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Impact of pre-service education on the effectiveness of in-service training for inclusive preschool teachers in China: a potential profile analysis

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The inclusive education competence of educators is crucial for the high-quality development of preschool inclusive education. Currently, the unsatisfactory effectiveness of in-service training for preschool inclusive educators has become one of the obstacles to improving the quality of preschool inclusive education. Through an exploratory latent profile analysis of the effectiveness of in-service training, this study aims to investigate the impact of pre-service education on different categories of in-service training effectiveness in inclusive education. The present study investigated an examination of 404 preschool educators in China who underwent comprehensive training encompassing both pre-service and in-service inclusive education components. The latent profile analysis approach was employed to identify potential latent categories of in-service training effectiveness among them. Logistic regression analysis was used to examine the impact of pre-service education on the categories of training effectiveness for educators. The findings elucidate the existence of three distinct potential categories, denoted as “low-efficiency” (LE, 10.6%), “medium-efficiency” (ME, 41.1%), and “high-efficiency” (HE, 48.3%). A more detailed exploration further exposes the factors within pre-service education that contribute significantly to educators falling within the ME or HE categories during their subsequent in-service training. These factors encompass the opening courses “Educational Diagnosis and Evaluation for Children with Special Needs” and “The Formulation and Implementation of Individualized Education Program”, professional competence of teacher trainers, practical experience gained in inclusive education kindergartens and special education institutions, as well as the availability of teaching resources within university settings. These elements can ensure that preschool educators achieve better training effectiveness in the in-service training. The implications of these findings extend to the realm of preschool inclusive education, offering an evidence-based foundation and practical insights for the effective integration of pre-service education and in-service training programs.

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Introduction

The institutionalization process of inclusive education commenced with the 1994 *Salamanca Statement*, which established the fundamental principle of constructing an educational ecosystem responsive to learner diversity (Brown et al., 2013), thereby initiating a paradigm shift in educational placement for children with special needs (Rodríguez Fuentes et al., 2021). Under the guidance of sustainable development principles, international discourse has recently prioritized inclusive education. UNESCO's *Education 2030 Framework for Action* (2015) emphasized equitable access to quality early childhood development for all children, providing a critical reference for advancing global inclusive preschool education. In 2021, UNESCO further delineated practical pathways through its report *Inclusive Early Childhood Care and Education: From Commitment to Action*, which serves as a strategic blueprint for national policymaking and implementation. This document has emerged as a policy action guide for enhancing inclusive preschool education worldwide (Deng et al., 2024).

In the process of policy implementation, inclusive preschool education has demonstrated distinctive practical characteristics. Compared to other educational stages, inclusive education for children aged 3–6 places greater emphasis on developmental support for individuals (Warren et al., 2016). Empirical evidence demonstrates that placing children with special needs in mainstream preschools not only enhances their social adaptability through early intervention (Dessemontet et al., 2012) but also constructs an initial framework for inclusive social cognition (Rodríguez-Oramas et al., 2021; Wang et al., 2025). This bidirectional benefit mechanism positions preschool education as a force multiplier for inclusion, yet simultaneously elevates demands on educators' professional competencies. Effective implementation requires practitioners skilled in special needs assessment, differentiated instructional design, and inclusive environment creation (Majoko, 2019).

The study. Despite global institutional advancements in preschool inclusive education frameworks, implementation barriers persist. UNESCO's *Global Education Monitoring Report* (2020) identified systemic disjunctions in teacher training systems as a critical bottleneck: pre-service programs emphasize theoretical paradigms, while in-service training prioritizes operational skills, lacking coherent integration. This fragmentation contradicts the demands of preschool inclusive education: educators must internalize both the ethical value of inclusive education and the practical wisdom to respond dynamically to the differences in children's development. Existing studies predominantly adopt variable-centered approaches to analyze interactions among pre-service preparation, in-service training, and other factors (Clipa et al., 2019; Opoku et al., 2021). While valuable, such methodologies overlook individual heterogeneity and fail to capture trajectories of professional development. This study introduces latent profile analysis (LPA), an individual-centered statistical technique that emphasizes acknowledging intragroup differences and identifies shared variations across variables, enabling an in-depth analysis of subgroup characteristics (Wang and Hanges, 2011).

Building on this theoretical foundation, the study employs LPA to explore the classification of in-service training effectiveness among inclusive preschool teachers, while investigating dynamic interactions between pre-service education and in-service training effectiveness. It addresses two research questions:

Research Inquiry 1: Based on LPA, into how many categories can the in-service training effectiveness of inclusive preschool

teachers be classified? What are the defining characteristics of each category?

Research Inquiry 2: How do aspects of pre-service education, such as curriculum design, pedagogical mentorship, and experiential learning opportunities, influence the efficacy of in-service training programs for these educators?

Literature review

Pre-service education of inclusive preschool teachers. Pre-service education, a vital prerequisite for successful inclusive practices (Aldabas, 2020), involves the training and learning phase before university students transition to teaching roles (De Haro Rodríguez et al., 2019), emphasizing the acquisition of essential skills and knowledge for inclusive educational practices. Current trends indicate that talent development institutions are actively incorporating inclusive attitudes, knowledge, and skills into their curricula, emphasizing the cultivation of positive attitudes toward children with special needs among prospective teachers (Dignath et al., 2022; Koliqi et al., 2023). In terms of knowledge, the curriculum for pre-service education of inclusive preschool educators covers conceptual frameworks, policies, and child developmental characteristics. Regarding skills, universities prioritize teaching practical competencies like classroom management (Majoko, 2017a), collaborative methodologies (Allday et al., 2013), and family communication (Flecha and Soler, 2013). In terms of implementation format, personnel development includes practical facilities and partnerships, enabling educators to meet diverse demands in inclusive settings (Kwon et al., 2017) and apply knowledge in effective pedagogy (Hassanein et al., 2021). Simultaneously, the abundant resources and conducive conditions offered by pre-service education institutions facilitate prospective teachers in enhancing their professional development through creating inclusive classroom environments, effective teaching strategies, quality course materials, and mastering various techniques and technologies (Zabeli and Gjela, 2020). Nonetheless, while many educators exhibit favorable attitudes, their inability to impart effective instruction may undermine self-efficacy in inclusive education (Hu et al., 2016). Consequently, improvements in pre-service education are necessary to address these gaps and enhance the preparation of inclusive preschool educators.

In-service training of inclusive preschool teachers. In-service training, a critical avenue for teachers' professional growth and lifelong learning, involves educators engaging in organized studies like seminars, courses, and expert teaching guidance to enhance their career-related knowledge and skills. In-service training programs play a crucial role in enhancing the pedagogical capabilities of preschool educators and fostering inclusive education attitudes. These programs provide teachers with extensive foundational knowledge, instructional techniques, and pedagogical strategies, enabling them to establish a robust educational framework aligned with inclusive principles, thereby facilitating the implementation of high-quality inclusive education practices (Kurniawati et al., 2017; Valle-Flórez et al., 2022). Empirical research highlights the importance of such training in shaping teachers' self-efficacy and positive orientation towards inclusive education, with a significant correlation observed between training receipt and the development of these attributes (Štemberger and Kiswarday, 2018; Zabeli and Gjela, 2020). These training programs are predictive and offer vital support for the evolution of inclusive education-related attitudes and self-efficacy (Kisbu-Sakarya and Doenya, 2021; You et al., 2019).

Nonetheless, an extensive examination of the global landscape of inclusive education reveals a concerning trend: studies consistently highlight the scarcity of substantive and effective in-service training opportunities for preschool educators (Ginja and Chen, 2023; Scanlon et al., 2022). Studies indicate that preschool inclusive education teachers generally receive little or no professional training in educating children with special needs (Chu, 2021). Issues facing the training of these teachers include inadequate support from educational administrations (Gonzalez-Gil et al., 2019) and a lack of diversity in training approaches (Ackah-Jnr, 2020). This not only limits the effective allocation of training resources but also undermines the training’s impact, hindering teachers’ substantial growth and improvement. Moreover, the majority of in-service training focuses on improving the overall quality and competence of the teaching force, often adopting a “large class size teaching” approach (Westbrook and Croft, 2015), which lacks personalized analysis and fails to meet individual teachers’ needs (Sharma and Jacobs, 2016). Nearly half of preschool inclusive teachers who had in-service training consider the training ineffective and struggle to apply the knowledge in their inclusive education practice, affecting their self-identification with their competence (Agbenyega and Klibthong, 2014). This inadequate training has emerged as a significant barrier to enhancing the quality of preschool inclusive education (Hernández-González et al., 2022; Tristani and Bassett-Gunter, 2020). Therefore, in-service training, designed to perpetuate the culture of lifelong learning, is imperative. It can continue the learning outcomes achieved in the pre-service stage and support the sustainable development of early childhood educators’ abilities.

Ingration of pre-service education and in-service training of inclusive preschool teachers. Teacher professional development is not a one-time intervention but a sustainable process encompassing pre-service and in-service stages (Sun and Feng, 2024). According to teacher professional development theories (Zhu, 2014), constructing an integrated mechanism for pre-service and in-service training of inclusive preschool teachers helps overcome stage fragmentation, ensuring that inclusive education principles permeate teachers’ careers and better equipping them to address challenges in future teaching practices. Empirical evidence suggests that the integration of pre-service and in-service professional development has become a mainstream trend in teacher education, facilitating the transformation and transfer of theoretical knowledge into practical contexts, thereby enhancing teaching competence and educational quality (Zhou and Wang, 2024). Guided by modern lifelong education principles, teacher education in Guangdong, China, has shifted from a pre-service-focused model to an integrated pre-service and in-service system, gradually forming a comprehensive, continuous, and open teacher education framework (Wang and Xiu, 2024). Similarly, the United Kingdom has established a lifelong education system for teachers by providing proactive induction support and continuous in-service training for primary and secondary school teachers (Sun and Feng, 2024).

However, due to the relatively recent development of inclusive preschool education, an integrated professional development mechanism for inclusive preschool teachers has yet to be established. Existing research primarily focuses on specific stages, such as pre-service teachers’ attitudes toward inclusive education or in-service training support for inclusive preschool teachers (Wray et al., 2022). Few studies have explored the relationship between pre-service and in-service stages from an integrative perspective. This lack of integration may lead to fragmentation in the teacher training system, ultimately hindering the effective improvement of inclusive education quality.

Methods

Based on the study’s objectives, we examined the conditions of preschool inclusive educators in China, specifically focusing on the efficacy of their pre-service education and in-service training. This section outlines the participants, research methods, and data analysis procedures.

Participants. With the rapid development of inclusive preschool education, pilot kindergartens have sprung up all over China to provide inclusive education (Gu and Zhu, 2023; Liu et al., 2022). At the same time, teachers are receiving the necessary in-service training in inclusive education. For example, under the National Training Plan, preschool teachers receive support from university experts and special educators (Liang, 2018). By contacting the teachers in charge of the national pilot kindergartens for inclusive education, we selected and invited qualified teachers as participants, who have prior experience in pre-service education and in-service training for preschool inclusive education.

After contacting these teachers, the survey was distributed through the online platform “Questionnaire Star” (www.wjx.cn), and participants were provided with an information guide and informed consent and then anonymously completed it. They were asked to truthfully report the specific information (such as curriculum, learning resources and conditions, etc.) about their pre-service inclusive preschool education. Further, combined with the experience and situation of the preschool inclusive education training received in the process of working in the kindergarten, the training effectiveness was measured. It is worth noting that the assessment response time was more than 60 s, and abnormal samples such as all answers were consistent or there were omissions in the answers were carefully removed. Finally, 404 valid questionnaires were obtained. The demographic characteristics of the survey respondents are presented in Table 1.

Survey instruments

Survey of inclusive preschool teachers’ pre-service education. To examine the support for preschool inclusive education teachers during pre-service education, we utilized the *Accreditation Standards for Preschool Education Programs (2017 Edition)* as the foundation for question development. This standard, issued by

Table 1 Basic information of the participants (n = 404).

Variables	Levels	n	%
Age	Age 25 and under	109	27.0
	26–30 years old	111	27.5
	31–35 years old	74	18.3
	Age 36 and above	110	27.2
Seniority of teaching	5 years and below	197	48.8
	6–10 years	94	23.2
	11 years and above	113	28.0
Educational degree	Senior high school and below	30	7.4
	Junior college	178	44.1
	Bachelor degree and above	196	48.5
Professional background (multi-selection)	Preschool education	354	87.6
	Special education	34	8.4
	Medical rehabilitation	6	1.5
	Others	27	6.7
Kindergarten type	Public	360	89.1
	Private	44	10.9
Pilot preschool inclusive education kindergarten	Yes	331	81.9
	No	73	18.1
Children with special needs in the class	Yes	188	46.5
	No	216	53.5

the People's Republic of China, is widely used to evaluate the quality of talent training for preschool education majors in higher education institutions. Based on this criterion, questions were designed in five dimensions: curriculum, teacher trainer, collaboration and practical engagement, supportive contextual conditions, and the value of pre-service education. Participants were then able to complete a 10-item multiple-choice questionnaire recalling and reporting their experiences with pre-service inclusive education.

Specifically, in the curriculum dimension, the single choice "Whether the university major offered courses on preschool inclusive education" was used to verify whether the participants had received pre-service education. Meanwhile, the multiple-choice question "What kind of pre-school inclusive education courses were offered" was used to help participants better recall and report the content and categories of the courses. In the teacher trainer dimension, one multiple-choice question was used to ask the participants about the professional background of the teacher trainers in the pre-service education stage, and the other two single-choice questions were used to evaluate the professional ability and practical ability of the teacher trainers in the five-point scales. In the dimension of collaboration and practical engagement, the multiple-choice "The places for learning and practice of preschool inclusive education" and "The forms for carrying out practical activities of preschool inclusive education" were used to investigate the specific situation of participants' preschool inclusive education practice in the pre-service education stage. In the dimension of supportive contextual conditions, two five-point Likert-type questions were employed to assess whether the professional platform of the university furnished them with supporting facilities like resource classrooms and special children assessment rooms, as well as teaching resources such as textbooks and videos. In terms of the value dimension of pre-service education, the five-point single-choice question "The pre-service inclusive education received at school will greatly help you carry out inclusive education work after entry" was adopted, and participants were asked to independently evaluate the effectiveness of the pre-service education they received.

Investigation of the effectiveness of inclusive preschool teachers' in-service training. This section investigates the effectiveness of in-service training for inclusive preschool teachers using the Kirkpatrick Model, consisting of four dimensions: reaction, learning, behavior, and result (Alsalamah and Callinan, 2021). Regarding the effectiveness of in-service training, the Likert five-point scoring method was primarily employed in this section. The questionnaire consisted of 24 items, with response options ranging from 1 to 5. Higher scores indicate better effectiveness of the in-service training. The scientific validity of the scale has been better validated in a earlier study, and the results of the study showed that the scale had good cultural appropriateness and demonstrated good reliability and validity (Wei et al., 2022).

The reaction dimension, with four questions, measured teachers' satisfaction with the content and implementation of the training courses, e.g., "I find the training course content and implementation to be scientifically designed." The learning dimension, comprising seven questions, assessed the acquisition of knowledge and skills related to inclusive preschool education, e.g., "I learned how to develop and implement individualized educational support programs for children with special needs." The behavior dimension, consisting of nine questions, evaluated the extent to which teachers applied their training in their workplace, e.g., "I can facilitate mutual support and learning between typical children and children with special needs in the classroom." Finally, the result dimension, including four questions, examined the benefits experienced by kindergartens due to

teacher training, e.g., "My kindergarten's confidence and willingness to enroll children with special needs have increased."

This section manifests a robust measurement index, supported by a commendable overall Cronbach's alpha coefficient of 0.981. Furthermore, each dimension demonstrated a satisfactory level of internal consistency, with Cronbach's alpha values ranging from 0.933 to 0.974. Interdimensional relationships were established through correlation coefficients, which varied between 0.638 and 0.876. Likewise, the correlation coefficients between each dimension and the composite total score exhibited substantial associations, ranging from 0.796 to 0.969. Confirmatory factor analysis outcomes revealed that the model fit was acceptable, with specific indicators as follows: $\chi^2/df = 4.48$, RMSEA = 0.093, SRMR = 0.017, CFI = 0.935, IFI = 0.935, and TLI = 0.927.

Data collection and analysis. In this study, descriptive statistics were used to elucidate basic information about inclusive preschool teachers. Furthermore, the reliability and validity of the Training Effectiveness Evaluation Scale were assessed using SPSS 26.0 and confirmatory factor analysis (CFA). Then, LPA was conducted using Mplus 7.0 software to delineate the scientific potential classification of the effectiveness of in-service training of inclusive teachers of young children according to the criteria for fitting the indicators of the method (AIC, BIC, aBIC, etc.) (Nylund et al., 2007). Subsequently, based on the data characteristics of the dependent variable (classification of training effectiveness), multiple regression analyses were used in order to examine the impact of the profile of pre-service education on the effectiveness of in-service training of different categories of preschool inclusive teachers.

Results

Potential categories and characteristics of the effectiveness of inclusive preschool teachers' in-service training. To gain a deeper comprehension of the performance characteristics of preschool inclusive education educators in terms of the effectiveness of in-service training at four levels (reaction, learning, behavior, and result level), this study employed the method of LPA to divide the measurement subjects into several different latent categories, delving into the group features of preschool inclusive education teachers in the effectiveness of in-service training (Hu et al., 2023).

In LPA, the following statistical indicators are commonly used to assess the goodness of fit of the model: including Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), sample size-adjusted Bayesian Information Criterion (aBIC), Entropy, Lo-Mendell-Rubin (LMR) criterion, and Bootstrapped Likelihood Ratio Test (BLRT). Among these, lower values in the AIC, BIC, and aBIC indicators indicate a better fit between the model and the data. The entropy indicator ranges from 0 to 1, with values closer to 1 indicating higher classification accuracy; an entropy of 0.80 suggests a classification accuracy exceeding 90% (Nylund et al., 2007).

The various indicators of latent profiles in this study (Table 2) show that although participants were divided into four different categories, both the AIC and BIC reached their lowest values. However, a noticeable inflection point in the decrease of AIC and BIC is observed when participants are divided into three categories. Additionally, when participants are divided into three categories, the Entropy index is closest to 1 (0.976). Therefore, based on these data results and the principle of model parsimony (Ferguson et al., 2020), we conclude that the three-category model is the optimal choice for describing the effectiveness of in-service training for kindergarten inclusive education teachers. Figure 1 provides a visual representation of the overall effectiveness of

Table 2 Model fit indices for the latent profiles of inclusive preschool teachers' in-service training effectiveness.

Model	Log-Likelihood	AIC	BIC	aBIC	Entropy	LMR(p)	BLRT	Category probability
1 Profiles	−1643.797	3303.594	3335.606	3310.221	—	—	—	1
2 Profiles	−1151.957	2329.915	2381.933	2340.682	0.935	0.000	0.000	0.465/0.535
3 Profiles	−840.427	1716.855	1788.880	1731.764	0.976	0.000	0.000	0.106/0.411/0.483
4 Profiles	−772.438	1590.877	1682.909	1609.928	0.967	0.351	0.000	0.097/0.257/0.473/0.173

Bold values denote the final selection of the 3-profile model as the optimal latent profile solution.

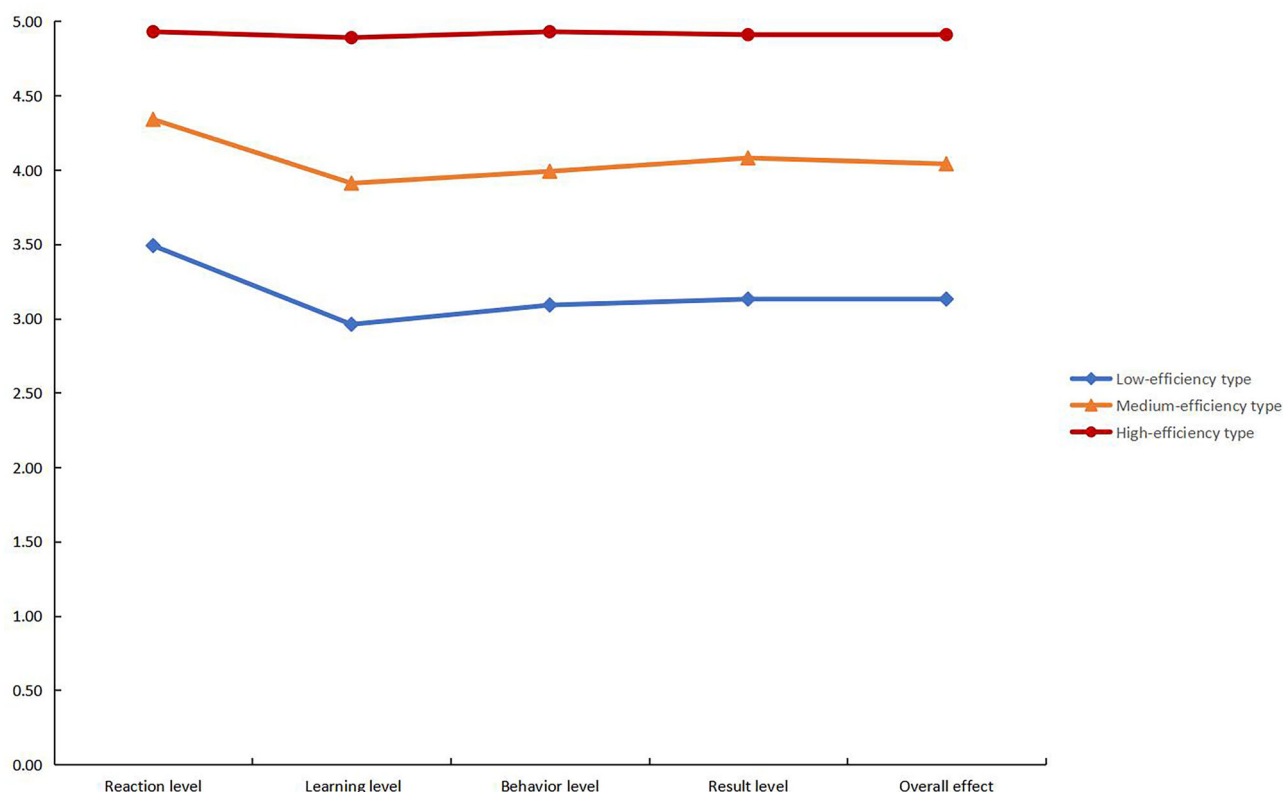


Fig. 1 Potential classification results of the effectiveness of inclusive preschool teachers' in-service training. The figure presents three efficiency types—high (●), medium (▲), and low (◆)—across five outcome dimensions: reaction, learning, behavior, result, and overall effect.

Table 3 Analysis of the differences in the scores of different in-service training effectiveness types in each dimension.

	Reaction level (SD)	Learning level (SD)	Behavior level (SD)	Result level (SD)	Overall effect (SD)
1 Low-efficiency ($n = 43$)	3.49 (0.61)	2.96 (0.35)	3.09 (0.30)	3.13 (0.40)	3.13 (0.23)
2 Medium-efficiency ($n = 166$)	4.34 (0.50)	3.91 (0.43)	3.99 (0.24)	4.08 (0.44)	4.04 (0.21)
3 High-efficiency ($n = 195$)	4.93 (0.23)	4.89 (0.27)	4.93 (0.16)	4.91 (0.25)	4.91 (0.15)
F	251.58***	679.80***	1771.20***	525.46***	2098.08***
p	<0.001	<0.001	<0.001	<0.001	<0.001
Post-hoc comparisons	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3	1 < 2 < 3

*** $p < 0.001$

in-service training and its four constituent dimensions scores for the three categories of preschool inclusive teachers.

To assess the differences in the effectiveness of the three types of teachers' in-service training, a one-way analysis of variance (ANOVA) test was conducted. The analysis revealed significant differences in the scores of the three groups of teachers across the four dimensions of training effectiveness: reaction level

($F = 251.58$, $p < 0.001$), learning level ($F = 679.80$, $p < 0.001$), behavior level ($F = 1771.20$, $p < 0.001$), result level ($F = 525.46$, $p < 0.001$), and overall effect level ($F = 2098.08$, $p < 0.001$) (Table 3). Therefore, based on the characteristics and score performance of the three potential categories of preschool inclusive teachers across various dimensions of training effectiveness and total scores, we have named these three categories of

Table 4 Multinomial logistic regression analysis of in-service training effectiveness types (taking Type LE as a reference).

		Medium-efficiency type			High-efficiency type		
		B	OR	p	B	OR	p
Pre-service training courses	The basic theory and concept of preschool inclusive education	−0.557	0.573	0.268	0.194	1.214	0.715
	Psychology and education of special needs children	−0.128	0.880	0.774	−0.227	0.797	0.620
	Educational diagnosis and evaluation for special needs children	−0.378	0.686	0.443	0.845	2.328	0.085
	The formulation and implementation of individualized education program	0.870	2.387	0.040	0.429	1.536	0.309
	Curriculum design and teaching planning of preschool inclusive education	−0.199	0.819	0.609	−0.163	0.850	0.678
	Rehabilitation and training of special needs children	−0.290	0.749	0.594	−0.232	0.793	0.666
	Behavior modification for special needs children	0.098	1.103	0.863	0.366	1.442	0.516
	Family and community support for special needs children	0.487	1.627	0.339	0.006	1.006	0.991
	Communication for special needs children	0.020	1.020	0.974	−0.237	0.789	0.691
	Professional teamwork in preschool inclusive education	−0.040	0.961	0.937	0.640	1.896	0.185
Trainer type	Teachers with preschool education background	0.245	1.278	0.644	1.036	2.819	0.065
	Teachers with special education background	0.076	1.079	0.845	−0.189	0.828	0.624
	Educational rehabilitation therapists	−0.287	0.751	0.517	0.386	1.471	0.372
Trainers' professional ability		1.103	3.014	0.000	2.448	11.567	0.000
Trainers' practical teaching ability		1.036	2.819	0.000	2.666	14.389	0.000
Practice base	Special education institutions	1.050	2.857	0.026	1.259	3.520	0.007
	Kindergartens with inclusive education	−0.002	0.998	0.998	0.574	1.775	0.267
	Kindergartens for children with special needs but without inclusive education	−0.384	0.681	0.413	0.150	1.162	0.740
Practical activities	Experiential practice (apprenticeship observation in general kindergarten)	−0.177	0.838	0.661	0.577	1.780	0.162
	Project-based practice (practice in inclusive education kindergartens/special education institutions)	0.273	1.314	0.453	1.036	2.817	0.004
	Developmental/integrated practice (graduating or internship practice)	0.417	1.518	0.276	0.350	1.419	0.359
Teaching facilities		0.700	2.014	0.000	2.419	11.233	0.000
Teaching resource		0.839	2.313	0.000	2.965	19.387	0.000
Value of pre-service education		1.191	3.292	0.000	3.619	37.318	0.000

preschool inclusive teachers as Low-Efficiency (LE), Medium-Efficiency (ME), and High-Efficiency (HE), accounting for 10.6%, 41.1%, and 48.3% of the total, respectively.

As illustrated in Fig. 1, the scores of HE, ME, and LE teachers across the four dimensions and total scores demonstrate a hierarchical progression (HE > ME > LE), while the variation patterns suggest dimension-specific differentiation. HE teachers exhibit exceptional performance across all four dimensions of training effectiveness, reflecting their substantial knowledge base and strong transferability of theoretical knowledge into teaching practices (Qin et al., 2020). In contrast, ME and LE teachers, despite demonstrating relatively satisfactory performance at the reaction level (compared to the other three dimensions), reveal their limitations at the learning level (with the lowest scores among the four dimensions). This pattern indicates their insufficient acquisition of knowledge and skills related to inclusive preschool education during training, consequently hindering their ability to transform knowledge into effective teaching practices in real-world settings (Mao et al., 2022).

Impact of preschool inclusive teachers' pre-service education on in-service training effect categories. Based on the LPA of the effectiveness of in-service training for preschool inclusive teachers, this study further explores the impact of pre-service education received by teachers on their categories of in-service training effectiveness. Considering the dependent variable as a multi-class variable, this research employs multinomial logistic regression to treat the three training effectiveness categories as the

dependent variables, with pre-service education factors (such as curriculum, teacher trainers, collaborative practices, support conditions, and educational values) as the independent variables (Table 4). In this analysis, Type LE teachers are used as the reference category for baseline comparison.

The findings of the analysis pertaining to pre-service education courses demonstrate that the course titled "Educational Diagnosis and Assessment of Children with Special Needs" serves as a reliable indicator for discerning Type HE within the program. This implies that individuals who underwent this particular course during their pre-service education are more prone to transitioning into Type HE educators during their in-service training. On the other hand, "The Formulation and Implementation of Individualized Education Program" stands out as a significant predictor for Type ME, signifying that teachers who gained experience with this program in their pre-service preparation are more inclined to fall into the category of Type ME rather than Type LE instructors. This finding provides insights for the design of pre-service education courses in early childhood inclusive education: for teachers, the ability in diagnostic assessment and development of individualized teaching plans is crucial in identifying children with special needs and providing targeted assistance during the early childhood education phase (Kisbu-Sakarya and Doenyas, 2021).

Furthermore, the study revealed that inclusive preschool teachers who receive training from teacher trainers well-versed in early childhood education are more likely to be classified as Type HE during in-service training. Additionally, the professional

competence and pedagogical wisdom of these teacher trainers are often factors predicting outcomes for Type ME and HE. This result leads to an intriguing inference: given that the practical field of early childhood inclusive education primarily lies in regular kindergartens rather than special schools, teacher trainers with a professional background that combines expertise in both early childhood education and special education should have a deeper understanding of early childhood education. This would better facilitate the provision of teaching cases more tailored towards general educational settings.

In terms of practical experience, pre-service educators who underwent training in special education institutions as part of their practice sites are more predisposed to evolving into either Type ME or HE educators during their in-service training. When considering practical activities, pre-service teachers who engaged in project-based practicum experiences, such as those within inclusive education kindergartens or special education institutions, during their pre-service education, are statistically more inclined to be classified as Type HE educators. Additionally, it is noteworthy that the availability of teaching facilities, teaching resources, and value of pre-service education collectively serve as predictive factors for distinguishing between Type ME and HE teachers. These results underscore the close relationship between the acquisition of teaching-related practical opportunities, environments, and resources during pre-service education and an individual's training outcomes during their professional development, emphasizing the high demand for specific teaching practices in the pre-service training of teachers (Wang, 2024).

Discussion

The impact of pre-service education curriculum on the effectiveness of different types of in-service training. The study identified a significant link between teachers' educational experiences and their tendency to exhibit Type HE characteristics, as well as their ability to achieve favorable training outcomes. Notably, completion of the "Educational Diagnosis and Evaluation for Children with Special Needs" course during pre-service education was particularly influential. Similarly, participation in "The Formulation and Implementation of Individualized Education Program" helped educators demonstrate Type ME characteristics and improve training outcomes.

Both courses are recognized for their effectiveness in improving in-service training outcomes (Kisbu-Sakarya and Doeniyas, 2021), attributed to the early emergence of learning, emotional, and behavioral challenges among children with special needs (Cade, 2023). Consequently, it becomes imperative for preschool educators to cultivate a comprehensive grasp of crucial facets of assessment, intervention, and the design of personalized instructional strategies within special education. Based on the principle of "early detection, early diagnosis, and early intervention," "Educational Diagnosis and Evaluation for Children with Special Needs" provides future educators with tools to comprehend and assess these children's fundamental characteristics (Koliqi et al., 2023), while "The Formulation and Implementation of Individualized Education Program" enables them to offer targeted educational support.

According to Ausubel's theory of learning transfer, prior knowledge and experiential learning significantly influence subsequent educational endeavors. Hence, preschool educators who have undergone the pedagogical rigors of these two courses during pre-service education experience a "reviewing effect" during in-service training, highlighting the impact of effective curriculum design during pre-service education on professional knowledge acquisition and teaching ability application

(Casanova-Fernández et al., 2022). Consequently, pre-service education, particularly in these courses, plays a pivotal role in nurturing preschool educators into erudite and empathetic professionals.

The impact of pre-service teacher trainers on the in-service training effectiveness of different types. The findings emphasize the crucial role of teacher trainers' professional expertise and practical aptitude in enhancing preschool educators' adoption of a Type HE orientation and their achievement of superior outcomes in in-service training. On the one hand, Teacher trainers' professional competence influences the acquisition of high-quality indirect experiences by prospective preschool educators during pre-service education. A deeper exploration of inclusive education concepts, policies, and legislative frameworks of teacher trainers can improve pre-service educators' attitudes, as noted by Tuncay and Kizilaslan (2021), thereby supporting the advancement of inclusive educational practices, including curriculum optimization and the creation of a conducive learning environment (Kwon et al., 2017).

On the other hand, teacher trainers' practical competence significantly contributes to the acquisition of direct experience in preschool inclusive education by trainees (Yang and Rusli, 2011). Trainers with high practical acumen can share numerous instances of inclusive education practices and contextual knowledge, catalyzing the elicitation, transmission, and application of pertinent insights when educators encounter similar scenarios in their in-service training and professional endeavors. Furthermore, the cultivation of practical teaching skills enables educators to develop essential competencies such as adept classroom management (Majoko, 2017b), collaborative teaching (Flecha and Soler, 2013), and differentiated instruction (Allday et al., 2013) within inclusive educational settings. These developments may help educators avoid the pitfalls of diminished self-efficacy stemming from an initial lack of real-world teaching experience (Mirosevic et al., 2020).

Notably, consistency in the professional backgrounds of teacher trainers in pre-service education could positively impact the efficacy of in-service training programs for preschool educators. While trainers with backgrounds in special education and rehabilitation therapy bring expertise in handling children with special needs (Majoko, 2018), those with foundations in early childhood education may exhibit heightened awareness of the challenges preschool teachers may face in inclusive education. This heightened awareness may enable them to deliver more tailored and pertinent training for prospective preschool instructors.

The impact of collaboration and practice opportunities in pre-service education on the in-service training effectiveness of different types. This study reveals that collaboration and practical engagement during pre-service education significantly impact the effectiveness of in-service training for inclusive preschool teachers. Educators who gain practical experience in specialized educational institutions during pre-service training are more likely to become ME or HE-type teachers, demonstrating enhanced in-service training outcomes. In interdisciplinary education, the successful implementation of inclusive preschool education relies heavily on professional development's cumulative effects, with teachers' attitudes and behaviors towards inclusive education being influenced by their pre-service experiences in special education (Dignath et al., 2022). These authentic settings, which allow direct interaction with children with special needs, help future preschool educators develop more positive attitudes toward inclusive education. (Rakap et al., 2017).

According to Ajzen's Theory of Planned Behavior, attitudes and subjective norms influence one's inclination to take action, indirectly guiding human behavior (Smith and Tyler, 2011). Pre-service training equips prospective educators with the knowledge and practical skills necessary to accommodate the individual needs of special children, fostering positive attitudes towards inclusive education and translating into more affirmative conduct during in-service training. Furthermore, acquiring and internalizing professional knowledge during pre-service training helps future educators build strong professional values and norms, amplifying the efficacy of their in-service training.

Educators with hands-on project-based teaching experience during pre-service training are more likely to become ME-type teachers, yielding superior outcomes. The theory of contextual learning suggests that learning occurs through thinking and practicing in real situations (Hwang et al., 2023). In pre-service education, learners also gain knowledge through social interaction. In the actual teaching situation, effective knowledge transfer, cooperation, and communication between educators are crucial for the success of inclusive education. By collaborating with professionals in inclusive or special education settings, prospective preschool teachers learn to select appropriate strategies for managing diverse behavioral styles through project-based practice, enabling themselves to continuously update their knowledge systems to address practical problems and effectively apply theoretical knowledge (Nketsia and Saloviita, 2013). This foundation allows preschool instructors to effectively cater to special education students' needs, enhance their pedagogical skills through in-service training, and play a pivotal role in advancing high-quality inclusive educational practices.

The impact of support conditions and resources in pre-service education on the effectiveness of different types of in-service training. In this investigation, it has been ascertained that support conditions during the pre-service education stage exert a significant influence on the categorization of the effectiveness of in-service training for preschool inclusive educators. More precisely, educators who received pre-service training in institutions with ample teaching facilities and resources were more likely to progress into the Type HE and ME during in-service training. The primary challenge in implementing pre-service education programs for these instructors is the scarcity of necessary teaching facilities and professional resources (Zabeli and Gjelaj, 2020). Consequently, the inability of higher education institutions to provide adequate resources for pre-service education emerges as the key factor contributing to the lack of readiness to develop inclusive education instructors (Gonzalez-Gil et al., 2019). The presence of a substantial reservoir of high-quality teaching facilities and professional resources is crucial for prospective instructors to acquire knowledge and assistive technology tailored to the needs of children with special needs, forming a solid foundation for competency development during in-service training.

Human capital theory suggests that the quality of human capital can be enhanced through the management of resources such as vocational training and education (Sweetland, 1996). Similarly, the Resource Dependence Theory proposes that individual development within an organization relies on the resources provided by the organizational environment, which serve as platforms and motivational support for professional growth (Powell and Rey, 2015). This principle applies to teacher training, where prospective preschool teachers, as human resources, are influenced by the diversity, richness, and innovativeness of educational resources in developing their professional competence. Educational institutions provide an environment conducive to acquiring practical experience and theoretical

knowledge, enabling educators to expand their intellectual horizons (Makoelle and Burmistrova, 2021). High-quality resources assist prospective preschool instructors in acquiring appropriate knowledge and technology tailored to the developmental needs of children with special needs, enabling them to apply their existing competencies with greater adaptability through in-service training that capitalizes on pre-service education knowledge. This approach fosters the advancement of high-quality inclusive preschool education.

Conclusions

This study focused on inclusive preschool teachers who had completed both pre-service education and ongoing in-service professional development. The results indicate that in-service training effectiveness among inclusive preschool teachers can be categorized into three types: low efficacy (LE), moderate efficacy (ME), and high efficacy (HE). In addition, pre-service education of inclusive education significantly enhances the effectiveness of in-service training, increasing teachers' likelihood of benefiting and improving their pedagogical skills. Specifically, curriculum, teacher trainers' characteristics, collaboration, practical engagement, and supportive contextual conditions in pre-service education have a notable impact on the effectiveness of inclusive education in in-service training. These findings reveal how pre-service education influences in-service training outcomes, offering valuable insights for optimizing teacher preparation and pre-service education systems. These findings also support the theoretical integration of teacher training and offer practical implications for enhancing the pre-service education system.

Implications

This study offers strong empirical support for integrating pre- and in-service training for inclusive preschool educators, providing practical guidance for selecting effective course components and promoting teacher development. To further improve program efficacy, the following measures and research directions should be considered to support the ongoing development of inclusive teacher training.

Policymakers should refine regulatory frameworks to provide clearer guidance for educational institutions in optimizing curriculum design for inclusive preschool education, ensuring alignment with the authentic demands of inclusive pedagogical practices. Rational resource allocation is critical to guaranteeing the relevance, specialization, and overall quality of instructional delivery. Pre-service education institutions should recruit diverse, high-caliber experts in inclusive education as trainers and establish state-of-the-art integrated education facilities. These institutions ought to adopt practice-based approaches, such as simulation teaching and classroom placements, to assess and develop pre-service teachers' inclusive teaching competencies. Additionally, fostering collaborative partnerships between pre-service institutions and special education schools could significantly enrich pre-service teachers' experiential learning by providing opportunities to observe and serve children with diverse needs, thereby deepening their understanding of instructional challenges and strategies in inclusive environments. Finally, in designing in-service training programs, differentiated professional development plans should be constructed by considering teachers' diverse pre-service educational backgrounds, reforming the current "one-size-fits-all" training approach. This requires establishing an "efficacy diagnosis-precision matching" mechanism that addresses distinct group characteristics. For instance, HE teachers could be offered advanced challenge tasks to maintain professional vitality, whereas ME and LE teachers

should receive targeted knowledge enhancement alongside establishing practice-based communities to facilitate knowledge transformation.

Contributions and limitations

This study employed LPA to focus on the categorization and characteristics of the effects of in-service training for preschool inclusive education teachers. From an integrated perspective on teachers' career development, the study investigated how key components of pre-service education influence the classification of in-service training outcomes. These findings provide new insights and inspiration for the design of pre-service education for inclusive education teachers. Furthermore, the integrated model of pre-service and in-service training for preschool inclusive education teachers emphasizes the provision of professional competence, practical resources, and opportunities by trainers, which can also be effectively applied to other educational stages. However, given the differences in cognitive, emotional, and social aspects among learners at different educational stages, it is essential to tailor training and support in accordance with the characteristics and needs of each educational stage during teacher education and training.

This study utilized a cross-sectional design to investigate the influence of teachers' pre-service education on the effects of in-service training. This methodological choice to some extent constrained a comprehensive exploration of the longitudinal and sustained processes of the impact of pre-service education on the effects of in-service training. Therefore, future research should consider implementing more extensive longitudinal tracking studies to investigate the complex causal mechanisms through which pre-service education shapes the patterns of in-service training.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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References

- Ackah-Jnr FR (2020) The teacher should be learning: in-service professional development and learning of teachers implementing inclusive education in early childhood education settings. *Int J Whole Sch* 16(2):93–121. <https://doi.org/10.13140/RG.2.2.13653.86248>
- Agbenyega JS, Klibthong S (2014) Assessing Thai early childhood teachers' knowledge of inclusive education. *Int J Incl Educ* 18(12):1247–1261. <https://doi.org/10.1080/13603116.2014.886306>
- Aldabas R (2020) Special education teachers' perceptions of their preparedness to teach students with severe disabilities in inclusive classrooms: a Saudi Arabian perspective. *SAGE Open* 10(3):215824402095065. <https://doi.org/10.1177/2158244020950657>
- Allday RA, Neilsen-Gatti S, Hudson TM (2013) Preparation for inclusion in teacher education pre-service curricula. *Teach Educ Spec Educ: J Teach Educ Div Counc Except Child* 36(4):298–311. <https://doi.org/10.1177/0888406413497485>
- Alsalamah A, Callinan C (2021) Adaptation of Kirkpatrick's four-level model of training criteria to evaluate training programmes for head teachers. *Educ Sci* 11(3):116. <https://doi.org/10.3390/educsci11030116>
- Brown CM, Packer TL, Passmore A (2013) Adequacy of the regular early education classroom environment for students with visual impairment. *J Spec Educ* 46(4):223–232. <https://doi.org/10.1177/0022466910397374>
- Cade J (2023) Child-centered pedagogy: guided play-based learning for preschool children with special needs. *Cogent Educ* 10(2). <https://doi.org/10.1080/2331186X.2023.2276476>
- Casanova-Fernández M, Joo-Nagata J, Dobbs-Díaz E, Mardones-Nichi T (2022) Construction of Teacher professional identity through initial training. *Educ Sci* 12(11):822. <https://doi.org/10.3390/educsci12110822>
- Chu S-Y (2021) Culturally responsive teaching efficacy in inclusive education at Taiwanese preschools. *Asia-Pac J Teach Educ* 50(1):97–114. <https://doi.org/10.1080/1359866X.2021.1880547>
- Clipa O, Mata L, Lazar I (2019) Measuring in-service teachers' attitudes towards inclusive education. *Int J Disabil, Dev Educ* 67(2):135–150. <https://doi.org/10.1080/1034912X.2019.1679723>
- De Haro Rodríguez R, Arnaiz Sánchez P, Nuñez de Perdomo CR (2019) Teacher competences in early childhood education and inclusive education: design and validation of a questionnaire. *Rev Electrón Interuniv Form Profr* 23(1):1–20. <https://doi.org/10.6018/reifop.407111>
- Deng M, Ye T, Zhang L (2024) International experience and China's strategy in promoting inclusive preschool education. *Mod Educ Manag* 8:43–45. <https://doi.org/10.16697/j.1674-5485.2024.08.005>
- Dessemontet RS, Bless G, Morin D (2012) Effects of inclusion on the academic achievement and adaptive behaviour of children with intellectual disabilities: effects of inclusion on children with intellectual disabilities. *J Intellect Disabil Res* 56(6):579–587. <https://doi.org/10.1111/j.1365-2788.2011.01497.x>
- Dignath C, Rimm-Kaufman S, van Ewijk R, Kunter M (2022) Teachers' beliefs about inclusive education and insights on what contributes to those beliefs: a meta-analytical study. *Educ Psychol Rev* 34(4):2609–2660. <https://doi.org/10.1007/s10648-022-09695-0>
- Ferguson SL, Moore EWG, Hull DM (2020) Finding latent groups in observed data: a primer on latent profile analysis in Mplus for applied researchers. *Int J Behav Dev* 44(5):458–468. <https://doi.org/10.1177/0165025419881721>
- Flecha R, Soler M (2013) Turning difficulties into possibilities: engaging roma families and students in school through dialogic learning. *Camb J Educ* 43(4):451–465. <https://doi.org/10.1080/0305764X.2013.819068>
- Ginja TG, Chen X (2023) Conceptualising inclusive education: the role of teacher training and teacher's attitudes towards inclusion of children with disabilities in Ethiopia. *Int J Incl Educ* 27(9):1042–1055. <https://doi.org/10.1080/13603116.2021.1879958>
- Gonzalez-Gil F, Martín-Pastor E, Poy Castro R (2019) Inclusive education: barriers and facilitators for its development: analysis of teachers' perceptions. *Profesorado* 23(1):243–263. <https://doi.org/10.30827/profesorado.v23i1.9153>
- Gu CF, Zhu LF (2023) Research on the current situation of inclusive education and support services in inclusive Kindergartens in Beijing-taking 13 Kindergartens as an example. *Chin J Spec Educ* 4:26–31. [in chinese]
- Hassanein EEA, Alshaboul YM, Ibrahim S (2021) The impact of teacher preparation on preservice teachers' attitudes toward inclusive education in Qatar. *Heliyon* 7(9):e07925. <https://doi.org/10.1016/j.heliyon.2021.e07925>
- Hernández-González O, Spencer-Contreras R, Sanz-Cervera P, Tárraga-Mínguez R (2022) Analysis of the autism spectrum disorder (ASD) Knowledge of Cuban teachers in primary schools and preschools. *Educ Sci* 12(4):284. <https://doi.org/10.3390/educsci12040284>
- Hu BY, Wu HP, Su XY, Roberts SK (2016) An examination of Chinese preservice and inservice early childhood teachers' perspectives on the importance and feasibility of the implementation of key characteristics of quality inclusion. *Int J Incl Educ* 21(2):187–204. <https://doi.org/10.1080/13603116.2016.1193563>
- Hu Y, He G, Wang W (2023) Profiles of Chinese teachers' emotional labor: evolution and relations with job demands, resources, and burnout. *Teach Teach Educ* 132:104230. <https://doi.org/10.1016/j.tate.2023.104230>
- Hwang W-Y, Hariyanti U, Chen N-S, Purba SWD (2023) Developing and validating an authentic contextual learning framework: promoting healthy learning through learning by applying. *Interact Learn Environ* 31(4):2206–2218. <https://doi.org/10.1080/10494820.2021.1876737>
- Kisbu-Sakarya Y, Doenyas C (2021) Can school teachers' willingness to teach ASD-Inclusion classes be increased via special education training? uncovering mediating mechanisms. *Res Dev Disabil* 113(June):103941. <https://doi.org/10.1016/j.ridd.2021.103941>
- Koliki D, Koliki K, Zabeli N (2023) Pre-service teachers' attitudes and the factors influencing their formation regarding inclusive education in Kosovo. *Br J Spec Educ* 50(3):379–393. <https://doi.org/10.1111/1467-8578.12463>
- Kurniawati F, de Boer AA, Minnaert AEMG, Mangunsong F (2017) Evaluating the effect of a teacher training programme on the primary teachers' attitudes, knowledge and teaching strategies regarding special educational needs. *Educ Psychol* 37(3):287–297. <https://doi.org/10.1080/01443410.2016.1176125>
- Kwon K-A, Hong S-Y, Jeon H-J (2017) Classroom readiness for successful inclusion: teacher factors and preschool children's experience with and attitudes toward peers with disabilities. *J Res Child Educ* 31(3):360–378. <https://doi.org/10.1080/02568543.2017.1309480>
- Liang YJ (2018) Problems and suggestions of current preschool teacher training: based on the analysis of "National Training Plan". *Cross Cult Commun* 14(1):84–87. <https://doi.org/10.3968/10245>

- Liu SQ, Zhu ZS, Dong YX, Xu RH (2022) On the social participation of children with special needs in integrated education based on the survey data analysis of 42 Integrated classes in H City. *Stud Early Child Educ* 1:46–58. <https://doi.org/10.13861/j.cnki.sece.2022.01.003>. [in chinese]
- Majoko T (2017a) Practices that support the inclusion of children with autism spectrum disorder in mainstream early childhood education in Zimbabwe. *SAGE Open* 7(3):215824401773038. <https://doi.org/10.1177/2158244017730387>
- Majoko T (2017b) Mainstream early childhood education teacher preparation for inclusion in Zimbabwe. *Early Child Dev Care* 187(11):1649–1665. <https://doi.org/10.1080/03004430.2016.1180292>
- Majoko T (2018) Zimbabwean general education preschool teacher needs in inclusion. *Sage Open* 8(2):2158244018777568. <https://doi.org/10.1177/2158244018777568>
- Majoko T (2019) Teacher key competencies for inclusive education: tapping pragmatic realities of Zimbabwean special needs education teachers. *Sage Open* 9(1):2158244018823455. <https://doi.org/10.1177/2158244018823455>
- Makoelle TM, Burmistrova V (2021) Teacher education and inclusive education in Kazakhstan. *Int J Incl Educ* 1–17. <https://doi.org/10.1080/13603116.2021.1889048>
- Mao J, Wang S, Yang JL (2022) Practical Inspection and optimization strategy of kindergarten teachers' inclusive of educational literacy: taking Henan province as the analysis object. *J Henan Norm Univ* 49(1):151–156. <https://doi.org/10.16366/j.cnki.1000-2359.2022.01.20>
- Mirosevic JK, Tot D, Lozancic AJ (2020) Designing an inclusive educational process: preschool and primary school teachers' self-assessment. *Nova Pristut* 18(3):547–560. <https://doi.org/10.31192/np.18.3.8>
- Nketsia W, Saloviita T (2013) Pre-service teachers' views on inclusive education in Ghana. *J Educ Teach* 39(4):429–441. <https://doi.org/10.1080/02607476.2013.797291>
- Nylund KL, Asparouhov T, Muthén BO (2007) Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte Carlo simulation study. *Struct Equ Modeling: A Multidiscip J* 14(4):535–469. <https://doi.org/10.1080/10705510701575396>
- Opoku MP, Nketsia W, Alzyoudi M, Dogbe JA, Agyei-Okyere E (2021) Twin-track approach to teacher training in Ghana: exploring the moderation effect of demographic variables on pre-service teachers' attitudes towards inclusive education. *Educ Psychol* 41(3):358–377. <https://doi.org/10.1080/01443410.2020.1724888>
- Powell KK, Rey MP (2015) Exploring a resource dependency perspective as an organizational strategy for building resource capacity: Implications for public higher education universities. *Manag Educ* 29(3):94–99. <https://doi.org/10.1177/0892020615586805>
- Qin Y, Sun RB, Deng XL, Wang YL (2020) A survey study on the competence of kindergarten teachers in inclusive education. *Chin J Spec Educ* 2:8–14. [in chinese]
- Rakap S, Cig O, Parlak-Rakap A (2017) Preparing preschool teacher candidates for inclusion: impact of two special education courses on their perspectives. *J Res Spec Educ Needs* 17(2):98–109. <https://doi.org/10.1111/1471-3802.12116>
- Rodriguez Fuentes A, Caurcel Cara MJ, Gallego Ortega JL, Navarro Rincon A (2021) Comparative study about inclusive education among working and trainee teachers. *Int J Incl Educ* 1–21. <https://doi.org/10.1080/13603116.2021.1958262>
- Rodriguez-Oramas A, Alvarez P, Ramis-Salas M, Ruiz-Eugenio L (2021) The impact of evidence-based dialogic training of special education teachers on the creation of more inclusive and interactive learning environments. *Front Psychol* 12:641426. <https://doi.org/10.3389/fpsyg.2021.641426>
- Scanlon G, Radeva S, Pitsia V, Maguire C, Nikolaeva S (2022) Attitudes of teachers in Bulgarian kindergartens towards inclusive education. *Teach Teach Educ* 112:103650. <https://doi.org/10.1016/j.tate.2022.103650>
- Sharma U, Jacobs DK (2016) Predicting in-service educators' intentions to teach in inclusive classrooms in India and Australia. *Teach Teach Educ* 55:13–23. <https://doi.org/10.1016/j.tate.2015.12.004>
- Smith DD, Tyler NC (2011) Effective inclusive education: equipping education professionals with necessary skills and knowledge. *Prospects* 41(3):323–339. <https://doi.org/10.1007/s11125-011-9207-5>
- Štemberger T, Kiswarday VR (2018) Attitude towards inclusive education: the perspective of Slovenian preschool and primary school teachers. *Eur J Spec Needs Educ* 33(1):47–58. <https://doi.org/10.1080/08856257.2017.1297573>
- Sun YT, Feng GH (2024) The measures, characteristics and implications of induction support for novice teachers in primary and secondary schools in Britain. *Mod Educ Manag* 12:68–76. <https://doi.org/10.16697/j.1674-5485.2024.12.008>
- Sweetland SR (1996) Human capital theory: foundations of a field of inquiry. *Rev Educ Res* 66(3):341–359. <https://doi.org/10.2307/1170527>
- Tristani L, Bassett-Gunter R (2020) Making the grade: teacher training for inclusive education: a systematic review. *J Res Spec Educ Needs* 20(3):246–264. <https://doi.org/10.1111/1471-3802.12483>
- Tuncay AA, Kizilaslan A (2021) Pre-service teachers' sentiments, attitudes and concerns about inclusive education in Turkey. *Eur J Spec Needs Educ* 37(2):309–322. <https://doi.org/10.1080/08856257.2021.1873524>
- UNESCO (2015) Education 2030: incheon declaration and framework for action for the implementation of sustainable development goal 4: ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000245656>
- UNESCO (2020) Global education monitoring report 2020: inclusion and education: All means all. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000373718>
- Valle-Flórez R-E, de Caso Fuertes AM, Baelo R, Marcos-Santiago R (2022) Inclusive culture in compulsory education centers: values, participation and teachers' perceptions. *Children* 9(6):813. <https://doi.org/10.3390/children9060813>
- Wang CG (2024) Can educational practice improve the labor market performance of normal university students? Analysis from the perspective of organizational socialization theory. *J Educ Sci Hunan Norm Univ* 23:113–122. <https://doi.org/10.19503/j.cnki.1671-6124.2024.05.014>
- Wang H, Xiu Q (2024) Study on the integrated development of teacher education in the Guangdong-Hong Kong-Macao Greater Bay Area from the perspective of global education governance. *Res Educ Dev* 43(Z2):80–90. <https://doi.org/10.14121/j.cnki.1008-3855.2024.z2.017>. [in chinese]
- Wang L, Lei Y, Zhou Q, Wei Y (2025) Impact of inclusive education on early childhood development: a systematic review and meta-analysis. *Int J Incl Educ* 1–16. <https://doi.org/10.1080/13603116.2025.2449848>
- Wang M, Hanges PJ (2011) Latent class procedures: applications to organizational research. *Organ Res Methods* 14(1):24–31. <https://doi.org/10.1177/1094428110383988>
- Warren SR, Martinez RS, Sortino LA (2016) Exploring the quality indicators of a successful full-inclusion preschool program. *J Res Child Educ* 30(4):540–553. <https://doi.org/10.1080/02568543.2016.1214651>
- Wei Y, Yang M, Lei Y, Zhou Q, Ma Y, Li Q (2022) Practical status and improving path of preschool inclusive education teacher construction in China. *Stud Early Child Educ* 8:13–26. <https://doi.org/10.13861/j.cnki.sece.2022.08.002>
- Westbrook J, Croft A (2015) Beginning to teach inclusively: an analysis of newly-qualified teacher pedagogy in lower primary classes in Tanzania. *Teach Teach Educ* 51:38–46. <https://doi.org/10.1016/j.tate.2015.05.003>
- Wray E, Sharma U, Subban P (2022) Factors influencing teacher self-efficacy for inclusive education: a systematic literature review. *Teach Teach Educ* 117:103800. <https://doi.org/10.1016/j.tate.2022.103800>
- Yang C-H, Rusli E (2011) Teacher training in using effective strategies for preschool children with disabilities in inclusive classrooms. *J Coll Teach Learn* 9(1):53–64. <https://doi.org/10.19030/tlc.v9i1.6715>
- You S, Kim E, Shin K (2019) Teachers' belief and efficacy toward inclusive education in early childhood settings in Korea. *Sustainability* 11(5):1489. <https://doi.org/10.3390/su11051489>
- Zabeli N, Gjela M (2020) Preschool teacher's awareness, attitudes and challenges towards inclusive early childhood education: a qualitative study. *Cogent Educ* 7(1):1791560. <https://doi.org/10.1080/2331186X.2020.1791560>
- Zhou X, Wang H (2024) How could teacher training bridge the gap between theory and practice? *Educ Sci* 40(4):67–72
- Zhu XD (2014) On the construction of theoretical model for teacher professional development. *Educ Res* 35:81–90

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Author contributions

YL, YW, YM, XW, and QZ contributed equally to the conceptualization, investigation, data collection and analysis, and drafted the initial manuscript together. YL and YW jointly supervised this study. YW contributed to the project administration and funding acquisition.

Competing interests

The authors declare no competing interests.

Ethics approval

This study was performed in line with the principles of the Declaration of Helsinki. Ethical approval was approved by the committee review board of School of Educational Sciences of Chongqing Normal University on January 6, 2022 (Ethics approval number: ECE-CQNU20220106). The scope of the approval included the purpose and content of this study, the investigating procedure and participants.

Informed consent

In the instructions of the questionnaire for this study, while collecting data from January 6 to May 23 in 2022, we have explicitly informed all participants that: (1) The survey is anonymous, ensuring the confidentiality of each participant; (2) The purpose and value of this research; (3) The collected data will be used solely for research purposes and analyzed at an aggregate level, without individual analysis of any participant's data; (4) Participation in this questionnaire survey is voluntary, and respondents may withdraw their consent at any time.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-025-05576-3>.

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