Evaluating the Impacts of Punjab Early Childhood Education Policy 2017

By
Naveed Hussain
PIDE2022FMPHILECO01

Supervised
By
Dr. Shujaat Farooq
&
Co–Supervised
By
Dr. Ghulam Mustafa

MPhil Economics
PIDE SCHOOL OF ECONOMICS (PSE)
Pakistan Institute of Development Economics,
Islamabad
2025

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS

Pakistan Institute of Development Economics, Islamabad

PIDE School of Economics

CERTIFICATE

This is to certify that this thesis entitled: **"Evaluating the Impacts of Punjab Early Childhood Education Policy 2017"** submitted by **Mr. Naveed Hussain** is accepted in its present form by the School of Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in Master of Philosophy in Economics.

Supervisor:	Dr. Shujaat Farooq	Signature:
Co-Supervisor:	Dr. Ghulam Mustafa	Signature:
Internal Examiner:	Dr. Muhammad Jehangir Khan	Signature:
External Examiner:	Dr. Jangraiz Khan	Signature:
Director, PSE PIDE School of Economics:	Dr. Iftikhar Ahmad	Signature:

DEDICATION

This thesis is dedicated to my parents and siblings whose support has always been there with me. Also, it's dedicated to all my teachers and friends who have played their role directly or indirectly in this journey.

Contents

List of Abbreviations

AEOs	Assistant Education Officers
ASC	Annual School Census
BISP	Benazir Income Support Programme
DiD	Difference-in-Differences
ECCE	Early Childhood Care and Education
ECE	Early Childhood Education
FE	Fixed Effects
IPW	Inverse Probability Weighting
M&E	Monitoring and Evaluation
MPI	Multidimensional Poverty Index
NSB	Non-Salary Budget
NSER	National Socio-Economic Registry
PES	Pakistan Education Statistics
PHCIP	Punjab Human Capital Investment Project
PSLM	Pakistan Social and Living Standards Measurement Survey
PSM	Propensity Score Matching
SED	School Education Department
ToC	Theory of Change

List of Tables

List of Figures

Abstract

Early Childhood Education (ECE) has increasingly been identified as a crucial investment in human capital development, enhancing school readiness, and promoting long-term outcomes in education. Global studies, such as Heckman's theory of human capital, focus on the fact that investments in the earliest years produce the greatest economic and social returns. In Punjab, Pakistan, significant investments in ECE have been made over the past decade, supported by international partners such as UNICEF, UNESCO, and the World Bank, and institutionalized through the Punjab ECE Policy 2017. Despite these commitments, limited evidence exists regarding the policy's effectiveness, quality of implementation, and contribution to meeting Pakistan's Sustainable Development Goal 4 (SDG-4) obligations.

This analysis assesses the effects of the Punjab ECE Policy 2017 on early grade performance, specifically Grade 1 retention through Grade 3. Employing a large-scale longitudinal sample of more than 240,000 school-year observations for 2018–2022, (with more than 105,000 schools from 2016-17) and employing doubly robust regression analysis (Inverse Probability Weights with Fixed Effect) in addition to propensity score matching, the analysis estimates both the provision of ECE interventions (classrooms, trained teachers, caregivers, and equipment) and the quality of their implementation according to policy standards.

The study finds that the availability of ECE classrooms and trained teachers significantly improves Grade 1 retention up to Grade 3. Quality implementation through dedicated classrooms, trained teachers, and adequate materials drives stronger results, further supported by school infrastructure like water, electricity, and internet access. The Punjab ECE Policy 2017 positively influenced early-grade access and persistence, though unevenly, depending on implementation quality and infrastructure.

The study recommends expanding ECE classrooms, strengthening teacher training, ensuring learning materials, and improving infrastructure. Overall, it emphasizes institutionalizing quality ECE across schools to achieve inclusive, sustainable progress toward SDG-4.

Chapter 01

1. Introduction

1.1 Background

Early Childhood Education is considered an important area that shapes life- learning capacity and development for children. It's regarded as a key factor in promoting children's cognitive, socio-emotional and physical development. Recent global evidence reinforces the economic value of ECE. The World Bank (2022) argues that quality ECE is among the most cost-effective investments for building human capital in low- and middle-income countries. Different researchers are of the view that investing in ECE yields economic, educational and societal benefits by increasing labor productivity, enhancing educational attainment, improving health outcomes, and reducing crime rates (Heckman, 2006).

Heckman has worked extensively on the economics of human capital development. His research work highlights that early investments yield the highest rate of long-term economic returns. Heckman's equation and the curve provide an important understanding that interventions in the later stages like primary, middle or high school are comparatively less effective because they cannot compensate for early years' gaps as it's often too late to provide great value. Similarly, UNESCO (2024) highlights that early childhood learning yields lifelong returns not only in cognitive and socio-emotional development but also in long-term economic outcomes.

UNICEF's global report on early years' investment states that those children who were enrolled in some form of pre-primary education, were seen to be developing important skills which are needed to proceed in school without getting dropped out (UNICEF, 2019). A comprehensive review by Hahn & Barnett (2023) demonstrates that ECE significantly benefits disadvantaged children, improving school readiness and promoting equity underlining that ECE is not just an educational intervention but a socio-economic policy instrument.

In the context of Punjab, socio-economic disparities are prevalent, and access to quality ECE services remains unequal amidst the fact that there have been different interventions for more than a decade in the province with the support of the international financial

institutions and donors. Multi Indicator Cluster Survey (MICS) 2017-18 shows that approximately 70 percent of the children in Punjab have attended some form of ECE, but it does not reveal whether participation translates into improved readiness or retention and progression which is whether they made it to primary schools or just left it after attending ECE for some time. Also, it's of immense importance to see whether there are enough ECE classrooms with necessary equipment in the schools.

This research study is aimed at adding to the evidence base by determining whether policy has resulted in improvements in measurable indicators such as grade one enrollment, readiness in classrooms, and retention at ECE facility schools. The results are anticipated to provide actionable evidence for policymakers, educators, and development partners seeking to scale and sustain early learning reforms in Pakistan and similar contexts.

1.2 Problem Statement

It has been over a decade that Punjab has been making investments in early childhood education. Most of these interventions have become viable with the support of international financial institutions such as the World Bank and the United Nations (UN) organizations such as UNICEF and UNESCO etc. These investments have taken the children to pre-primary education and raised awareness as evident in the provincial ECE policy.

The MICS 2017-2018 report attests that children in the past years have been attending some type of ECE. Since then, though, there have been no recent studies evaluating the status of ECE regarding effectiveness, quality and sustainability. UNICEF's recent report (2025) states that streamlining the policy has been a challenge and whether the government is interested in bringing sustainability through domestic funding. Also, it has highlighted that there are inconsistencies across the sectors especially in terms of coordination in implementing the projects and policy. Gaps in pre-primary enrollment have been another concern which needs to be addressed. Such issues can only be addressed through evidence generated for evaluations of the kind. Similarly, data integration and utilization is another challenge that the development sector has been grappling with.

Given the significance, there is great necessity to examine this longitudinal data and cross it with the standards outlined in the Punjab ECE Policy 2017 to determine if the implementation measures are aligned with desired standards. There is not enough evidence

to say if the schools have institutionalized ECE practices to an optimal level. It's also of much interest to judge the situation with an eye to see if the province is fulfilling its international obligations under SDGs aimed at equitable and inclusive quality education for all.

Although policy papers and donor reports emphasize the scope of interventions, the absence of systematic, policy-connected evaluation makes it problematic to attribute changes in observed enrolment or learning outcomes to ECE reforms directly. Available administrative data, including the Annual School Census, are still not maximally utilized for impact estimation, especially to ascertain causal relationships between policy interventions like ECE Classroom, ECE materials, trained teachers and ECE caregiver. By using the longitudinal data, this study has the scope to fill this gap and make informed recommendations to enhance ECE provision.

In the absence of disaggregated, evidence-based analysis, the structural disparities are likely to go undetected in policy reviews, undermining the provincial ECE strategy as well as Pakistan's efforts towards its SDG-4 targets.

1.3 Objectives of the study

The main aim of this study is to conduct a thorough analysis of the effects of the Punjab ECE Policy 2017 on early grade performance, specifically retention in grades 1 to 3 in the province. This evaluation aims at providing strong empirical evidence on whether the policy's desired effects have been achieved in practice and to what degree its enactment has impacted the student movement in the earliest years of schooling. Through analysis of both quantitative trends and qualitative measures of change, the research aims at advancing greater insight into how ECE reforms have influenced early learning pathways at the school level.

Considering this broad objective, the following are the major goals of the study:

- To assess the effects of the ECE interventions on grades 1 to 3 retention at the school level.
- To assess the effects of the quality of implementation of ECE on grades 1 to 3 retention at school level.

In the first case, the purpose is to examine longitudinal school-level data to establish whether the introduction and expansion of ECE interventions have been reflected in quantifiable gains in student access and ongoing participation in the early grades. The analysis accounts for variations across urban and rural settings, and different types of schools to capture the breadth of policy influence.

Similarly in the second case, the focus is on whether qualitative aspects of ECE provision like the committed availability of ECE classrooms, the regular provision of learning materials appropriate to children's ages, and the deployment of qualified ECE teachers are linked with improved enrollment and retention. This aim enables differentiation between the impact of adopting simple policy and the advantages of the quality provision of ECE.

By achieving these aims, the study has come up with evidence-based explanations of both the extent and the quality of ECE implementation under Punjab ECE Policy 2017. The results are hoped to not only guide provincial education policy but also act as a benchmarking tool for national and regional stakeholders interested in improving early grade achievements through targeted and sustainable ECE interventions.

1.4 Research Questions

Based on the above-mentioned objectives of the study along with problem statement, below are the key research questions:

- Did the Punjab ECE Policy 2017 result in an increase in grade 1 to 3 retention at treated versus non-treated public schools?
- How has the compliance of ECE minimum quality standards been maintained in schools with reference to Punjab ECE Policy 2017 such as ECE classrooms presence in schools, ECE trained teachers at schools and ECE learning materials' availability at schools?
- Does the quality of the implementation of the Punjab ECE Policy 2017 increase the retention in grade 1-3 at high versus low quality implementation of the ECE policy at public schools?

1.5 Significance of the study

The research is of relevance to the education policy planners engaged in service delivery and for the scholarly literature on economics of ECE. Policy-wise, Punjab being the largest province of the nation has its strategic significance as any policy that shows achievements or reflects shortcomings in Punjab, can have bearing for other provinces in terms of scaling up or maintaining the initiatives.

Now different donors and lenders are investing in Punjab in the areas of foundational learning and human capital etc. Thus, a study which analyzes the implementation of ECE with the ECE policy and diagnoses the system, can contribute towards the decision to a better and transparent allocation of resources. Likewise, the economics of human capital and ECE is still a less researched field in Pakistan as compared to other related fields. Across the world this field is under extensive research.

For a nation like Pakistan with a low human capital index relative to other nations in Asia World Bank (2023), spending on early years, therefore, appears to be of phenomenal significance. Heckman is frequently cited as having said that countries that are deep in debt can pay their loans back without any effort if they spend wisely on their children. Given this, academic debates should also reach this very important aspect of economics.

Moreover, the research helps fill the gap between international evidence and local circumstances by situating global models within the socio-economic context of Pakistan. Although most of the research on the economics of ECE is based on high-income or upper-middle-income nations, Punjab's structural issues, resource availability, and demographic pressures offer a unique pattern of conditions. This study thus adds to comparative education literature by providing insights from a lower-middle-income setting with high population density and education diversity.In addition, the results of the research have the potential to inform medium- and long-term sector planning, especially in coordinating provincial plans with national education priorities and Pakistan's SDG-4 commitments. By emphasizing the economic payoffs and system-wide efficiencies linked with quality ECE, the study aims to make the argument for institutionalizing ECE as a part of public education funding. This, in a way, could stimulate long-term political will, inter-sectoral

collaboration, and evidence-based reforms that can be replicable at scale across other provinces.

The Punjab government spends about 6% to 7% of its education budget on activities related to ECE, largely under the non-Salary Budget and external funding programs such as Punjab Human Capital Investment Project (PHCIP) under which $ 68 million has been allocated for ECE and education related matters.

Chapter 02

2. Review of Literature

2.1 Literature Review

The study mainly focuses on Human Capital Theory which states that education is the key to human development and economic growth. Gary Becker was the first economist to formally and academically study the importance of skills and training for humans. He has stated that just like a company invests in its essential equipment or products to expand, in the same way it's needed to invest in the skills enhancement and training or education of individuals for their growth and to make them more productive. Becker was awarded the Nobel Prize in 1992 for his noteworthy work on human capital.

Gary Becker in his paper "Revised Human Capital" quotes Alferd Marshall from his Principles of Economics that "The most valuable of all the capital is that invested in human beings (Becker, 1964, 1975)".

Like Becker, Heckman, the Nobel laureate, has also worked extensively in the economics of human capital. Heckman's equation is of great importance. It says that for developing a thriving economy that produces gains for multiple generations, it's essential to provide early childhood education of high quality to children from disadvantaged families (Heckman, 2020).

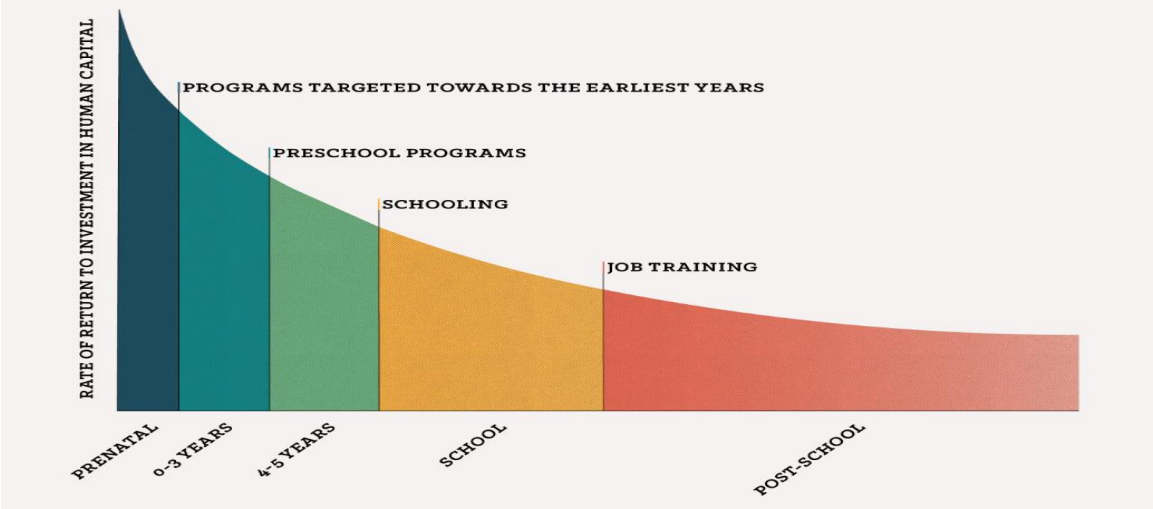

Figure 1: Heckman's Curve

Heckman thoroughly studied on the ECE interventions in Jamaica and assessed the simulation treatments' impact on the outcomes of labor market His findings show that every dollar invested in such programs from birth to age five can yield a 13 percent annual return, driven by improved educational and health outcomes for children, increased parental employment, enhanced economic productivity, and reduced costs related to healthcare and crime. This groundbreaking work of both the Nobel laureates makes it quite relevant to study more in different contexts like Pakistan where this area seems to have been given less importance at least till the early 2010s.

In China, ECE investments were also studied extensively as Wei Y et al. explain that to ensure universal access to Pre Primary Education (PPE) in China, future policy needs to consider enrolling more children from low-income families in public kindergartens and enhancing government investments in low-income families through subsidizing children enrolled in PPE (Yi Wei, 2023). In India, recent policy integration of ECE under NEP 2020 reflects the direction towards consolidating foundational education. In Pakistan, unfortunately, quantitative assessments of ECE policies are weak. Some studies like ASER Pakistan (2018) and Mahbub ul Haq Research Centre (2020) report inequalities in access to and quality of ECE across provinces. Punjab's experience of ECE reform since 2017 is not yet a research focus area, particularly causal effect on enrolment, classroom quality, and student learning achievement.

The World Bank (2018) also states that quality ECE improves school readiness, lowers repetition and dropout rates, and supports equity in educational outcomes. In the case of South Asia, ECE is critical because high levels of early childhood deprivation, malnutrition, and low access to pre-primary schooling occur (UNESCO, 2019). Likewise, Karoly (2016) adds that although many preschool programs have been evaluated for their educational effectiveness, comparatively few have been subjected to economic evaluations. Most of the estimates of the long-term economic returns of preschool education rely on benefit-cost analyses of decades-old program when preschool participation was much less prevalent—and that followed participants into adulthood.

There are scholars who focus on the role of public ECE programs. As (Barnett, 2022) argues, given that resource poverty tends to be localized in low-income and minority communities, publicly funded universal ECE can be an effective vehicle to promote social equity. For instance, Berlinski & Schady (2015) estimated strong long-run learning and labor market gains from publicly supplied Early Childhood Education (ECE) in Latin America. Similar approaches can be utilized in the Pakistani context based on Annual School Census (ASC) data.

In the context of Punjab, Alam et al. states that in 2022, Punjab spent the highest proportion of its education budget on ECE (6.9 percent) among all provinces. (Abdullah Alam, 2024). Ansari et al in their paper mention that an approach to process evaluation with a systems orientation can help governments to more effectively diagnose both the barriers and opportunities involved in providing high-quality early learning at scale via sound system infrastructure. Malik (2018) points out the chronic underfunding of ECE, mentioning that NSB funds earmarked for ECE are instead spent on other school requirements since there are no targeted accountability measures. Similarly, through exploring the processes behind to establish if existing mechanisms of operation are contributing to this desired end appropriately on behalf of the Government of Punjab, Pakistan, the study also fills a necessary informational gap (Amna Ansari, 2024).

Also, Ferriera (2019) states that according to their research, there is a high need for reassessment of ECE related educational policies. Through a production function model, they studied the impact of early childhood education on productivity. Emphasizing on the importance of conducting more empirical and longitudinal researches to evaluate policies, (Patnaik, 2023) describes that while research demonstrates that there is a correlation between ECE and positive economic growth and development, it is crucial that there be more empirical and longitudinal research conducted in order to improve the quality of available datasets and as a result, better the implementation of policy.

The Obama administration in their (Executive Office, 2014) emphasized much on preprimary education and their report written in 2014 states that through early childhood education crimes can be reduced as well because of it, there will not be a high need for remedial education. Similarly, a research study conducted by PIE in 2017 (the then

AEPAM) share their dissatisfaction over the implementation of such policies and mention that ECE policies have not been implemented fully in all provinces/regions and therefore, it is of high importance to see what has changed over the years and whether these policies are being implemented now.

Institutionalization of ECE in Punjab is quite recent. ECE provision was random and not systemic, mostly based on donor-funded pilot initiatives or grassroots initiatives before the 2017 policy. Although the National Education Policy 2009 recognized ECE as a priority, it was still a non-mandatory stage in the formal system (MoE, 2009). There were isolated efforts in the form of katchi classes, but these were often congested and run by untrained teachers (Shahid, 2016). The Punjab ECE Policy 2017 aimed to institutionalize and regularize these isolated efforts through the introduction of formal ECE classrooms, curriculum guidelines, and teacher training programs, bringing ECE from a peripheral and unorganized practice to an organized part of the education system (Government of Punjab, 2017).

Punjab's 2017 policy and Pakistan's ECE reforms are influenced by global education agendas in a very strong way. The Dakar Framework for Action (2000) of Education for All followed by the SDGs put early childhood care and education at the center of international development commitments (UNESCO, 2015). Punjab's policy makes an open reference to SDG 4.2, which focuses on access to good quality early childhood development, care, and pre-primary education. Engagement by global agencies like UNICEF, UNESCO, and the World Bank has not only assisted with financial aid but has also impacted policy design through technical assistance and monitoring frameworks (World Bank, 2018). However, authors are of the view that dependence on external finances can have the effect of creating policy dependency unless supplemented by strong provincial resource allocations (Khan, 2021).

Literature increasingly emphasizes the equity implications of ECE access. In Pakistan, access to ECE has long benefited urban, more affluent children (ASER, 2021). In Punjab, even though the policy aspiration exists, enrollment gaps between schools in rural and urban areas and between girls and boys persist (UNICEF, 2019). Rural girls are confronted with a range of barriers, i.e., cultural attitudes, long distances to schools, and domestic

duties, which may lower the chances of prolonged retention even when basic ECE enrollment has occurred (Malik & Rose, 2020). This supports evidence from international research that equal access to ECE demands conscious targeting of disadvantaged groups (Rao & Sun, 2015). The Punjab ECE Policy 2017 sets an enabling policy, but its success is contingent on implementation measures that give priority to disadvantaged populations.

While the 2017 policy calls for earmarked classrooms and specialized teacher deployment, various studies indicate long-standing problems in budget planning and tracking (Jamil, 2019; Malik, 2020). ECE is financed on a limited scale, sometimes being drawn down from wider primary education budgets, resulting in underfunding for material purchase and professional training for teachers. In addition, poor coordination between district and provincial officials leads to patchy implementation, with urban schools, which are better-endowed, having greater chances of adhering to policy requirements than rural schools. Experience from other countries indicates that long-term ECE reforms are best made with ring-fenced finances, strong monitoring, and accountability mechanisms (Rao et al., 2017). Without these institutional arrangements, Punjab stands to fall below its own policy ambitions and international obligations.

According to a very recent UNICEF country report on ECD and ECE, the sectors in charge of delivering ECD and ECE services in Pakistan are making a growing and noteworthy effort to achieve policy coherence. Policies at the national and subnational levels support an integrated multisectoral strategy that involves areas including protection, water, sanitation, and hygiene (WASH), education, nutrition, and health. Cross-sectoral integration is still difficult to fully achieve, despite the existence of coordination tools like frequent review meetings and the incorporation of important frameworks like the NCF. Even while the functions of many ministries, such as health and education, are clearly defined, there is still irregular coordination between them. Service delivery gaps and function overlap can occasionally result from the absence of defined, interministerial procedures.

The recent comprehensive report of UNICEF on ECE recommends securing the effective operationalization and implementation of ECD policies by promoting transparent budgetary commitments, strong accountability systems, and political will at national and

provincial levels. It emphasizes prioritizing securing sustainable public funding to fund the integrated ECD policies so that they can reach marginalized and underserved groups.

Also, it further suggests strengthening state capacity to coordinate and scale up combined ECD programs, with great emphasis on enhancing cross-sectoral collaboration among education, health, nutrition, child protection, and WASH sectors at federal, provincial, and local levels. This involves setting clear guidelines for partnership and incorporating ECD into overall national and provincial development strategies.

Similarly, it focuses on enhancing investments in the training, recruitment, and retention of skilled ECD workers, especially in disadvantaged areas, to provide quality ECE and support services. This encompasses creating long-term recruitment plans to provide well-trained ECD professionals in all communities, especially rural communities.

By and large, the literature indicates that Punjab's ECE Policy 2017 is located within a global policy landscape and a local historical context of patchy provision. Although the policy offers a promising framework for enhancing early grade performance, gaps in equity, governance, and financing are core issues. Both stronger domestic commitment to institutionalizing ECE and alignment with education sector reforms are needed to overcome these challenges. The facts highlight that apart from access, quality, equity, and sustainability are the key parameters that will define whether Punjab's ECE reforms achieve their promise of driving SDG-4 targets and enhancing human capital outcomes in Pakistan.

2.2 Punjab ECE Policy 2017

The Punjab Early Childhood Education Policy 2017 was a significant leap in the province's bid to enhance the quality of education. Instead of fragmented early childhood activities, it charted out a concrete agenda to establish ECE as a permanent and well-structured component of the school system. The policy was most closely associated with the Punjab Government's commitment to achieving the Sustainable Development Goals (SDGs) particularly SDG 4.2, which sought that all girls and boys have access to early childhood development, care, and pre-primary education of good quality by 2030. This reflected the government's perspective that early years form the basis for a child's lifelong learning and social growth.

The policy was formulated in 2017 through extensive consultations. It united various government departments like the Programme Monitoring and Implementation Unit (PMIU), the School Education Department (SED), the Quaid-e-Azam Academy for Educational Development (QAED), the Punjab Curriculum and Textbook Board (PCTB), the Punjab Examination Commission (PEC), and the Punjab Education Foundation (PEF). Local and international stakeholders like the World Bank, Plan International, UNICEF, and Idara-e-Taleem-o-Aagahi (ITA) also provided their recommendations. They collectively formed a vision to consolidate and institutionalize early learning in Punjab with specific roles, responsibilities, and standards.

The policy was founded on the principle that a good return can be achieved by investing in children in their earliest years. It sought to make quality early education accessible and affordable for all so that children, regardless of gender, location, or family circumstances, would be able to begin school with the fundamental skills they require to achieve. It supported a child-centered, play-based approach to learning and facilitated inclusion, ensuring that each child's needs were taken into consideration.

In operation, the policy required full-time ECE classrooms within public schools for children from 3 to 5 years old, preferably with a two-year program prior to Grade 1. It imposed minimum quality standards on school buildings, teacher training, teaching materials, and student-teacher ratios, and health, hygiene, and nutrition education was incorporated into the learning environment. QAED was tasked with training and assisting

teachers, while PMIU and district education offices were to ensure monitoring of progress. PCTB and PEC were to take the lead in developing ECE curriculum, assessment materials, and learning resources appropriate to local needs.

Monitoring was embedded into the policy via PMIU's data platforms, aided by special instruments such as MELQO (Measuring Early Learning and Quality Outcomes) to monitor learning and classroom quality. Later the World Bank's tool Anchor Items in Measurement of ECD (AIMD) was used as well. By 2017 and 201818, more than 15,000 ECE classrooms were established in Punjab and another 3,600 in the next year. Yet only roughly one-third of targeted-age children were attending, and differences in access between rural and urban areas were still large.

The implementation of the policy also encountered setbacks. Parents did not understand the worth of ECE in many places, school facilities were inadequate in some places, and instructors tended to teach more than one level simultaneously. Coordination among the various institutions was vague at times, and budgets were limited in some places. Despite all these problems, the policy established solid groundwork for Punjab's ECE that can serve as a blueprint for increasing and enhancing early learning in the future.

As per the Punjab ECE Policy, an ECE room is a specially designed classroom tailored to meet the needs of children, different from a primary classroom, equipped with child-friendly furniture, learning corners, visual aids, and activity-centered play-learning resources. ECE rooms are designed in a manner that favors activity learning, safety, and socio-emotional development over rote learning.

In short, the Punjab ECE Policy 2017 was a change in mindset regarding early education from optional to an integral part of the school system. Its vision aligns with international goals and national needs. Though implementation at a full level has been difficult, it laid the groundwork for sustained efforts to ensure that all children in Punjab begin school ready to learn.

2.3 Theory of Change

Drawing on the vision and aims of the Punjab ECE Policy 2017, the theory of change for this research demonstrates a clear line from policy inputs to enhanced educational

outcomes. The policy outlines an ambitious goal: to substitute the widespread unstructured and informal Katchi classes that have heretofore been prevalent in public schools with well-equipped Early Childhood Education classrooms. These classrooms are envisioned to be specially designed or redesigned learning areas staffed with materials appropriate to the age, a systematic curriculum, and trained early childhood pedagogy teachers.

The underlying presumption is that if these inputs including trained teachers, appropriate learning materials, and facilitative classroom environments are provided in a consistent and equitable manner, they will create good foundational capacities in children in their early years. Specifically, the policy aims to foster cognitive development (problem-solving and early numeracy), linguistic skills (vocabulary development and language understanding), and socio-emotional development (cooperation, empathy, and self-esteem). These skills are anticipated to prepare children for a less bumpy and more effective transition into Grade 1, minimizing early-grade repetition and dropouts.

The theory also predicts that it will not be one-off interventions that yield progress but a recurring cycle of implementation, monitoring, and refinement. Consistent monitoring of ECE performance, both classroom quality and student outcomes, is deemed essential. This facilitates timely feedback for teachers and administrators, allowing them to modify teaching styles, resource use, and staff training. Integrating monitoring systems like PMIU's data platforms and other assessment tools fortifies this feedback loop.

If implemented "in letter and spirit," to use the policy's own words, the combined impact of these measures is projected to reach far beyond early grades. Children who have access to high-quality ECE are more likely to enter primary school on time, stay in school throughout the primary cycle, and further their education into middle and high school. In the long term, this trajectory promotes higher educational achievement, improved life chances, and breaking cycles of intergenerational disadvantage.

Essentially, the change theory connects the policy's structural changes infrastructure development, well-trained teachers, good learning materials, and monitoring on a systematic basis to the end product of establishing well-rounded learners who are equipped

to excel in formal schooling and life. It emphasizes fidelity to the vision of the policy, government commitment over time, and continuous modification based on field evidence.

Chapter 03

3. Data, Variables and Methodology

3.1 Data Description

The Punjab government through its Programme Monitoring and Implementation Unit (PMIU) and the School Education Department (SED) collects ASC data from the public schools annually with the purpose of providing a real time snapshot of schools, to monitor the provision of education and to make data driven decisions among other uses. Schools self-report this data on the School Information System which is a digital platform accessible to all public sector schools in the province. This data comprises crucial information on schools, enrollment, teachers, non-teaching staff, budgetary practices and school infrastructure among other aspects.

Annual School Census (ASC) data has been used for this study. The longitudinal data from 2016 to 2022 from Punjab serves as the primary dataset. The panel nature of the data enables the study to draw causal inference regarding the implementation and effectiveness of ECE in Punjab. One caveat was that during this timeframe COVID-19 happened and the abnormal nature of implementation might have certain uncertainties, however, the use of school year fixed effects seems to absorb the shocks as the COVID-19 abnormality not only affected the treated schools, but also the untreated schools as well. To see the impact and compliance, the Punjab ECE Policy 2017 has been taken as a reference which provides important indicators. By integrating the ASC data and the ECE policy components, the study drew cross-sectional and longitudinal trends and analysis across districts and schools in the province.

Table 1: Initial list of schools as per the raw data

Year	Total Schools	Treated	Control
2016	52941		
2017	52443		
2018	52470	11478	40992
2019	48207	12278	35929
2020	48238	14556	33682
2021	48240	15440	32800
2022	48362	19841	28521

We don’t have information on treated and control schools before 2017 which is pre ECE policy time and after the implementation of the Punjab ECE 2017 policy, but we have the data for interventions in 2018 and after till 2022. It is seen in the table above that over the years the number of ECE interventions has increased from 11478 schools to 19841 in four years.

The reports published based on the ASC data state that this data is crucial for policy formulation, resource allocation and monitoring and evaluation etc. Also, the authorities working at the PMIU and SED mention in their reports and on the websites that over the years, this data has been digitized, significantly improved in accuracy and there has been a greater focus on ECE.

After cleaning and solving problems like missing values and inconsistencies, panel data was made comparable over schools and years by balancing it. Here around less than 2% of observations had to be discarded, mostly from the tail end of one or two years when data for some records were missing. Because these missing cases were just a minimal portion of the dataset and did not systematically influence the primary treatment or outcome measures. Their exclusion did not directly influence the validity of the analysis. The resulting final balanced panel thereby constituted a sound foundation on which to study the impact of the Punjab ECE Policy 2017 on early grade enrollment and retention.

Table 2: List of schools after balancing the panel dataset

Year	Number of Schools	Percentage
2016	48,062	14.29
2017	48,062	14.29
2018	48,062	14.29
2019	48,062	14.29
2020	48,062	14.29
2021	48,062	14.29
2022	48,062	14.29
Total	336,434	100

3.2 Variables

Two types of variables are focused on in this study: outcome variables and explanatory or treatment variables.

3.2.1 Outcome Variables

Enrollment and retention in Grade 1 is used as a proxy indicator for the transition of children from ECE to formal primary education which is called readiness to learn in the education sector domain. It shows the number of students who have potentially benefitted from the ECE program and entered the grade 1. It shows the immediate outcome of early-year investment in terms of readiness to school.

Retention rate in Grade 1-3 is used for the medium-term outcome of the ECE program as it shows the rate at which students continue to progress from grade 1 to 3 without getting dropped out. This shows the continuity in education for the children who potentially availed the ECE program.

Retention rate is measured through "Grade-to-grade progression ratios (number of students in Grade 2 in year$_{t+1}$ / Grade 1 in year t)"

3.2.2 Treatment Variables

For the treatment variable, for each dimension like ECE room in school, availability of learning materials and presence of an ECE trained teacher, binary values are used where "1" is for yes or presence/availability while "0" is for "No" or unavailability which means that binary values show whether the school is treated or not.

Since these variables don't have a "1" for all-in-one school as there is an ECE room but not a trained ECE teacher or similarly, the school has a trained teacher and an ECE room, but not the learning materials.

These variables have been taken from the ASC data from 2016-2022 and are normalized for index formation where needed.

3.3 Empirical Design of the Study

In order to measure the effectiveness and the quality of implementation of ECE at school level, through the Factor Analysis method, an ECE Quality Compliance Index (ECE_QCI)

has been developed based on the four dimensions ECE room, ECE learning materials and ECE trained teacher and ECE Caregiver. This composite index measures the extent to which schools show compliance with the basic quality requirements specified in the Punjab ECE Policy 2017. Factor Analysis is used as all the four mentioned variables have binary values as "Yes" or "No".

This index possesses quality ratings like high, medium and low and based on these quality ratings, a school is categorized into groups as Group Low, group Medium and group High. These groups are then compared with the non-treated schools to see the impact:

(i) Low quality implementation of ECE policy versus non-treated schools
(ii) Medium quality implementation of ECE policy versus non-treated schools
(iii) High quality implementation of ECE policy versus non-treated schools

The first dimension, the ECE room, shows whether a school possesses an ECE room for providing the physical environment for the children. A dedicated ECE room indicates that the school has formalized ECE within its physical structures.
The second dimension, learning materials, shows whether the school is provided with play-based and instructional materials appropriate for young children. These resources are essential for promoting cognitive, language, and socio-emotional development in early years, and their availability is used as a proxy measure for pedagogical preparedness. The third factor, the ECE-trained teacher, represents whether the school has recruited or employed a teacher who has been specially trained in early childhood education. This is an essential element, since the ECE Policy 2017 highlights teacher capacity as important to providing age-appropriate, play-based, and inclusive education. Having a trained teacher suggests the school is ready to carry out the curriculum in a responsive manner. Also, a caregiver is appointed who assists the teacher and ECE students.

Regarding the evaluation methods, there are several empirical methods which are employed to evaluate the impacts of any policy intervention such as experimental and quasi-experimental approaches. These include Regression Discontinuity Design (RDD), Difference-in-Difference (DID), Propensity Score Matching (PSM), and others. The application of these methods depends on the structure of intervention, and data availability.

So, given the structure of the intervention (Punjab ECE Policy 2017) and data structure, the choice of any method is not as simple due to certain reasons:

(i) the structure of intervention is not random
(ii) multiple interventions related to ECE
(iii) the occurrence of the problem of the selection bias because of the possibility of systematic biases in selecting schools for intervention, and we have only school level observables but the information of socioeconomic structure of the students is missing.

This brings serious challenge to estimate the said objectives of this study. The application of simple DID or school fixed effect is not appropriate to implement if we want to obtain counterfactual analysis. To the best of our knowledge, if we integrate school fixed effects with Inverse Probability Weighted (IPW), it will be more appropriate and robust approach to evaluate the causal impacts of the Punjab ECE Policy 2017 on retention rates in grade 1-3. This integration of the two approaches would help to cover the limitations such as selection bias, and unobservable confounders related to students' socioeconomic backgrounds. (Yuqin Wei, 2023). This integrated approach is called "Doubly Robust Method", because this approach provides the unbiased estimates. The IPW is usually used as an alternative to PSM (Sheri A Lippman, 2011). Usually, the PSM approach aims to reduce selection bias by ensuring that treatment and control groups are comparable by balancing them based on probabilities estimated from observable characteristics before estimating the treatment or based on pre-intervention school characteristics. But in the setting of the IPW approach, these probabilities will be further used to generate inverse probability weights which will balance the treatment and control confounding residuals which means that it estimates the probability of unobservable confounders based on observable confounders. So, here in the context of this study, we will be using IPW because of unobservable confounders related to socioeconomic characteristics of the students, which will be estimated using logistic regression model.

At the proposal stage, we were of the view that once we compute inverse probability, this will be imputed with DID or fixed effect model. If the parallel assumption holds, i.e. parallel trend before the intervention, we will use DID approach, otherwise the school level

fixed effect approach will be integrated with IPW. This weighted dataset will then be used to estimate the causal impact of ECE interventions over time between treated and control groups.

At the estimation stage, we found out that the dataset was able to be balanced, hence we balanced it after running different diagnostic tests and then used the IPW with Fixed Effect method. Fixed Effects method removes time-invariant unobserved heterogeneity at the school level. Random Effects were not used because the assumption that unobserved school characteristics are uncorrelated with treatment assignment is implausible. Hausman logic therefore favors FE.

3.3.1 Specification of Integrated Approach

Evaluating the causal impacts of the Punjab ECE Policy 2017 presents methodological challenges because the intervention was not randomly assigned, multiple ECE-related activities were rolled out simultaneously, and schools selected for treatment may differ systematically from non-treated schools. In addition, the dataset provides school-level characteristics but lacks direct information on students' socioeconomic backgrounds, introducing the possibility of unobservable confounding. Under these conditions, simple PSM, DID or FE models may produce biased estimates.

To address these issues, this study adopts a doubly robust estimation strategy, integrating IPW with panel fixed effects. This approach balances observable characteristics between treated and comparison schools, while accounting for time-invariant unobservable heterogeneity.

In the first stage, we model the probability that a school receives the ECE intervention as a function of pre-intervention school-level characteristics. The treatment assignment model is specified as:

$$treat_i = \propto + \gamma_1 Area_i + \gamma_2 SL_i + \gamma_3 TSR_i + \gamma_3 Facility_i + U_i \quad (1)$$

The equation (1) is a treatment equation, which estimates the probability of being treated schools based on before treatment observable school level characteristics. Where, $treat_i$ shows the binary variable of treatment (whether school is treated=1 or untreated=0) which

is a dependent variable, while $Area_i$ shows binary variable if school is located at rural=1 or urban areas=0, while SS_i shows school size (enrollment), TSR_i demonstrates teacher-student ratio, $Facility_i$ indicates the binary variable of facilities (electricity, toilet. boundary wall, drinking water and internet). Hence, based on these observable factors, we estimate the above model by using Logit model, which would provide us with the probabilities. For IPW, we take the inverse of the estimated probabilities, and these probabilities are used in the next outcome model. For IPW, we test some diagnostic tests such as testing the holding of balance property.

A logit model is estimated to obtain the predicted probability of receiving treatment:

$$P_i = P(treat_i = 1 \mid X_i)$$

3.3.2 Construction of Inverse Probability Weights

Secondly, using the estimated propensity scores, we compute inverse probability weights that are correct for selection bias:

$$W_i = 1/P_i \quad \text{if treated}$$

$$W_i = 1/(1 - P_i) \text{ if untreated}$$

These weights re-scale the data such that treated and untreated schools become comparable on observable characteristics. Diagnostic balance tests are performed to confirm covariate balance after weighing.

3.3.3 Integrated Weighted Outcome (IPW–FE Model (Doubly Robust))

The causal impacts of the ECE policy on retention (grade-to-grade progression) are then estimated by integrating IPW with FE. Parallel trends do not hold in this dataset; therefore, DID alone is not appropriate. Given the failure of the parallel trends' assumption, we incorporate IPW into a fixed-effects specification:

$$[W_i * logY_{it}] = \ \propto + \beta_1 treat_{it} + \beta_2 \sum Xi + \mu_i i + \lambda_t + \epsilon_{it} \qquad (2)$$

This integrated estimator remains unbiased if either the treatment model or the outcome model is correctly specified. All other variables have been explained as above and $\sum Xi$ accounts for all school level variables.

3.3.5 Estimating Effects by Implementation Quality

To examine heterogeneous effects, the binary treatment indicator is replaced with indicators for:

- Low-quality implementation vs. non-treated
- Medium-quality implementation vs. non-treated
- High-quality implementation vs. non-treated

The same weighted FE structure is used for estimation.

In short, the doubly robust IPW–FE estimator addresses selection bias in non-randomized settings, balances treated and comparison schools on observable characteristics, and controls for time-invariant unobservable. This makes it a suitable causal inference approach for evaluating the Punjab ECE Policy (2017) using school panel data, where standard DID assumptions do not hold.

Chapter 4

4. Results and Discussion

This chapter comprises of two parts the situational analysis and regression analysis. Situational analysis contains school characteristics, ECE implementation figures and the outcome (retention rates). Similarly, regression analysis comprises of estimated figures for ever treated schools, types of intervention and the ECE quality.

4.1 Situational Analysis

4.1.1 School Characteristics

The whole learning environment is greatly influenced by school features including drinking water, toilet, electricity, internet, libraries, and boundary walls. These facilities serve as markers of a school's quality, safety, and inclusivity in addition to being its physical characteristics. Modern teaching techniques and digital tools are made possible by electricity and internet connectivity, while students' health and regular attendance are guaranteed by access to clean drinking water and sanitary facilities. Similarly, having a library encourages reading and self-study, and having secure infrastructure creates a welcoming and safe environment. Examining these characteristics aids in comprehending differences between schools and identifies places where enhancements might greatly improve learning and teaching results.

	Ever Treated Schools	Non-Treated Schools
Water	99.54	99.27
Electricity	98.26	97.37
Toilet	99.54	99.27
Boundary Wall	98.07	97.42
Internet	23.65	18.22
Library	30.21	18.38

Table 3: Facilities at schools with respect to intervention

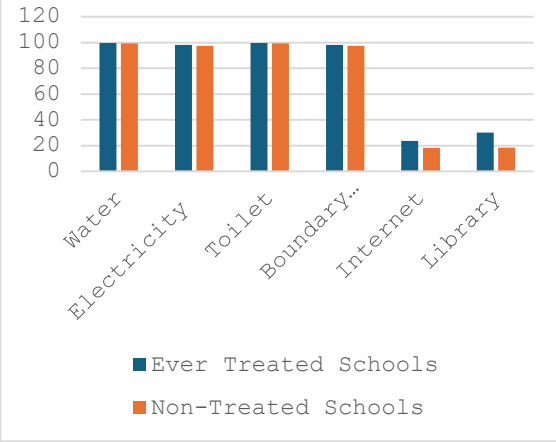

Figure 2: Facilities at schools with respect to intervention

The evaluation of school facilities reveals that ever-treated schools have persistently higher availability across all attributes than non-treated schools, but the size of difference is not

consistent. For simple infrastructure like drinking water, electricity, and toilets, both groups of schools have nearly universal coverage over 97 percent. In this high coverage, treated schools have marginally higher proportions, suggesting that interventions sustained even those services that were already commonly available. Availability of the boundary wall also tracks in the same direction, with treated schools having a slight edge over non-treated schools, indicating relatively stronger physical security at the site.

Similarly, heterogeneity between the two groups is increased when looking at sophisticated facilities. Connection to the internet is noted in around one-fourth of treated schools, as opposed to less than one-fifth among non-treated schools, underlining a huge difference in access to online facilities. In the same way, library facilities exist in almost a third of treated schools but less than a fifth of non-treated schools. The findings indicate that although basic differences in infrastructure are small, treated schools enjoy a better quality of facilities that improve the learning environment.

Generally, results suggest a two-way pattern: homogeneity in basic infrastructure throughout the system, and heterogeneity in higher-level educational resources, with treated schools performing significantly better. This suggests that not only did interventions sustain basic service levels but also made a positive contribution to the learning environment in ways that could have significant implications for student outcomes.

4.1.2 ECE Implementation statistics

The Punjab ECE Policy has emphasized the implementation of all ECE factors in its true spirit, so it’s necessary to see the implementation over the years. Over the years the province has seen multiple donors engaged in the early learnings and have been providing funds. In parallel, the government departments like PMIU, SED and other related organizations have expressed interest in working more actively in the areas of foundational learning. Without having a look at the figures on whether the projects have shown some progress, it’s difficult to comment on the nature of implementation. Therefore, it’s necessary to have a look at the statistics to understand the context and nature of implementation and interventions.

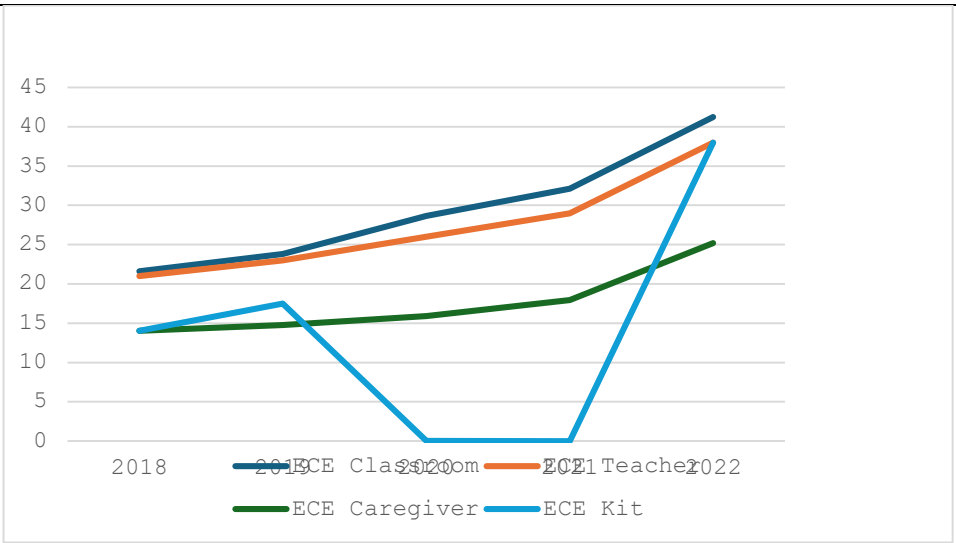

Figure 3: ECE Intervention by years

Between 2018 and 2022, schools show steady improvement in ECE interventions, with the strongest improvements in 2022 following pandemic-induced disruptions. In 2017, there were very few ECE classrooms (or at least data was not reported). ECE classrooms improved steadily from 22% to 41% of schools, consistent with long-term infrastructure investment. ECE teachers also show a similar pattern, increasing from 21% to 38%, indicating organized teacher deployment in line with classroom growth.

ECE caregivers have increased more slowly, from 14% to 25%, reflecting slower uptake of this support function. ECE Kits also known as learning materials showing early expansion but fell to almost 0% in 2020–2021, possibly because of COVID-19 interruptions as children probably took materials to home. Soon after the pandemic recovery was seen strongly to 38% in 2022.

The strong increase in 2022 in all measures indicates the policy momentum and catch-up investment after the pandemic. As classrooms and teachers grow in parallel, slower growth in caregiver supply and previous learning materials disruption points to areas calling for specific focus to ensure evenly balanced quality improvements throughout the ECE system.

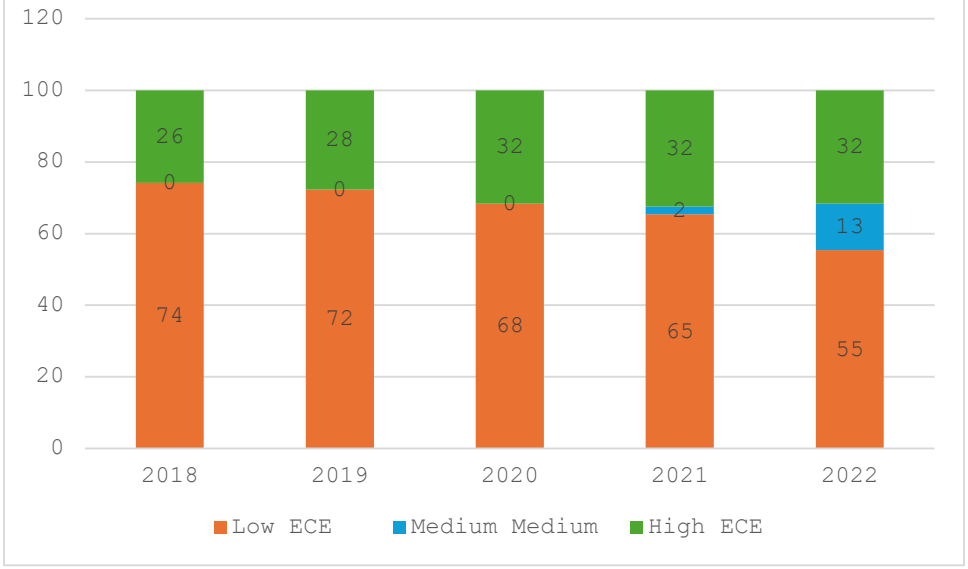

Figure 4: ECE Quality improvement over the years

This graph shows that between 2018 and 2022, the percentage of Low ECE quality schools fell gradually from 74% to 55%, showing progressive improvement in ECE standards. The percentage of High ECE quality schools increased moderately from 26% to 32%. A Medium ECE quality category appeared in 2021 (2%) and grew steeply to 13% in 2022, indicating more recent interventions are shifting schools out of the lowest quality level, although they are not yet at high compliance.

The evidence points to promising gains in eliminating low-quality provision but also indicates the necessity of interventionist approaches to enable medium-tier schools to advance to the high-quality category so that overall system improvement translates into equitable, long-lasting gains.

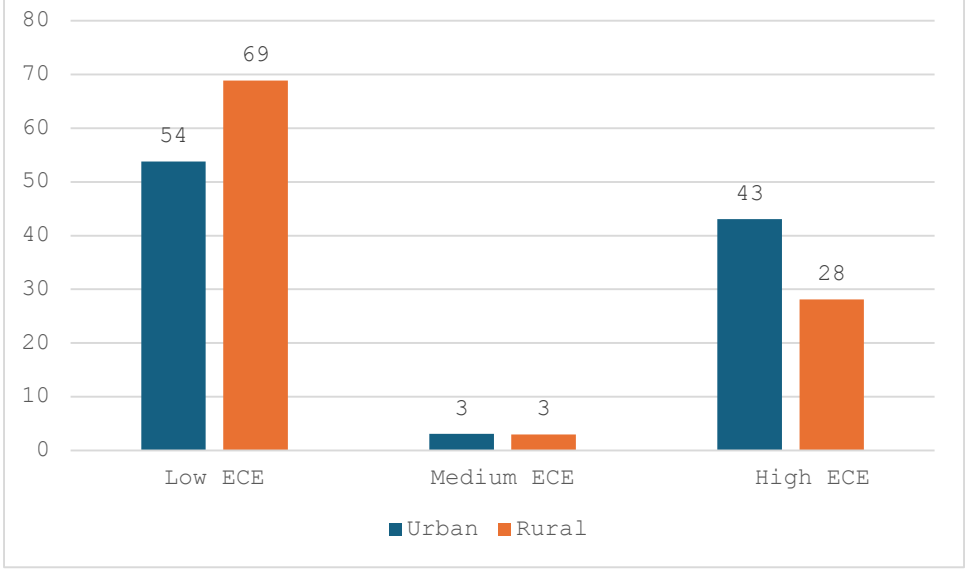

Figure 5: ECE Quality location wise

The urban-rural relationship with the ECE quality in schools is shown in this graph. ECE quality is unevenly distributed across the urban and rural regions. In urban schools, High ECE quality is attained by 43% of schools versus just 28% in rural schools. At the same time, Low ECE quality is more common in rural areas (69%) than in urban ones (54%). Medium ECE quality is very low in both environments (3%), which means schools are highly concentrated either at one end or the other of the quality scale.

This shows the improved availability of trained teachers, physical facilities, and learning materials in urban schools. Rural schools seem to have chronic challenges most importantly in staffing, leading to a clustering in the low-quality category.

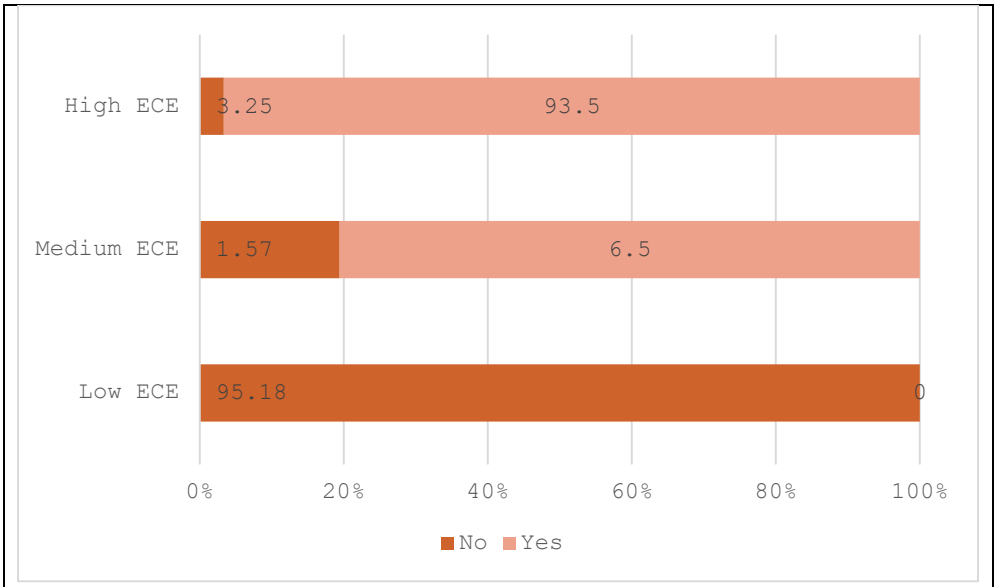

Figure 6: ECE Quality by ECE room availability

The availability of ECE rooms is highly correlated with increased quality:

- High ECE quality: 93.5% have a separate ECE room.
- Medium ECE quality: 6.5% have an ECE room.
- Low ECE quality: 95.18% do not have an ECE room at all.

This trend shows that a separate room for ECE is an important distinguishing factor between low- and high-quality provision. It is required but not on its own sufficient. There are some medium-quality schools that do have rooms but are still failing because of deficiencies in teacher training or learning materials.

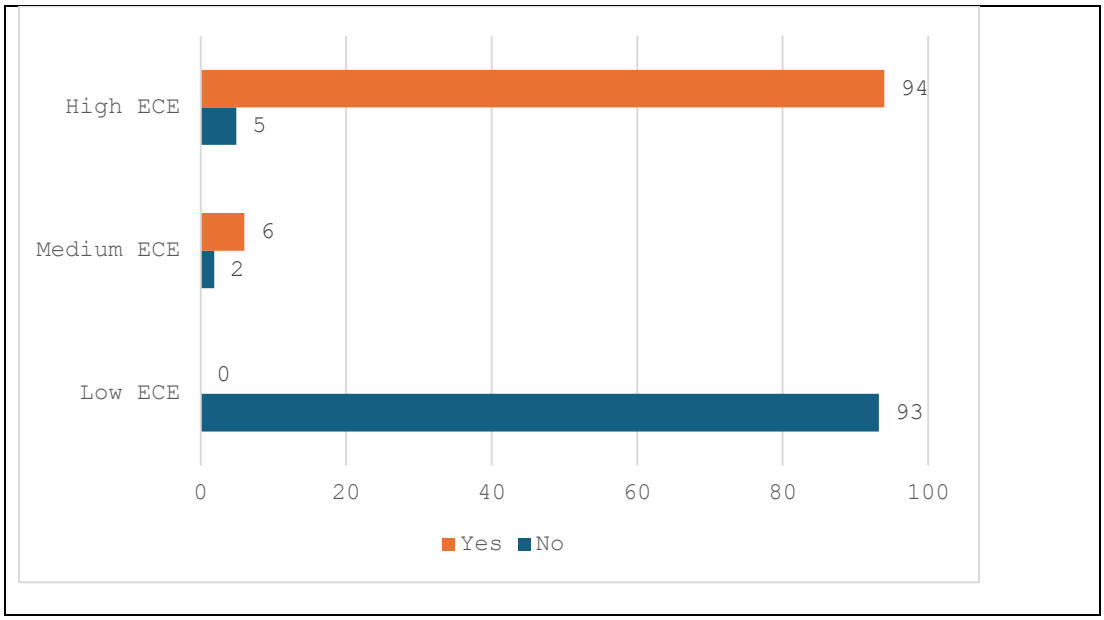

Figure 7: ECE Quality by ECE teacher availability

Availability of an ECE room and the presence of a trained ECE teacher are both highly associated with increased ECE quality. Nearly all schools of High ECE quality possess an ECE room (93.5%) and a trained ECE teacher (94%), while Low ECE quality schools nearly uniformly lack both (95% lacking rooms, 93% lacking teachers).

Medium-quality schools usually possess at least one of these features frequently an ECE classroom or a trained teacher, but are still not in high compliance, indicating that infrastructure or personnel by themselves are required but not enough for top quality. These results confirm that total improvement must be facilitated with investment in facilities, teacher training, and other quality components like learning materials and caregiver support all at once.

4.1.1 Retention rate by School level Quality

a) Analysis of the Mean Retention Rates in ECE Vs Non-ECE Schools

Table 4: Average Retention Rate by Quality of ECE Policy

Average Retention Rate (%) by Quality of ECE Policy			
	Kachi to Grade-1	**Kachi to Grade-2**	**Kachi to Grade-3**
Low ECE	51	46	39
Medium ECE	70	61	51
High ECE	76	72	60

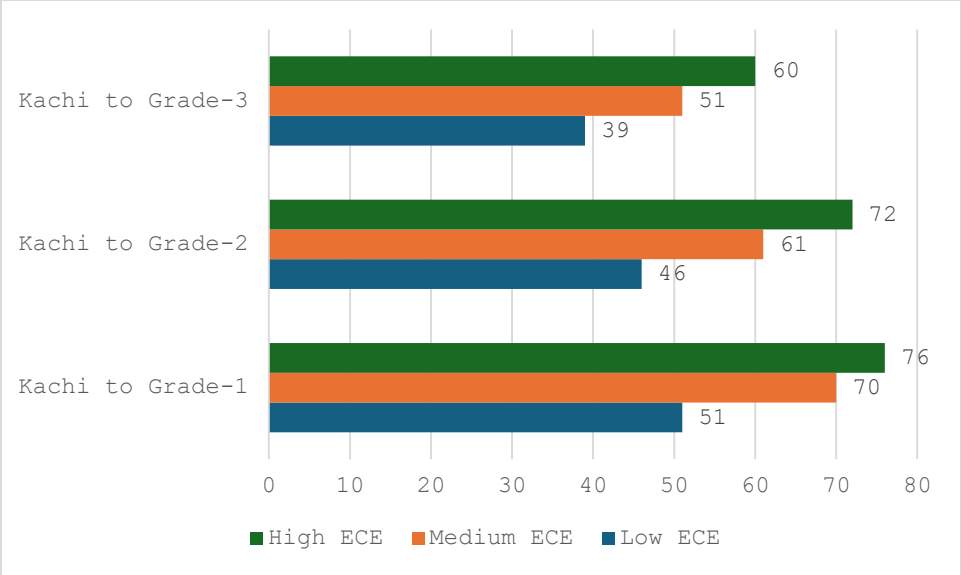

Figure 8: Retention rate by School Level Quality

These statistics in the above table show a very distinct and systemic correlation between the quality of ECE implementation and retention of students from ECE/Katchi to Grades 1, 2, and 3. Schools in the Low ECE quality category show lower retention rates in all grades, with only 51% of students advancing from Katchi to Grade 1, 46% to Grade 2, and only 39% to Grade 3. These results indicate a high early dropout where minimum quality requirements are poorly satisfied.

Medium ECE schools show significantly greater retention, with 70% of students retained through Grade 1, 61% through Grade 2, and 51% through Grade 3. The gains over Low ECE schools (a 19-percentage-point rise for Grade 1, 15 points for Grade 2, and 12 points for Grade 3) highlight the beneficial impact of even intermediate quality standards in securing children's school-going continuity.

The most visible improvements, however, are in schools classified as having High ECE quality, for which retention is 76%, 72%, and 60% in Grades 1, 2, and 3, respectively. These rates not only surpass Low ECE school rates by wide margins (25–21 percentage points over grades) but also indicate that more high-quality provision maintains its lead as students' progress through the early grades. However, retention rates fall with grade in every quality group showing the overall problem of maintaining student involvement in the first few years. The slope of decrease is not as steep in higher-quality ECE schools. For

instance, the decline from Grade 1 to Grade 3 is 12 percentage points for High ECE schools, as opposed to 20 percentage points for Low ECE schools.

Together, these patterns of description indicate that the hypothesis that ECE quality is positively related to immediate and long-term retention outcomes holds true. They are consonant with global evidence that shows early experience in well-organized high-quality ECE settings enhances children's school readiness and decreases the risk of dropout in future grades. In Punjab, these findings highlight that not only the existence but the quality of ECE implementation is key to maintaining the gains in enrollment and ensuring passage through the early years of education.

b) Analysis of the Mean Retention Rates in ECE Vs Non-ECE Schools

Table 5: Average Retention Rate by Quality of ECE Policy (Non-ECE Schools)

Average Retention Rate (%) by Quality of ECE Policy			
	Kachi to Grade-1	**Kachi to Grade-2**	**Kachi to Grade-3**
Low ECE	51	46	39
Medium ECE	70	61	51
High ECE	76	72	60

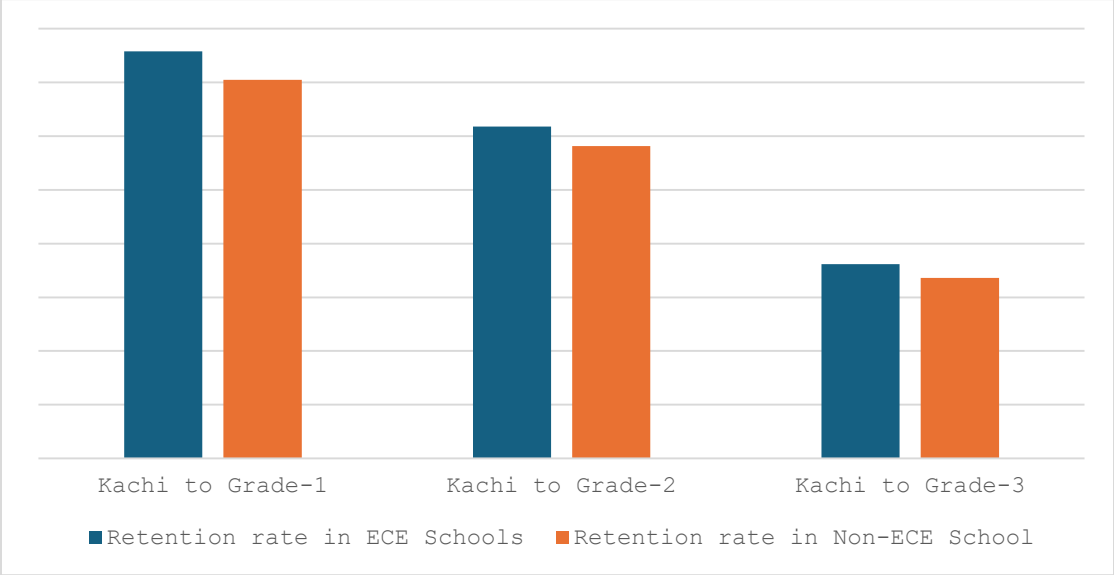

Figure 9: Retention rate by Schools

The mean retention analysis in the above table provides the descriptive proof of the effects of ECE on student persistence across early grades. For all grade levels, schools with ECE

availability show higher retention rates than schools without ECE, indicating a persistent positive relationship between ECE availability and student progress.

For moving on from Katchi to Grade 1, ECE school retention stands at 75.8%, while that in non-ECE schools is 70.4%, a mean difference of 5.3 percentage points. This quite sizeable gap at the first stage emphasizes the short-term advantage of ECE in allowing easier entry into mainstream primary education.

As children advance to next grades, the retention benefit of ECE schools reduces somewhat but continues to be positive. From Kachi to Grade 2, ECE schools indicate a mean retention rate of 61.8% against 58.2% for non-ECE schools, a variance of 3.6 percentage points. Likewise, by Grade 3, retention is 36.2% for ECE schools and 33.6% for non-ECE schools, a variance of 2.6 percentage points. While the absolute magnitude of the ECE advantage wanes in subsequent grades, the persistently positive gaps reflect that ECE helps maintain participation beyond the initial entry point.

In short, ECE's effect is largest at the earliest transition (Kachi to Grade 1), and this implies that ECE mainly adds to school readiness and supports initial enrollment stability. Secondly, whereas retention rates fall in grades in both ECE and non-ECE schools are a general trend in early primary schooling, the fall is slightly less in ECE schools indicating a cumulative but gradually weakening effect of ECE exposure.

By and large, the descriptive findings suggest that the availability of ECE is linked to moderate but substantial gains in retention rates.

4.2 Regression Analysis

Inverse Probability Weighting (IPW) with Fixed Effect (FE)

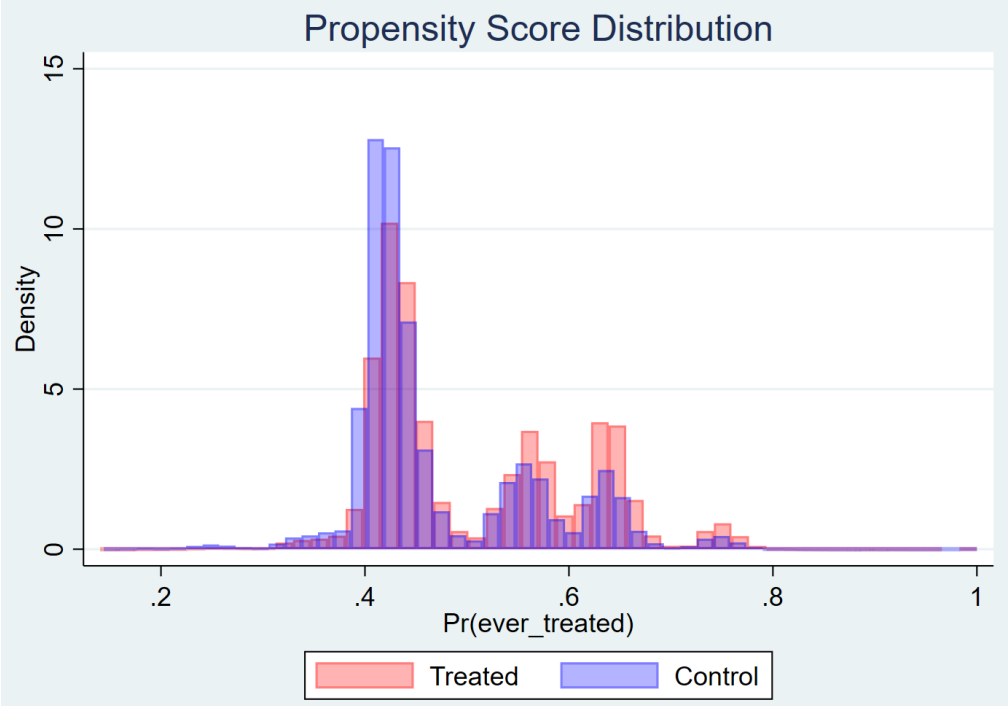

Figure 10: Propensity Score Distribution

This plot shows the distributions of the propensity score for the treated (red) and control (blue) schools. The majority of scores cluster between 0.35 and 0.70, with significant overlap between groups in favor of the common support assumption in causal inference.

Most importantly, the control group is denser at lower propensity scores, while treated schools are in the middle-to-upper range. This imbalance indicates systematic differences in pre-treatment traits, which makes the matching or weighting approach necessary to enhance comparability between the two groups

4.2.1 Ever treated schools and impact of ECE interventions

Table 6: Ever treated schools & Impact of ECE interventions

	(1)	(2)	(3)
VARIABLES	Retention to G-1	Retention to G-2	Retention to G-3
Ever treated schools	0.0506***	0.0248***	0.01006***
	(0.00186)	(0.0023)	(0.0025)
Teacher-to-Student Ratio	-0.00045***	-0.0009***	-0.0019***
	(4.81e-05)	(9.96e-05)	(0.00024)
School Level- Middle	-0.0931***	-0.405***	-0.374***
	(0.00520)	(0.00936)	(0.00970)
School Level- High	0.0157***	-0.322***	-0.186***
	(0.00144)	(0.00285)	(0.00208)
School level - Higher Secondary	0.0155	-0.00943	0.00442
	(0.0137)	(0.0156)	(0.0145)
School Level- Others	-0.0117	-0.271***	-0.246***
	(0.0116)	(0.0115)	(0.0106)
School Location -Rural	0.521***	0.404***	0.257***
	(0.00257)	(0.00235)	(0.00212)
Water Availability	-0.0330***	-0.0857***	-0.0428***
	(0.0104)	(0.0104)	(0.0125)
Electricity Availability	-0.0846***	-0.123***	-0.0451***
	(0.00369)	(0.00383)	(0.00357)
Toilet Availability	-0.0383***	-0.0483***	-0.0539***
	(0.0122)	(0.0123)	(0.0119)
Boundary Wall	0.0298***	-0.0212***	0.0331***
	(0.00566)	(0.00731)	(0.00744)
Playground	-0.0304***	-0.0649***	-0.0870***
	(0.00179)	(0.00236)	(0.00220)
Internet	0.157***	0.299***	0.243***
	(0.00281)	(0.00415)	(0.00355)
Constant	0.371***	0.655***	0.402***
	(0.0162)	(0.0190)	(0.0235)
Observations	334,268	334,268	334,268
R-squared	0.407	0.279	0.182
Number of Schools	48,062	48,062	48,062

By applying Inverse Probability Weighting with Fixed Effect, we estimate the relationship between treatment exposure to ECE policy interventions and Katchi to Grade 1–3 student retention. The key policy indicator, ever_treated, is positive and very significant in all grades. The effect is largest at grade transition to Grade 1 (+5.06 percentage points), decreases at Grade 2 (+2.48 percentage points), and continues to be positive though smaller

at Grade 3 (+1.01 percentage points). This trend implies that the ECE policy has the greatest impact in the early years, effects that remain but decrease as they move to the next grades. These results are consistent with the hypothesis that early advantages are strong at entry points and inevitably close as other influences come across.

The decrease in grades 1 to 3 represents the point at which treatment effects fade as children grow older, the implication being that the effects of ECE will continue to be maintained by ongoing investment in the grades in accordance with the Human Capital Theory.

The teacher–student ratio (TS_ratio) has a negative and statistically significant correlation with retention throughout all three grades, and the size becomes increasingly negative by Grade 3. More crowded classrooms in practical terms are associated with lower continuity, particularly as the children get older. This aligns well with previous evidence that younger children thrive on more individual teacher attention and crowding dissipates interest and continuity. Rural schools show significantly greater retention at each transition point (+52.1 percentage points at Grade 1). This would be expected to capture more intense community attachments, lower mobility, and fewer alternative schooling options in rural areas.

Water, electricity, and toilet indicators are correlated with retention across these models. These facilities exist more frequently in urban schools where mobility and school changing may be higher, lowering measured retention. Conversely, a boundary wall is weakly positive in Grades 1 and 3 (and slightly negative in Grade 2), suggesting that security and containment are more important at entry and stabilization points. Lastly, access to the internet has a strong positive correlation, particularly at Grade 2 (+29.9 percentage points) which could be picking up on wider school capacity, administrative strength, and the pedagogical and parental engagement advantages of being connected.

Model fit confirms these trends. Explained variation is greatest for Grade 1 ($R^2 = 0.407$) and decreases by Grade 3 ($R^2 = 0.182$). This shows that school-level attributes (policy exposure, resources, level, and location) are more predictive of early moves and less predictive as children grow up.

The school-level indicators also reveal important patterns. Middle schools consistently show a negative and statistically significant effect across all grades, suggesting that institutions oriented toward older students provide weaker support to early-grade continuity. High schools have a small positive effect at Grade 1, with negative associations at Grades 2 and 3, indicating difficulty sustaining progression beyond initial entry. The Higher Secondary Schools show no meaningful relationship with retention, reflecting their limited focus on early-primary instruction. Playground availability is also negatively associated with retention across all transitions, probably because such facilities are more common in larger or urban schools where student mobility is higher, and because playgrounds alone do not enhance continuity without strong pedagogical support.

By and large, three messages are drawn out. First, exposure to ECE does indeed work, with the most powerful gains at the earliest transition and significant persistence thereafter. Second, class size control (lower TS_ratio) lies at the heart of maintaining those gains through subsequent grades. Third, context is important as rural environments and more connected schools (internet) are associated with higher continuity.

4.2.2 Types of intervention

Table 7: Types of intervention

	(1)	(2)	(3)
VARIABLES	Model 1	Model 2	Model 3
ECE Classroom	0.0637***	0.0436***	0.173***
	(0.00253)	(0.00293)	(0.00404)
ECE teacher in school	0.0183***	0.0126***	0.0551***
	(0.00245)	(0.00261)	(0.00375)
Caregiver in school	0.00637***	0.0152***	0.00892**
	(0.00245)	(0.00327)	(0.00385)
ECE equipment in school	-0.0251***	0.0849***	-0.0249***
	(0.00144)	(0.00264)	(0.00219)
Teacher to student ratio	0.00109***	0.00160***	-0.00358***
	(0.000157)	(0.000230)	(0.000430)
School level - Middle	0.0749***	0.0415***	0.282***
	(0.0105)	(0.0113)	(0.0164)
School level- High	0.171***	0.0991***	0.627***
	(0.0115)	(0.0123)	(0.0177)
School level- Higher Secondary	0.200***	0.136***	0.833***
	(0.0218)	(0.0319)	(0.0646)

School level- Others	-0.104***	-0.103***	-0.272***
	(0.0119)	(0.0130)	(0.0127)
School location- Rural	0.0159*	0.0258***	0.0280**
	(0.00837)	(0.00825)	(0.0142)
Water Availability	0.0318**	0.00870	0.0879***
	(0.0131)	(0.0138)	(0.0190)
Electricity Availability	0.0415***	0.0223***	0.133***
	(0.00824)	(0.00839)	(0.0111)
Toilet Availability	-0.00767	0.00901	-0.00541
	(0.0200)	(0.0213)	(0.0225)
Boundary Wall	0.0385***	0.0246***	0.137***
	(0.00687)	(0.00740)	(0.0101)
Playground	-0.0169***	-0.0152***	-0.117***
	(0.00204)	(0.00219)	(0.00347)
Internet	0.0325***	0.0293***	0.0850***
	(0.00270)	(0.00278)	(0.00475)
Constant	0.521***	0.506***	-0.0194
	(0.0250)	(0.0287)	(0.0338)
Observations	240,309	240,309	240,309
R-squared	0.022	0.022	0.074
Number of Schools	48,062	48,062	48,062

This regression is conducted using three alternative model specifications to examine the effects of treatment interventions and school-level characteristics on the outcome of interest. The explanatory power, as indicated by the R-squared statistics, was modest in the first two models (0.022) but increased notably in Model 3 (0.074). This gain indicates that the new controls or model improvements in Model 3 account for a larger share of the variance of the dependent variable.

In all specifications, the classroom-related treatment (treat_CR) shows a positive and statistically significant relationship with the outcome variable. The size of the coefficient is larger in Model 3 (0.173) than Model 1 (0.0637) and Model 2 (0.0436), suggesting that the estimated effect becomes clearer after adjusting for additional covariates. Likewise, the teacher-targeted treatment (treat_Teacher) shows modest but positive and statistically significant effects in the early two models, with the coefficient increasing more than two-fold in Model 3 (0.0551). On the other hand, the caregiver-related treatment (treat_Care_giv) provides small effect sizes for all models, with a peak in Model 2 (0.0152). The Equipment treatment (treat_EQUIP) is a case of coefficient instability. It is negative and statistically significant in Model 1 (-0.0251) and Model 3 (-0.0249) but becomes positive and strongly significant in Model 2 (0.0849).

For control variables at the school level, the findings indicate that school level is a reliable predictor of the outcome. With primary schools serving as the reference group, higher levels of schooling have positive and statistically significant coefficients across all models, with increasing magnitudes in Model 3. Interestingly, "Higher Secondary" schools have the strongest positive relationship in the full specification (0.833). Rural areas are linked to a modest but statistically significant positive effect, which is greater than in Model3.

Infrastructure variables, such as the provision of drinking water, electricity, boundary walls, and internet, are positive and statistically significant predictors in all cases, with their influence becoming stronger in Model 3. The teacher–student ratio is positive in Models 1 and 2 but negative in Model 3, which implies that the direction of the relationship between staffing intensity and the outcome is dependent on other factors absorbed by the full specification.

School-level categories also exhibit clear patterns: Middle and High schools have positive and significant associations with the outcome across models, while Higher Secondary schools exhibit the strongest positive effect in the full specification, reflecting their greater institutional capacity. In contrast, “Other” schools consistently exhibit negative effects, indicating weaker structures for supporting early enrollment. Availability of playgrounds remains negative and significant in all models, probably reflecting higher student mobility in larger schools where such facilities are common.

Overall, the results highlight the significance of model specification for treatment effect estimation. Model 3's more complete set of controls not only enhances explanatory power but also significantly changes the magnitude and, in a few instances, the sign of major coefficients.

4.2.3 ECE Quality and the impact on retention rates

Table 8: ECE Quality and the impact on retention rates

	(1)	(2)	(3)
VARIABLES	Retention to G-1	Retention to G-2	Retention to G-3
Category of school in quality- Medium	0.0907***	0.188***	0.273***
	(0.00279)	(0.00309)	(0.0031)
Category of school in quality High	0.1435***	0.2183***	0.342***

	(0.00190)	(0.00203)	(0.00314)
Teacher to student ratio	0.00180***	0.00238***	-0.00512***
	(9.84e-05)	(0.000141)	(0.000262)
School level - Middle	0.0755***	0.0363***	0.291***
	(0.0106)	(0.0112)	(0.0165)
School level- High	0.170***	0.0750***	0.649***
	(0.0115)	(0.0121)	(0.0176)
School level- Higher Secondary	0.199***	0.110***	0.863***
	(0.0217)	(0.0313)	(0.0651)
School level- Others	-0.105***	-0.106***	-0.270***
	(0.0119)	(0.0129)	(0.0131)
School location- Rural	0.0158*	0.0259***	0.0243*
	(0.00834)	(0.00810)	(0.0144)
Water Availability	0.0349***	0.00978	0.0942***
	(0.0132)	(0.0136)	(0.0194)
Electricity Availability	0.0407***	0.0183**	0.130***
	(0.00817)	(0.00836)	(0.0110)
Toilet Availability	-0.00295	0.0121	0.00778
	(0.0197)	(0.0207)	(0.0218)
Boundary Wall	0.0388***	0.0234***	0.139***
	(0.00686)	(0.00731)	(0.0101)
Playground	-0.0172***	-0.0141***	-0.115***
	(0.00204)	(0.00218)	(0.00349)
Internet	0.0332***	0.0284***	0.0894***
	(0.00270)	(0.00275)	(0.00478)
Constant	0.504***	0.501***	0.00635
	(0.0247)	(0.0277)	(0.0325)
Observations	240,283	240,283	240,283
R-squared	0.023	0.021	0.078
Number of emis_code	48,062	48,062	48,062

The above table shows the estimated coefficients of three distinct regressions analyzing the link between ECE quality groups, school features, and availability of infrastructure and student retention to Grade 1, Grade 2, and Grade 3. Each of the models is estimated over the same dataset. Explanatory capability of the models is low for retention to Grade 1 (R^2 = 0.023) and Grade 2 (R^2 = 0.021) but jumps up significantly for retention to Grade 3 (R^2 = 0.078), showing that the model explains more variance in longer term retention.

The findings reveal a high and positive association between ECE quality and student retention across all grade levels. Compared to the reference category (low quality ECE), Medium-quality ECE has higher retention to Grade 1 (0.0907), Grade 2 (0.188), and Grade 3 (0.273), all of whose coefficients are significant at the 1% level. Even larger effect sizes

are associated with High-quality ECE, with respective coefficients of 0.1435, 0.2183, and 0.342. These results indicate that enhancements to the quality of ECE have a compounding positive effect on retention as children move through the early grades.

The teacher–student ratio (TS_ratio) is positively correlated with retention to Grade 1 and Grade 2, though the size of the effect is small. For retention to Grade 3, the coefficient becomes negative (-0.00512), which means that, while holding other variables constant, higher teacher–student ratios might be less successful in delivering longer-term retention results.

School level also proves to be a significant predictor. As the reference category, primary schools are considered; middle, high, and higher secondary schools all have positive and significant correlations with retention at all grades, while their effect sizes increase considerably for retention in Grade 3 (0.863 for higher secondary schools).

Among the location and infrastructure controls, rural schools are characterized by a weak but positive relationship to retention, which is statistically significant for Grade 1 and Grade 2, and marginally significant for Grade 3. Having basic infrastructure such as access to drinking water, electricity, boundary walls, and the internet is typically positively related to retention, and the impacts are strongest for retention to Grade 3 (0.0942 for access to water, 0.130 for electricity, and 0.139 for boundary walls). Availability of toilets is not significantly correlated with retention in any specification.

By and large, the results suggest that ECE quality is a particularly robust predictor of student persistence, with effects growing larger as students' progress through early grades. Physical infrastructure also matters highly, particularly for longer-term persistence, but the negative correlation with playground availability should be further explored. The inversion of the teacher–student ratio effect for Grade 3 persistence underscores the necessity of investigating potential differences in its short-term versus long-term impact on student persistence.

4.2.4 Qualitative Input on ECE Policy

According to a key official who works with the School Education Department (SED) in Punjab, the ECE policy 2017 was a great milestone paving the path ahead towards

streamlining ECE and ensuring quality in schools. The Punjab Human Capital Investment Project (PHCIP) was started in 2021 with an aim to enhance human capital and for this Bunyad is one of the three key components.

Under the PHCIP, the School Education Department, Punjab has operationalized more than 10,000 Early Childhood Care and Education (ECCE) classrooms in 13 target districts under the Bunyad component. Bunyad aims to increase access to quality ECCE for 3–5-year-old children with a focus on reaching socioeconomically disadvantaged households. The project aims to ensure that children establish strong foundational learning outcomes that contribute to long-term success. The project also works with parents and communities to promote awareness of the benefits of quality ECCE, safeguarding of children, gender equity in education, as well as clean and green practices, sanitation, and hygiene.

Another officer, who focused more on the Bunyad components of PHCIP and shared the following.

"The SED is carrying out a set of innovative interventions through the Bunyad programme of the PHCIP. Under this, over 10,000 Early Childhood Care and Education (ECCE) classrooms have been set up in 13 focus districts of Punjab through small repairs and thematic wall paintings, developing child-friendly learning environments. To further improve classroom quality, ECCE kits and age-specific furniture have been distributed to 9,397 schools. Capacity building has been a primary area of focus for the programme, and 20,329 members of the ECCE workforce, including head teachers, Assistant Education Officers (AEOs), ECCE teachers, and caregivers, have been trained in ECCE pedagogy and classroom management. Furthermore, 9,397 schools have been provided with reading corners for Grades 1, 2, and 3 in order to foster a reading culture and facilitate a seamless transition from ECCE to primary grades. Under this scheme, over 2.4 million books have been released to schools. Together, these interventions are having a notable effect, with about 1.16 million ECCE through Grade 3 children deriving the benefits of enhanced learning experiences and enhanced classroom environments in Punjab.

We further asked if the quality has been maintained considering the key features of the ECE policy, both the respondents were of the view that there are glitches like during pandemic 2019, it was not easier to maintain quality inside ECCE classrooms. Similarly,

in the rural areas, often issues are encountered, however, PHCIP focuses on purely rural areas, and it may help to tackle the issue in those 13 rural districts. A consultant who works in coordination with the government was of the view that the sustainability of these projects is often challenging and it's not sure till when the donors' money will be used for this. He further added that it should be of one's interest to see if the Non-Salary Budget is being used for such ECE activities to understand if schools are open for sustainability factor to rely less on donors' money and be in a position to work within their capacity and limitations.

In short, the key respondents working in the education sector in Punjab consider ECCE initiatives and the ECE policy great sources of bringing change in the education sector by strengthening the foundation of students. Yet, the sustainability point is equally important, which may need further research.

Chapter 5

5. Conclusion and Recommendations

5.1 Conclusion

This study evaluated the effectiveness of the Punjab ECE Policy of 2017 in improving early grade enrollment and retention within public schools. Using a rich longitudinal dataset and an empirical strategy that is doubly robust, the analysis provides credible evidence of how early childhood interventions have influenced early primary outcomes within Punjab's public education system.

Findings show that the policy has meaningfully contributed to strengthening early grade performance; the effectiveness of ECE provision, however, is neither uniform nor guaranteed. Instead of the presence of ECE interventions alone, it is the quality of their implementation trained teachers, functional classrooms, and adequate learning environments that determines the magnitude and sustainability of gains. This underlines the continuing need for investments in pedagogical quality, teacher preparation, and classroom readiness, as envisaged in the policy framework.

The findings also pinpoint the enabling role of supportive school infrastructure. While infrastructure is not a formal part of the ECE policy, facilities such as drinking water, electricity, and boundary walls play an enabling role in enhancing the impact of ECE services. Building on these foundational inputs can raise policy outcomes and contribute to more equitable learning trajectories across districts.

From a methodological perspective, this study contributes to the growing literature on education policy evaluation in low- and middle-income contexts by demonstrating the usefulness of a doubly robust IPW–FE approach in a scenario when randomization and clean identification strategies are not feasible. This approach offers policymakers a more reliable evidence base on how to assess large-scale policy reforms implemented across heterogeneous school landscapes.

While the current study provides key insights, it has limitations, such as a lack of data on household socioeconomic status and little insight into the nature of pedagogical practice within the ECE classroom. Linking administrative data to household surveys or observing

classrooms in future research would be useful in testing interactions among children's home environments and instructional quality with policy interventions. In all, the Punjab ECE Policy of 2017 has created positive momentum for improving early-grade access and persistence; sustaining and scaling up these gains, however, will require systemic attention to implementation quality, school readiness conditions, and continuous monitoring. Strengthening these elements is essential for making early childhood education live up to its promise as a foundation for long-term human capital development in Punjab.

5.2 Limitations

Our study relies on school-level data from the Annual School Census, although it is complete, but does not contain child- or household-level data. Therefore, it was not feasible to follow individual students through grades or include household variables such as parental education, socio-economic status, or decision-making strongly affecting enrollment and retention. Use of school-reported data also leaves room for measurement inconsistencies. While doubly robust estimation techniques were used to handle these difficulties, the lack of disaggregated data constrains the accuracy of causal inferences. Also, COVID-19 happened during this timeframe which might have created noise, but the use of Fixed Effects in the analysis seems to have addressed this. This needs to be taken into consideration in future studies.

Future analyses should thus aim to combine school-level administrative records with child- and household-survey data to allow direct monitoring of student trajectories and to capture the socio-economic and cultural context that shapes retention. Further, using mixed-method strategies such as qualitative findings from teachers, parents, and communities would enable an enhanced understanding of how interventions in ECE and quality requirements translate into long-term early grade attendance. This type of study would provide stronger evidence to support provincial policy and national commitments under SDG 4.

5.3 Recommendations

Given the findings of the study on the Punjab ECE Policy 2017, although the policy has had a positive impact on Grade 1 and early grade retention, how successful it has been also largely depending on the quality of implementation as well as the larger school climate. The following recommendations are henceforth advanced to close gaps and solidify gains.

Firstly, in order to ensure that the fade-out effects of the ECE do not happen from Grades 1 to 3, the government should try to support the investment in ECE with continuous investment in the early primary grades, particularly in terms of quality of instruction, reduced class sizes, and learning support to sustain the gains of early human capital formation.

The fact that high-quality ECE schools demonstrate 25 to 30 percent higher retention rates means that the key priority of the province should be to increase the number of ECE dedicated classrooms, both in rural schools and low-quality schools.

The important and highly significant role played by the caregivers indicates that ECE needs to be considered a two-adult model. Caregivers need to be institutionalized as part of the normal staff of ECE. Currently, they are ad-hoc and contingent employees.

The negative correlation between teacher-student ratio and retention by Grade 3 highlights the requirement of having small class sizes in Grades 1 to 3 in order to retain the gains of human capital achieved during this phase of education.

Furthermore, upgrading school facilities such as safe classrooms, drinking water, electricity, and boundary walls should be prioritized, given their direct impact on retention in later grades. Integrating infrastructure planning with ECE expansion will help minimize uneven impacts across schools. Continuous monitoring should be enhanced through PMIU data systems, utilizing tools like AIMECD, MELQO, and Teach ECE to track both quality and outcomes.

Last, but not least, special attention should be given to underperforming rural and resource-poor schools to reduce disparities in access and quality. Also, improvements are needed in data management, as ECE indicators in the Annual School Census lack uniformity. Ensuring coherence across data series and conducting rigorous data quality checks will be

important for reliable monitoring and analysis in future cycles. Improving school-level tracking capabilities to identify dropout vs. transfer in a future data system infrastructure would be a high priority.

6. References

Abdullah, A., & Alam, A. H. (2024). Ensuring an equal start for all Pakistani children: What will it cost? *World Bank Policy Research Working Paper.*

Ansari, A., & Amna, T. F. (2024). Ten years of early childhood education (ECE) in Punjab (Pakistan): What have we learned? *Journal of Research in Childhood Education*, S161–S179.

Barnett, W. S. (2022). Early childhood education: Health, equity, and economics. *Annual Review of Public Health*, 75–92.

Barnett, W. S., & Hahn, R. A. (2023). Early childhood education: Health, equity, and economics. *Annual Review of Public Health*, 44, 113–132.

Becker, G. S. (1975). *Human capital: A theoretical and empirical analysis with special reference to education* (2nd ed.). National Bureau of Economic Research. (Original work published 1964)

Berlinski, S., & Schady, N. (2015). *The early years: Child well-being and the role of public policy.* World Bank.

Delalibera, B. R., & Ferreira, P. C. (2019). Early childhood education and economic growth. *Journal of Economic Dynamics and Control, 98*, 82–104. https://doi.org/10.1016/j.jedc.2018.10.002

Executive Office of the President of the United States. (2014). *The economics of early childhood investments.* Washington, DC.

Geven, K., & Hasan, A. (2020). *Learning losses in Pakistan due to COVID-19 school closures: A technical note on simulation results.* World Bank.

Heckman, J. J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science, 312*(5782), 1900–1902.

Heckman, J. J. (2020). *Investing in early childcare and education produces significant economic returns.* The Economics of Human Capital, University of Chicago.

Hentschel, E., Tomlinson, H., Hasan, A., Yousafzai, A., Ansari, A., Chowdry, M. T., & Zamand, M. (2022). Risks to child development and school readiness among children under six in Pakistan: Findings from a nationally representative phone survey. World Bank Group.

Karoly, L. (2016). The economic returns to early childhood education. The Future of Children, 26(2), 37–56.

Lippman, S. A., & Benet, S. (2011). Inverse probability weighting in STI/HIV prevention research: Methods for evaluating social and community interventions. American Journal of Public Health, 101(3), 512–518.

Malik, A., & Rose, P. (2016). Financing education in Pakistan: Opportunities for action. Oxfam.

Patnaik, N. (2023). Teaching development: Critically evaluating ECE for economic growth in India. International Journal of Social Science and Economic Research. ★(Volume/pages not available)

PMIU–PESRP. (2018). Punjab Early Childhood Education Policy 2017. https://pctb.punjab.gov.pk/system/files/Punjab%20ECE%20Policy%202017.pdf

PMIU–PESRP. (2022). Annual school census report 2020–21. https://www.pesrp.edu.pk/publications

Pritchett, L. (2015). Creating education systems coherent for learning outcomes: Making the transition from schooling to learning. RISE Programme. https://riseprogramme.org/publications/creating-education-systems-coherent-learning-outcomes

Tomlinson, H. B., Hentschel, E., Chowdry, M. T., Ansari, A., Zamand, M., Yousafzai, A. K., & Hasan, A. (2023). Fostering early childhood development. In L. Ersado, A. Hasan, K. M. Geven, A. K. Kathuria, J. Baron, & M. Bend (Eds.), Pakistan: Human capital review – Building capabilities throughout life (pp. 65–98). World Bank Group.

UNESCO. (2019). South Asia regional review on early childhood care and education (ECCE). UNESCO.

UNESCO. (2024). Investing in early childhood care and education yields lifelong benefits. UNESCO.

UNICEF. (2019). A world ready to learn: Prioritizing quality early childhood education. UNICEF.

UNICEF. (2025). Evaluation of UNICEF work in early childhood development and early childhood education (2018–2023): Pakistan country report. UNICEF.

Wei, Y., Liu, K., & Yi, L. (2023). Assessing household financial burdens for preprimary education and associated socioeconomic inequalities: A case study in China. BMJ Paediatrics Open, 7(1), e001971. https://doi.org/10.1136/bmjpo-2022-001971

Wei, Y., Epland, M., & Liu, J. (2023, May 11). Inverse probability weighting difference-in-differences (IPWDiD). Observational Studies. Advance online publication.

World Bank. (2022). Investing in quality early childhood education is key to tackling learning poverty and building human capital. World Bank Press Release.