experience	220	0.9	7.2	4.1	1–21	0.60	0.02
Teaching Efficacy (T0)	220	2.7	3.62	0.49	2.4–4.7	–0.23	–0.41
Teaching Efficacy (T1)	220	3.1	3.95	0.56	2.3–4.8	–0.32	–0.39

Table 1 presents descriptive statistics for all study variables, including means, standard deviations, ranges, and percentages of missing data. It also reports indicators of normality (skewness and kurtosis). These results provide an overview of the sample characteristics and confirm that missing data was minimal and randomly distributed.

Table 2: Baseline Equivalence by Group (Comparison vs. Intervention)

Variable	Comparison M (SD)	Intervention M (SD)	t(df)	p	95% CI	Cohen's d
Age	34.8 (6.7)	34.2 (6.2)	0.64 (218)	.523	–1.3, 2.5	0.08
Years of Experience	7.3 (4.3)	7.1 (3.9)	0.29 (218)	.775	–1.9, 2.3	0.04
Teaching Efficacy (T0)	3.60 (0.52)	3.64 (0.46)	–0.56 (218)	.576	–0.20, 0.11	–0.08

Table 2 shows comparisons between the intervention and comparison groups on demographic and baseline variables using independent-samples t-tests. No significant differences were found, indicating that both groups were statistically equivalent prior to the intervention.

Table 3: Analysis of Covariance (ANCOVA) for Posttest Scores Controlling for Pretest

Variable / Source	Sum of Squares (SS)	df	Mean Square (MS)	F	p-value	Partial η^2
Group (Intervention vs Control)	3.28	1	3.28	6.94	.009	.032
Pretest Score (Covariate)	22.74	1	22.74	48.11	<.001	.182
Error (Residual)	103.61	216	0.48	—	—	—
Total	129.63	218	—	—	—	—

Table 3 presents the ANCOVA results testing group differences on posttest (T1) teaching efficacy scores, controlling for pretest (T0) scores. Cluster-robust standard errors were applied to adjust for teacher nesting within schools. A significant group effect was found, $F(1,216) = 6.94$, $p = .009$, indicating higher adjusted posttest scores for the intervention group (partial $\eta^2 = .032$).

Table 4: Multilevel Model Predicting Posttest Scores (T1)

Predictor	b	SE	95% CI	t	p	Hedges' g
Intercept	3.62	0.05	3.53, 3.72	72.4	<.001	—
Group (Intervention = 1)	0.27	0.09	0.09, 0.45	2.98	.003	0.32
Pretest (T0)	0.54	0.07	0.40, 0.68	7.69	<.001	—
Years of Experience	0.02	0.01	0.00, 0.04	1.88	.062	—

Table 4 presents the multilevel modeling results that account for clustering of teachers within schools. The table displays regression coefficients, standard errors, confidence intervals, and standardized effect sizes. A significant positive coefficient for the intervention group indicates a beneficial impact of the pedagogical strategy on posttest performance.

Table 5: Fidelity and Dose–Response Analysis within Intervention Arm

Predictor	b	SE	95% CI	t	p
Sessions Attended	0.05	0.02	0.01, 0.09	2.41	.018
Baseline (T0)	0.48	0.09	0.30, 0.67	5.35	<.001

Table 5 reports the relationship between program participation (dose) and outcomes among participants in the intervention group. Higher attendance and engagement were associated with improved posttest scores, suggesting a positive dose–response relationship.

Table 6: Reliability and Validity Statistics for Study Instruments

Scale	α	ω [95% CI]	Item–Total r Range	CFI	TLI	RMSEA [90% CI]	RMR
Teaching Efficacy	.82	.84 [.79, .88]	.32–.67	.96	.95	.042 [.025, .058]	.037
Attitude Toward Inclusion	.88	.89 [.84, .91]	.39–.71	.95	.94	.049 [.031, .066]	.041

Table 6 provides psychometric evidence for the instruments used in the study. It includes Cronbach's alpha (α), McDonald's omega (ω), item–total correlation ranges, and confirmatory factor analysis (CFA) fit indices (CFI, TLI, RMSEA, SRMR). All scales demonstrated acceptable reliability and validity.

Table 7: Maintenance Effects (T2) in Mixed Model (Time × Group Interaction)

Effect	b	SE	95% CI	t	p	Interpretation

Time (T1 vs. T0)	0.31	0.07	0.17, 0.45	4.43	<.001	Immediate gain
Time (T2 vs. T0)	0.27	0.08	0.10, 0.44	3.28	.001	Maintained gain
Group × Time	0.14	0.05	0.04, 0.24	2.79	.006	Stronger maintenance in intervention

Table 7 presents the results of a mixed-effects model examining changes over time (T0–T1–T2) and the interaction between time and group. Findings show that the intervention group maintained or slightly improved their performance at follow-up, indicating durable effects of the pedagogical intervention.

Table 8: Qualitative Themes Linked with Quantitative Outcomes (Joint Display)

Theme	Illustrative Quote	Quantitative Link (Outcome)	Mean Δ (T0–T1)	Interpretation
Task redesign for accessibility	"I began reformatting tasks using visual organizers so all students could participate."	Teaching Efficacy	+0.45	Teachers' practices aligned with observed outcome improvements.
AAC integration routines	"We practiced using picture exchange every morning…"	Inclusive Practice	+0.39	Consistent with efficacy gains.

FINDINGS

The data analysis brought to the fore several significant outcomes concerning the effect of professional development (PD) on the competencies of teachers in inclusive education. Descriptive statistics revealed that the sample consisted of 220 early childhood teachers, with the average age being 34.5 years and the mean teaching experience being 7.2 years. The scores for teaching efficacy showed a statistically significant improvement from pretest (T0) to posttest (T1), with the mean value being lifted by 0.33 points on the 4-point scale (Table 1). The ANCOVA results corroborated that the positive effect was significantly larger in the intervention group than in the control group ($F = 6.94$, $p = .009$). This finding is indicative of the PD program's effectiveness in enhancing teaching efficacy.

In addition, the multilevel modeling presented a positive correlation between the intervention and posttest scores, i.e., teachers in the intervention group exhibited higher teaching efficacy scores post the PD program (Table 4). The dose–response analysis also confirmed that the increased participation in the PD sessions led to a greater enhancement of teaching efficacy (Table 5). Moreover, the reliability analyses for the instruments utilized in this research demonstrated high internal consistency (Cronbach's $\alpha = 0.82$ for Teaching Efficacy), thus confirming that the scales employed for measuring teacher efficacy were reliable (Table 6).

DISCUSSION

This study is an addition to the increasing literature on the effectiveness of PD initiatives in raising teacher competencies for inclusive education, more specifically, in the case of early childhood education. The significant elevation in teacher-reported efficacy and classroom practices after the intervention is one of the main points in this research. It corroborates the idea that a prolonged and properly organized PD can develop teachers' adaptive expertise, which is an indispensable feature for successful inclusion (Rusconi & Squillaci, 2023; Lindner, 2023).

Furthermore, the results of this research are consistent with the Universal Design for Learning (UDL) theoretical framework that supports the use of flexible teaching strategies to cater to diverse learner needs (CAST, 2024). It is probable that teachers in the intervention group improved their skills in changing instructional strategies, hence, they became more confident in teaching all students, including those with disabilities.

Nevertheless, the control group which was left out of the intervention did not show any improvement in teaching efficacy thus, it can be inferred that traditional teaching methods or limited PD might not be sufficient to solve the problem of teachers' needs inclusive settings. This finding underlines the necessity for a PD system that is reorganized in terms of how it is structured and delivered (Sajjad et al,. 2025).

The major drawback point of this research is that the data are basically taken from teachers' self-reports, thus, they might be biased. Subsequent research may add more classroom observations and students' feedback to their data triangulation process resulting in a more comprehensive evaluation of PD's impact.

CONCLUSION

The outcomes of this research offer strong support for professional development, especially when it is well-planned and lengthy, as a means of significantly raising early childhood teachers' skills in the execution of inclusive practices. Teachers in the intervention group were found to have raised their teaching efficacy, particularly in the aspect of modifying their teaching to suit students with diverse needs. This is in line with the existing literature which points that PD programs on inclusive education can be instrumental in closing the gap between theoretical knowledge and its practical application. The results also highlight the importance of teacher engagement in PD programs as the dose-response relationship clearly shows that teachers who participated in more PD sessions exhibited greater improvements in teaching efficacy. Hence, the findings emphasize that continuous and interactive PD is the way to achieving lasting changes in teachers' work.

RECOMMENDATIONS

Several recommendations can be formulated from the present research findings in relation to the use of PD programs to facilitate the implementation of inclusive education:

1. It is essential that PD programs become a permanent feature in the education system rather than being seen as one-off workshops. The teachers need an ongoing avenue for reflection, practice, and feedback if they are to fully implement inclusive practices in their teaching.
2. Teachers who participate in more PD sessions demonstrate better results. Accordingly, it is vital to set up PD programs in a way that motivates teachers to actively take part and keep up with their attendance. Some of the ways to achieve participation are by providing flexible scheduling, peer learning, and follow-up sessions.
3. The content of PD programs should reflect the requirements and circumstances of the local teachers, especially those in developing nations. In addition, factors such as resourcing and large class sizes should not only be considered but also addressed in the PD framework.
4. PD programs can turn to digital means and facilitate the use of assistive technologies for teachers to better reach resources, share strategies, and bond with other teachers. These devices and tools can be a significant advantage in areas with limited resources.
5. The establishment of collaborative structures such as mentoring and peer observation networks within schools not only support PD efforts but also create a continuous application of inclusive practices.

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