Integrating Play-Based Learning in Early Childhood Physical Education: Benefits and Challenges

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Abstract

The integration of play-based learning (PBL) into early childhood education (ECE) is gaining increasing recognition due to its potential to enhance children's cognitive, physical, emotional, and social development. This study examines the benefits and challenges associated with incorporating PBL into early childhood physical education (ECPE) across both public and private ECE settings. The study was conducted across 27 ECE facilities, involving 46 instructors and 328 children. Data was analysed using SPSS 23.0 and Mplus 8.0 to perform descriptive statistics and reliability testing. Exploratory Factor Analysis (EFA) was employed to identify the benefits of PBL, while Confirmatory Factor Analysis (CFA) was used to validate its components. A coefficient correlation matrix analysis was conducted to assess the relationships between the beneficial and challenging factors associated with PBL implementation in ECPE. Independent t-tests evaluated the impact of teachers' activities, PBL educational strategies, and curriculum preparation on holistic child development. Multiple regression analysis was applied to explore the interrelationships and significant effects of various benefit and challenge factors on PBL outcomes. The benefits of PBL in ECPE were assessed using fit indices, including χ^2, TLI, CFI, RMSEA, and SRMR, with SRMR values below 0.08 indicating well-fitting factors**.** The study highlights that PBL significantly enhances children's socio-emotional, physical, and cognitive development, supporting overall mental and physical health. Both public and private ECE facilities exhibit similar trends, with instructor qualifications and experience playing a crucial role. Active engagement and PBL techniques are key to optimizing developmental outcomes. The study emphasizes the importance of capacity building and tailored curriculum design for the effective implementation of PBL in early childhood physical education, while addressing challenges such as variations in teacher qualifications and experience.

Keywords: Play-Based Learning (PBL), Benefits, Challenges, Early Childhood Education (ECE) and Physical Education (PE).

Introduction

The Foundation Phase of early childhood education should integrate formal and PBL. However, concerns persist regarding reduced PBL activities, inadequate leadership, and limited journalistic attention, which hinder implementation. The National Integrated Childhood Development Strategy aligns with international improvement guidelines (Khalil et al., 2022). PBL is a transformative approach in ECPE, fostering socio-psychological skills and self-concept by shifting the teaching focus from instructors to learners, promoting constructive knowledge acquisition (Sevimli-Celik, 2021). Accessible education supports lifelong learning for individuals with disabilities, ensuring inclusive opportunities (Demchenko et al., 2021). PE contributes to human development by incorporating traditional sports to enhance pupils' understanding of movement, addressing pedagogical and theoretical perspectives (Martínez-Santos et al., 2020). PE increasingly supports social and emotional learning, developing qualities essential for academic, professional, and democratic success through evidence-based programs (Dyson et al., 2021).

Emotional competence is critical for infant and adolescent development because it improves short- and long-term results. Despite its simplicity, there is no agreement regarding the way to define and conceptualize social and emotional competence. Manifestation techniques concentrate on identifying talents, aspirations, or actions without investigating the deeper causes of emotional and social competence (Collie, 2020). In terms of being healthy, educational institutions athletic events ought to safeguard learners and their well-being and health, but also encourage the growth of characteristics such as respect for work and accountability, respect for and appreciation for Provide Express peers, creating self-confidence, and accepting their physical features (Estevan et al., 2021). PE promotes in addition to physical, but also emotional, cognitive, and

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social development. MC is essential for continuous physical activity throughout life and is linked to a variety of health results, particularly being physically active. Many children and adolescents are experiencing symptoms of MC; thus, motor skill development is a critical feature of the physical lesson's syllabus (Alcaraz-Muñoz et al., 2020). The work explores the use of PBL in ECPE, with a focus on the possible advantages to child development and engagement. It also evaluates the problems that educators experience while applying PBL, giving insights into best practices and policy development in ECPE.

Key Contributions

- Establishing the nature of play-based teaching and learning.
- Analysing the benefits of ECPE.
- Identifying challenges faced during PBL implementation.
- Collecting data through observations, interviews, and surveys.
- Providing a detailed understanding of the current state and issues related to PBL in ECE academic centres.

The following sections of the study are as follows: Portion 2: Literature Review, Portion 3: Workflow Methodology of the study, Portion 4: Result with Discussion, and Portion 5: Conclusion.

Literature Review

Haile and Ghirmai (2024) explored Eritrean preschool educators' perceptions of PBL, highlighting a gap between their views and actual implementation. Most educators believed that PBL encompassed both free and directed play but felt that free play could not effectively teach specific academic skills such as numeracy and reading. A key barrier identified was the lack of knowledge among parents and principals. The study suggests that educators' attitudes towards PBL and its limitations may influence their position on the Child-Adult Involvement Continuum. Lungu and Matafwali (2020) examined PBL in Zambian ECE centres, focusing on educators' perspectives. Children participated in both traditional and indigenous play activities, particularly through free play. While teachers generally viewed PBL positively, its implementation varied across centres. Ndlovu and Mncube (2021) investigated the attitudes of pre-service early childhood educators in KwaZulu-Natal towards employing PBL in pre-Grade R and Grade R classrooms. The study emphasised the value of PBL pedagogies in developing skills such as counting, group picturing, and problem-solving, offering diverse approaches to hybrid pedagogical styles in the Foundation Phase. Aguilar (2024) examined the evolution of PBL in private early childhood centres in Vietnam, providing insights into its application and development within these settings.

The study emphasizes the importance of fostering creative, intellectual, social, and emotional growth in children, with benefits such as enhanced reading abilities, greater independence, and a healthy lifestyle. A descriptive and correlational methodology, alongside purposive sampling, was employed to assess the development of language and literacy, psychological and social competencies, creativity, self-confidence, a positive attitude towards learning, and physical abilities. Su and Yang (2024) proposed a five-concept framework for teaching pre-schoolers about Artificial Intelligence (AI) through robotics, combining robotics and PBL to make AI more accessible and engaging. This approach was compared to traditional K-12 models, emphasizing robotics and robot simulation, with recommendations for age-appropriate, narrative-driven, and play-centred teaching. Lee-Cultura et al. (2022) suggested Physical Motion-Based Learning Technologies (PMB-LT) to integrate play and analytical learning, utilizing Multi-Modal Data (MMD) to capture cognitive, emotional, and physiological responses. Combining MMD with traditional methods like video content analysis can provide a comprehensive view of children's learning experiences, although this approach remains underexplored. Paaskesen (2020) examined the significance of children's democratic rights in education and recommended using technology to enhance curricula and cross-curricular activities, while exploring how PBL methods can foster 21st-century competencies such as creativity, communication, collaboration, and critical thinking.

Leung et al. (2024) examined computational philosophy in young Hong Kong children using an untested multimedia exercise. A study of 23 children aged 3-6 in a kindergarten art class found that older children demonstrated more advanced cognitive skills in design, representation, algorithms, flexibility, and the use of hardware/software. The study underscores the need for age-appropriate curricula to develop children's computational thinking (CT) through animation art. Berson et al. (2023) explored AI and intelligence augmentation (IA) in preschool education, highlighting the integration of AI with creative inquiry and reasoning. The study emphasizes the importance of human presence in AI-driven learning experiences. Aslan et al. (2024) introduced "Kid's Space," an instructional tool designed to combat excessive screen time and promote physical activity and social interaction. Combining sensing technologies with interactive projections and a conversational AI bot, Kid's Space

tailored learning to individual development. Research involving 14 children and three teachers in an elementary school showed that it resulted in positive attitudes, high engagement, and significant learning improvements.

Pyle et al. (2023) explored the benefits of using semi-structured interviews and video-elicitation questioning to better understand the relationship between kindergarten teachers' perspectives and practices. Their qualitative study involved classroom observations, interviews, and video-elicitation questions with 20 kindergarten children across Ontario, Canada, with the interview data thematically analysed. Park et al. (2022) investigated early childhood educators' perspectives and needs for developing an AI curriculum for 5-year-olds. The study, using surveys and interviews, highlighted the importance of integrating AI education with early childhood education, emphasizing rigorous assessments, reflective practices for instructors, and a play-centred AI support environment.

Future AI education programs should promote awareness for learners of all ages. Ndlovu et al. (2023) explored the effects of learning through play in portable preschool and kindergarten settings, using socially constructed reality theory and an interpretative qualitative case study of eight rural professionals. The findings revealed a lack of awareness of play pedagogies, negatively affecting children's play opportunities. The study recommends providing practitioners with guidance on developing and implementing play-based methods while incorporating advanced academic skills into early learning curricula. Wainwright et al. (2020) examined the Welsh approach to play education for children aged three to seven, which encourages outdoor and experiential learning. Their three-year study found that children were more engaged in tasks perceived as playful, suggesting that increased engagement leads to deeper learning. Lamrani and Abdelwahed (2020) proposed an approach combining electronic PBL with serious video games, aligned with Montessori principles, to enhance young children's skills in early education through participatory environments.

Cereda (2024) examined gamification as an innovative educational approach that enhances student engagement and enthusiasm by incorporating games and challenges. However, it highlights the importance of avoiding excessive competitiveness, as it may undermine conceptual understanding. The study investigates the effectiveness and impact of gamification in physical education, identifying its advantages and drawbacks while ensuring it promotes student engagement. Aras (2024) proposed a study on how learning-oriented assessment improved the interaction skills of early childhood preservice teachers. Data from 17 early childhood educators, collected through observation notes and reflective diaries, indicated that child-focused methods, collaborative activities, free-play interactions, and effective monitoring and questioning were beneficial classroom strategies. The study underscores the role of learning-oriented assessment in fostering professional development within teacher education.

Methodology

The study employed a qualitative case study methodology to explore the role of play in ECE institutions. By focusing on individual cases, the research provided a nuanced understanding of the complexities and variations inherent in the implementation of PBL. This qualitative approach yielded rich, descriptive data, offering an in-depth portrayal of both the benefits and challenges faced by educators in applying PBL, as illustrated in Figure 1.

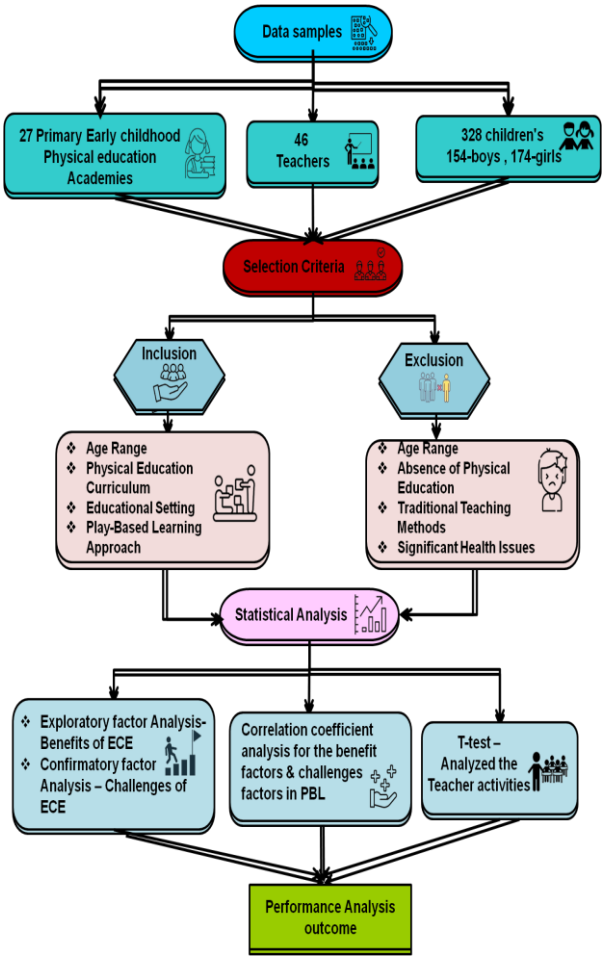


Figure 1: Workflow Methodology.

Study Samples

The study examined the impact of physical activity on mental health in primary school children. Initially, 51 pupils were selected, but the final sample consisted of 370 children (180 boys and 190 girls) aged 4 to 10 from 27

primary schools. Forty-two children (26 boys and 16 girls) were excluded due to insufficient data, outliers, or disabilities. Data was collected through semi-structured interviews with 46 teachers to inform them about the best practices and policy development in early childhood education and children's activities. The final dataset included 328 children (154 boys and 174 girls). The study aimed to assess potential effects on both physical and mental health, with detailed information provided in Table 1.

Selection Criteria

Inclusion Criteria

- Age Range: Children aged 3-8 years old.
- Educational Setting: Enrolment in an early childhood education program.
- Physical Education Curriculum: Includes a formal curriculum or dedicated physical activity time.
- Play-Based Learning Approach: Incorporates structured, free, guided play.
- Parental/Guardian Consent: Signed consent forms from parents or legal guardians.
- Teacher Participation: Willingness of physical education teachers to implement or continue play-based learning methods.
- Geographic Location: Schools or educational institutions within a specified region or locality.

Exclusion Criteria

- Age Outside the Range: Children younger than 3 years or older than 8 years.
- Lack of Formal Enrolment: Children not formally enrolled in an early childhood education program.
- Absence of Physical Education: Programs without a dedicated curriculum or regular physical activity time.
- Traditional Teaching Methods: Programs that do not utilize play-based learning approaches.
- Lack of Consent: Participants without signed parental consent forms.
- Teacher Non-Participation: Teachers unwilling to implement or adhere to play-based learning methods.
- Significant Health Issues: Children with medical conditions severely limiting their ability to participate in physical activities.

Table 1

Student Data Samples

Data Samples		**Quality of the Samples**		
Total Number of ECE Centres		**27**		
Teachers Data (n=46)		**ECE Type**		
		Public	**Private**	**Total**
Age (Years)	21-30	4	17	21
	31-40	9	7	16
	Above 40	7	2	9
Qualification	Undergraduate	3	7	10
	Postgraduate	11	14	25
	Doctor of Philosophy (Ph.D.)	9	2	11
Experience (Years)	More than 2	7	12	19
	More than 5	18	5	23
	Above 10	3	1	4
Gender	Male	9	5	14
	Female	14	18	32
Children's Data (m=328)		**ECE Type**		
		Public	**Private**	**Total**
Age (Years)	4-6	61	78	139
	6-8	62	84	146
	8-10	19	24	43
Gender	Boys	61	93	154
	Girls	77	97	174
Body Mass Index (BMI)	Underweight	14	13	27
	Normal	42	147	189
	Overweight	36	58	94
	Obese	12	6	18

Statistical Analysis Method

SPSS 23.0 was used for descriptive data analysis and reliability testing, while Mplus 8.0 was employed for correlation coefficient analysis. EFA identified the benefits of the ECE study, and CFA validated the components for PBL in ECE. t-tests were applied to assess the impact of teachers' activities, PBL pedagogical approaches, and capacity building in curriculum preparation on perceived child development. The Chi-Square (χ^2) test was used to examine the significant associations between multiple variables. The TLI assessed the accuracy of aspects related to the feasibility and difficulty of PBL in ECPE, with values above 0.90 indicating a good fit. The RMSEA and SRMR were used to measure model fit, with RMSEA values below 0.08 indicating an acceptable fit. The CFI compared the sample covariance matrix to a null model, with values greater than 0.90 reflecting a strong fit.

Results and Discussion

Validity and reliability are crucial for identifying the benefits and challenges of integrating PBL into ECPE. Validity ensures that measurement tools accurately represent the intended constructs, such as educators' gameplay beliefs and children's developmental outcomes. Content validity assesses the comprehensiveness of the concept being evaluated, while constructing validity examines whether the tool effectively captures the key elements that quantify the benefits and challenges of PBL. Reliability testing ensures that survey questions and monitoring processes remain consistent across different systems and time periods. Recognizing the factors that influence the benefits and limitations of PBL implementation is essential. The EFA and CFA methods are instrumental in analysing PBL implementation factors, highlighting key elements such as teachers' play beliefs, capacity building in syllabus planning, educational approaches in PBL, physical development, cognitive and language development, affective and social development, aesthetic development, teacher-child interactions, learning environments, parental involvement, teacher qualifications, experience levels, resource availability, time constraints, standardized testing pressure, curriculum rigidity, classroom management, parental expectations, and inadequate training. These factors are essential for assessing the advantages and challenges associated with PBL in ECPE. In the study, EFA was used to identify the advantages of PBL in ECPE. CFA was employed to validate the developed scale factors of PBL in ECPE by assessing the accuracy of the scales in measuring the target components. Together, EFA and CFA provide a robust framework for understanding both the benefits and limitations of introducing PBL into ECPE, while ensuring the study's validity and reliability. Table 2 presents the EFA results for PBL benefits in ECPE, including fit indices for various factors influencing educational outcomes, as calculated through correlation analysis. Tests such as chi-square (χ^2), degrees of freedom (df), RMSEA, CFI, TLI, and SRMR evaluate the goodness-of-fit for each factor model. Generally, lower RMSEA and SRMR values, along with higher CFI and TLI values, indicate a better factor analysis for assessing the benefits and challenges of PBL in ECPE.

Table 2

EFA Outcomes of PBL Benefits in ECPE

Factors	χ^2	df	RMSEA	CFI	TLI	SRMR
Teachers' Play Beliefs	398.47	115	0.052	0.948	0.925	0.32
Enhancing Capacity in Syllabus Planning	388.55	94	0.037	0.927	0.924	0.45
Teachers' Educational Approaches in PBL	374.67	57	0.049	0.924	0.903	0.40
Physical Development	510.37	162	0.094	0.999	0.938	0.68
Cognitive and Language Development	344.05	107	0.083	0.973	0.920	0.35
Affective and Social Development	475.24	98	0.048	0.987	0.994	0.69
Aesthetic Development	320.69	49	0.029	0.827	0.804	0.39
Teacher-Child Interactions	470.93	104	0.058	0.910	0.905	0.42
Learning Environment	350.76	79	0.043	0.898	0.893	0.35
Parental Involvement	270.42	48	0.026	0.795	9.797	0.27

Table 3 presents the EFA results for the challenges of PBL in ECPE, including the estimated indices for various

challenge parameters in the educational environment based on the correlation matrix. Metrics such as chi-square (χ^2), degrees of freedom (df), RMSEA, CFI, TLI, and SRMR are used to assess the model fit for each factor. Lower RMSEA and SRMR values, along with higher CFI and TLI values, indicate a better fit, with variables demonstrating varying levels of model fit quality.

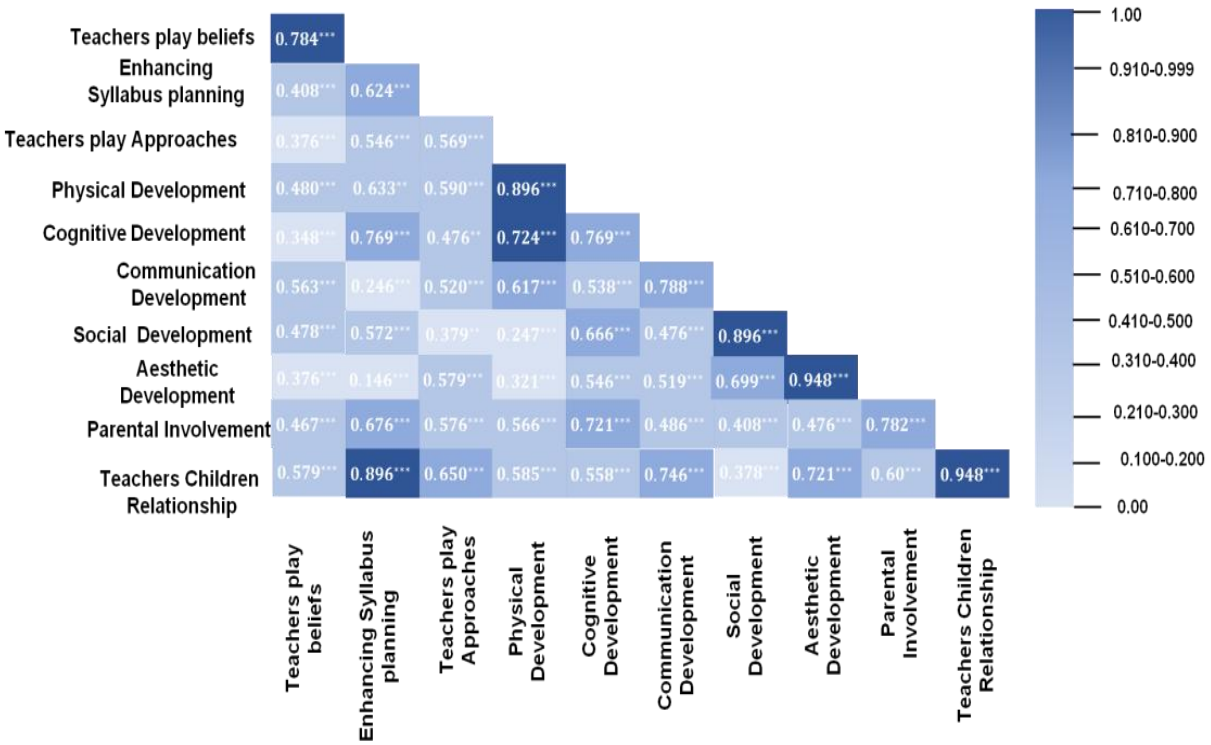
Table 3

CFA Results of PBL Challenges in ECPE

Factors	χ^2	df	RMSEA	CFI	TLI	SRMR
Teacher Qualifications	395.90	118	0.046	0.942	0.947	0.53
Experience Levels	420.49	125	0.051	0.958	0.928	0.47
Resource Availability	194.21	86	0.032	0.720	0.844	0.19
Time Constraints	69.28	50	0.118	0.489	0.593	0.08
Standardized Testing Pressure	395.49	209	0.037	0.391	0.401	0.49
Curriculum Rigidness	412.94	373	0.049	0.844	0.819	0.37
Classroom Management	380.95	119	0.023	0.787	0.793	0.48
Parental Expectations	510.93	211	0.084	0.932	0.989	0.53
Inadequate Training	528.95	382	0.079	0.917	0.938	0.67

Correlation Coefficient Analysis

A correlation coefficient analysis model was developed to examine the relationship between benefit factors, identifying those most significantly contributing to the improvement of PBL in ECPE, and challenge factors, which impact overall child development. The results are presented in Figure 2, illustrating the correlation of benefit factors, and Figure 3, showing the correlation of challenge factors.

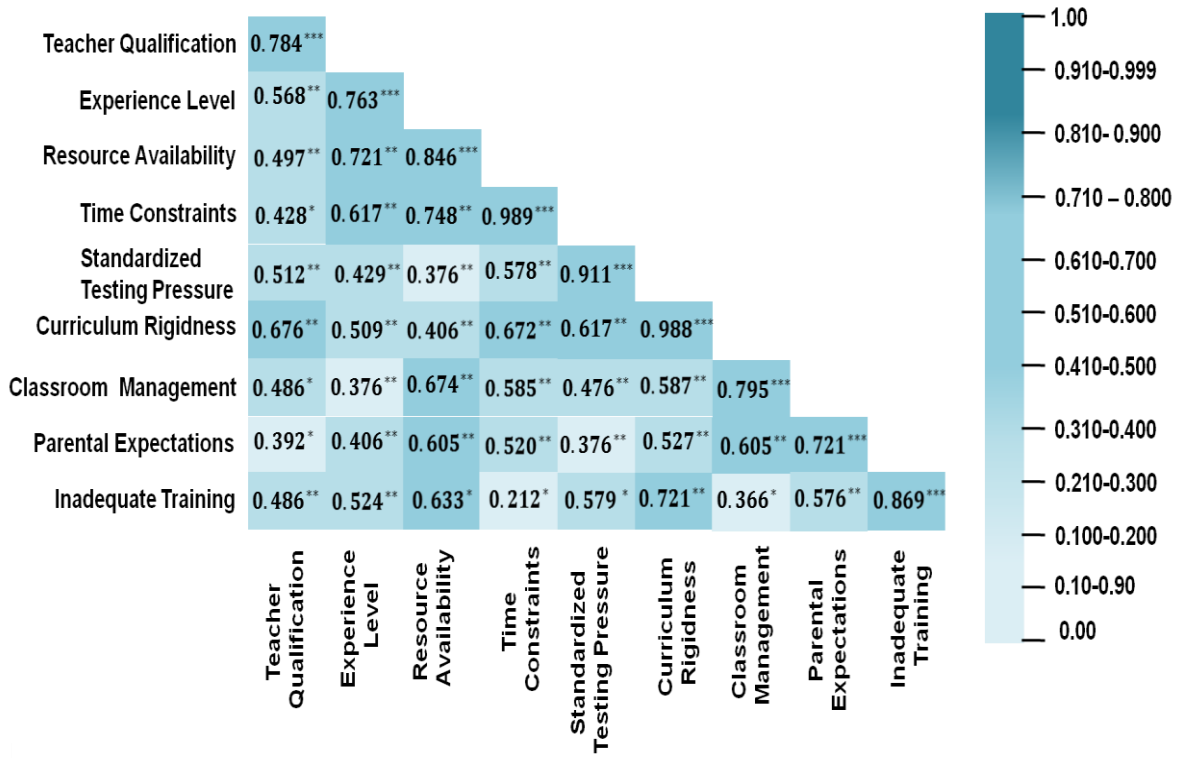


Note: *** β=0.5 ;p≤ 0.001 – *Large Benefits*

** β=0.3 ;p 0. 0. 5 ≥ p > 0.001 – *Moderate Benefits*

* β=0.1 ;p> 0. 05 – *Small Benefits*

Figure 2: Correlation of Benefit Factor.



Note:

*** $\beta = 0.5 \; ; p \leq 0.001$ – *high challenges*
** $\beta = 0.3 \; ; 0.05 \geq p > 0.001$ – *Maderated challenge*
* $\beta = 0.1 \; ; p > 0.05$ – *Small Challenges*

Figure 3: Correlation of Challenges Factor.

The T-Test Analysis:

The study employed average means and random sample t-tests to examine five variables related to both indoor and outdoor instructor activities in preschools, including co-playing, guidance, instruction, play environment, play equipment, and documentation of children's activities within PBL instructional methods. Table 4 presents the statistical analysis of teachers' training and expectations, as well as their indoor and outdoor activities, with significant t-values below 0.05, providing strong evidence against the null hypothesis.

Table 4

One Sample T-Test Outcomes

Factors	Number of Teachers	Mean	SD	Test Value	T-value	df	Significant (β)
Teachers Training and Motivations	25	0.456	520.65	47	1.96	103	0.001
Indoor and Outdoor Activities of the Teachers	21	0.456	520.53	52	-5.85	26	0.000

Discussion

The impact of PBL on children's holistic development and academic achievement remains ambiguous due to the diverse theoretical approaches employed in existing studies. PBL, which emphasizes free play with minimal adult interference, is believed to foster various aspects of children's development, including personal, social, communication, physical, and cognitive skills. However, research suggests that teacher involvement is necessary to some extent to facilitate academic learning within recreational activities, such as literacy and numeracy. The literature does not clearly define the level of teacher engagement required in PBL. Therefore, understanding the benefits of PBL is crucial for enhancing both children's overall development and academic outcomes.

PBL faces several challenges in its application within education. Teachers often struggle to balance policy, and curriculum demands with PBL practices, as well as to reconcile the perspectives of parents and the need for educator training. The PBL curriculum lacks a precise definition of "play," which complicates its integration into

teaching. Furthermore, traditional direct teaching methods often hinder the implementation of PBL. Parental perceptions also present a challenge, as some parents struggle to recognize the educational value in their children's play, leading to resistance. Additionally, teacher education and qualifications act as barriers, as many educators lack sufficient knowledge of PBL, resulting in classrooms where either child-directed activity dominate or where scripted, didactic instruction prevails.

Conclusion

The study employed a qualitative methodology to explore the adoption of PBL in ECPE at both public and private institutions, involving 46 instructors and 328 children, with data analysed using SPSS and Mplus for reliability testing and structural equation modelling. The findings indicated that PBL significantly enhances socio-emotional, physical, and cognitive development, emphasizing the importance of teacher qualifications, experience, and active involvement. Despite challenges related to teacher qualifications and experience, the study highlighted the critical role of capacity building and individualized curriculum development for the successful integration of PBL. While the study underscores the benefits of PBL in ECPE, it is limited by focusing primarily on the perspectives of educators rather than those of ECPE officials, parents, or children. Therefore, the findings are specific to urban teachers, administrators, and ECPE officials and may not be fully applicable to rural contexts. Future research should broaden the scope to include the viewpoints of ECPE officers, parents, and children to gain a more comprehensive understanding of PBL adoption. Additionally, conducting similar studies in rural areas could provide insights into the unique challenges and benefits in those settings, allowing for more targeted interventions and improvements in ECPE practices.

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