NBER WORKING PAPER SERIES

FROM ACCESS TO ACHIEVEMENT: THE PRIMARY SCHOOL-AGE IMPACTS OF AN AT-SCALE PRESCHOOL CONSTRUCTION PROGRAM IN HIGHLY DEPRIVED COMMUNITIES

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Working Paper 33543
http://www.nber.org/papers/w33543

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2025

We are grateful to Sophie Naudeau and Marie-Hélène Cloutier, without whose foundational work and vision this study would never have been possible and to Lúcia Nhampossa and Fadila Caillaud for their extremely valuable contributions to this project. We also thank Jem Heinzel-Nelson and Sandra Barros Martins for leading the qualitative data collection activities and analysis. This paper has benefited greatly from the helpful feedback of Orazio Attanasio, Hoyt Bleakley, Damien De Walque, Emanuela Galasso, Carolina Lopez, Costas Meghir, Norbert Schady, Manisha Shah, Dean Yang, and seminar participants at NEUDC2024, MWIEDC UChicago2024 and University of Michigan. This work was supported by the World Bank SIEF Trust Fund. DICIPE was financed by a World Bank and Global Partnership for Education grant through the Education Sector Support Fund (FASE). Ravindran is funded by a startup grant at the Lee Kuan Yew School of Public Policy, National University of Singapore. Juan Fernando Duque provided superb research assistance. The authors have no conflicts of interest to report. The findings, interpretations, and conclusions expressed in this report are entirely those of the authors. They do not necessarily represent the views of the World Bank and its affiliated organizations, its Executive Directors, or the governments they represent. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

From Access to Achievement: The Primary School-Age Impacts of an At-Scale Preschool Construction Program in Highly Deprived Communities
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NBER Working Paper No. 33543
March 2025
JEL No. I24, J13, L32

ABSTRACT

Using a randomized control trial, this paper studies an at-scale preschool construction program that serves poor communities in rural Mozambique. We show that the program significantly increased preschool enrollment in treated communities by 73 percentage points, from a small base of 2 percent of children enrolled in preschool in control communities. The program also had significant positive effects on enrollment in and progression through primary school, with an increase of 6 percentage points in enrollment in first grade at age 6, and a 0.16 standard deviation impact on an index of cognitive and social-emotional skills measured at primary school-age. The impacts are concentrated among children of less educated parents, in less poor households, and living closer to the preschools. We also find that enrollment in preschool is an important direct mechanism for primary school success. Finally, the program caused parents in treated communities to invest more time in supporting their primary school-aged children and increased preschool enrollment of younger siblings. Our paper shows that even in a context of extreme vulnerability, a preschool construction program can be implemented in a cost-effective way and significantly improve child development for the founding and future generations.

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1 Introduction

Globally, over 99 million children aged 0 to 4 years live in extreme poverty (Salmeron-Gomez et al., 2023), a condition that severely limits their ability to accumulate human capital from an early age and constrains their opportunities throughout life. This, in turn, can significantly hinder a country's long-term growth and development. Preschool education offers a promising solution, since access to formal education in early childhood may compensate for the disadvantages in children's development, and incentivize parents to support their children's human capital development through primary education and beyond. Once established, preschools can deliver long-term benefits to founding and future generations. However, the impact of preschools in contexts of extreme poverty remains unclear for two key reasons. First, parental human capital and household resources are often insufficient to complement the potential benefits of preschool education on children's outcomes. Second, implementing these programs at scale poses significant challenges, as many low-income countries may lack the capacity to manage and scale them effectively. In fact, only 20% of children in low-income countries were enrolled in preprimary education in 2019, underscoring the scale of the challenge and the need for targeted interventions.

In this paper, we fill this important gap by providing rigorous evidence on the short- and medium-term impacts of a large-scale formal preschool education program in Mozambique, a country with one of the highest levels of poverty in the world and only 3.5% of children between 3 and 5 years old enrolled in preschool (MINEDH, 2020).[1] Specifically, we use a cluster randomized control trial (RCT) to evaluate the large Mozambique Early Childhood Development Project (henceforth DICIPE, from its Portuguese acronym). The program targeted children aged 3 to 5 years living in rural communities and involved distinctive features that resulted in increased primary school-age cognitive skills, improved parental practices, and positive spillovers to younger siblings.

The DICIPE program design included two key components that may help explain its

[1] The small proportion of children who benefit from preschool enrollment does so mainly through private or community schools (MINEDH, 2020).

particularly high impacts compared to previous studies. First, a preschool center ("escolinha") was built in each treated community—in which there were no existing preschool services—and was staffed with locally trained instructors. These preschools were strategically constructed *walking distance* from the local primary school, with the aim of generating economies of scale between preschool attendance and primary school enrollment and progression. In addition, pedagogic activities involved the use of locally available, often recycled materials, such as bottle caps, rice sacks, sticks, and home-made educational materials. Moreover, the program hired local instructors who were selected by community leaders or the community itself. A minimum level of education was required and, to improve preschool quality (Andrew et al., 2024), teaching skills were complemented with upfront and ongoing training. The second main component involved regular parenting education sessions held with caregivers, which have proven effective in different contexts (Wang et al., 2023; Mehrin et al., 2022; Sylvia et al., 2021; Carneiro et al., 2024; Hamadani et al., 2019). Although the program was managed by the government, activities related to these key components were implemented by a third-party provider with strong community engagement and previous experience in preschool programs, which helped strengthen capacity within the Ministry of Education and Human Development (MINEDH) in the preschool subsector.

We evaluated the DICIPE program in 218 rural communities in the provinces of Cabo Delgado, Nampula, and Tete that met the eligibility criteria.[2] For example, eligible communities should not have had previous formal or informal preschool services. Because the number of eligible communities exceeded what the program could cover at this phase, we randomly assigned 110 of them to receive the DICIPE program and 108 to serve as the comparison group. This facilitates our rigorous impact evaluation of DICIPE.

We collected two rounds of data to measure the impacts of the DICIPE program. Baseline data collection took place between September and December 2016 and involved 4,687 caregivers and children, while endline data collection was carried out from December

[2]The program was implemented in five provinces, namely Maputo, Gaza, Cabo Delgado, Nampula, and Tete. Data collection and analysis in this paper focus on the three later provinces.

2019 to April 2020 with 3,765 caregivers and their children participating. Between June and July 2019 we gathered additional data from classroom observations and qualitative interviews with caregivers, facilitators, and school administrators from a subsample of communities. We define the youngest child in the household aged 36 to 59 months at baseline as the "target child" that the intervention targeted. Baseline characteristics depict acute deprivation among the target children and families of our sample. For example, the average target child is stunted and the vast majority of caregivers are illiterate (81%).

The impacts of the DICIPE preschool construction program on primary school-age outcomes are positive and large. First, preschool education increased massively after construction. Compared to a small base of 2% of children in control communities enrolled in preschool, the intervention increased preschool enrollment rates in treated communities by 73.4 percentage points. The program also had significant positive effects on enrollment in and progression through primary school: children in treated communities were 6 percentage points more likely to be enrolled in primary school (an effect of about 10%) and 3 percentage points less likely to repeat a grade (an effect of about 20%) compared to children in control communities. Overall, we document intent-to-treat (ITT) impacts of 0.16 of a standard deviation (SD) on a primary school enrollment index. Second, we assess children's cognitive and social-emotional skills and document ITT impacts of 0.16 SD on a skills index. The magnitudes of these estimates are comparable to those in other early childhood interventions in the literature (see, for example, Bos et al. 2024; Berlinski et al. 2009), but our context is of higher vulnerability. Moreover, using our estimates and data on intervention costs, we estimate benefit-to-cost ratios ranging from 6.4 to 33.8, which suggests that the direct benefits of the program significantly outweigh its costs.

Interestingly, the program impacted other secondary outcomes. First, it resulted in improved parental practices. We leverage data that we collected on parental stimulation and play activities and find that parents in treated communities provide a more stimulating environment for their children (a 0.17 SD effect), engage more in play at home with their children (0.08 SD), and are more involved with the child's primary school. For example, parents and other household members in the treated communities were 32% more likely to meet with the child's primary school principal in the past year relative to those in control

communities. Complementing this finding, we observe a slight but significant decrease in the labor supply of mothers, which suggests that parents faced minimal trade-offs when increasing support to their children. The majority of caregivers interviewed in the qualitative study report that they perceived improved children's learning, which could serve as a potential mechanism to the increased quality of parental practices.

Second, the program had interesting spillovers to younger siblings of the target child.[3] Using data on school enrollment from other children in the household, we document large, positive, and statistically significant impacts on preschool attendance for younger siblings, of about 85% of the estimated treatment impact for target children. This result speaks to the cost-effectiveness of the DICIPE program, as newly built preschools will be there to benefit future generations.

To understand the likely drivers of these big treatment effects we conduct an analysis of mechanisms in two ways. First, we explore heterogeneous treatment impacts based on relevant previously documented dimensions (for example, Dinarte-Diaz et al. (2023)). Interestingly, the DICIPE causes significantly higher improvements on child development for children of less educated parents but relatively wealthier households in this context of extreme poverty. Children residing closer to the preschools also see the highest impacts. Second, we build on Attanasio et al. (2020a) and Attanasio et al. (2022) to perform a mediation analysis to understand if DICIPE had a direct effect or one mediated by any of its two main components—preschool construction or parental education sessions. We find that enrollment in preschool is an important mediator for primary school performance.

To the best of our knowledge, our paper is the first rigorous evaluation of a large-scale preschool construction program, on child development outcomes beyond preschool, and in a context of extreme poverty. We detect large positive impacts, show the intervention was implemented in a cost-effective way, and provide evidence on which components made its success possible. Our study may serve as the basis for potential future replications of similar interventions.

[3] We argue that these results are spillovers because these younger siblings were not the target group when the program was being implemented, i.e., these kids were younger than 3 years of age at that time.

2 Contributions to the Literature

Our paper contributes to several strands of the growing literature on early childhood investments and their impacts on children's outcomes. First, we add to the body of evidence showing that interventions targeting children from birth to six years of age have great potential in improving their lifetime human capital and income (Holla et al., 2021; Black et al., 2017; Almond and Currie, 2011; Bos et al., 2024; Attanasio et al., 2022; Bailey et al., 2021; Sylvia et al., 2021; Attanasio et al., 2014). Specifically, we focus on preschool interventions for children aged 4 to 6 years. Holla et al. (2021) aggregates evidence from 57 studies and shows that preschool programs improve cognitive and socioemotional skills by an average of 0.15 SD and 0.12 SD, respectively, regardless of the country's income level. We extend these findings by examining the impact of a preschool program implemented in a context of extreme deprivation and limited public implementation capacity.

More specifically, we contribute to the recent mixed evidence on the impacts of preschool construction programs in low- and middle-income countries. Table A1 organizes the related literature into two panels: studies evaluating preschool construction interventions (Panel A) and those studying interventions using existing preschool infrastructure (Panel B).[4] While the previous preschool construction interventions target poverty in some form (e.g., targeting poorer villages), it is important to note that the Mozambique context in our study involves a much higher level of vulnerability. First, Mozambique is one of the lowest income countries among the countries in these studies. Moreover, caregivers' education level in our sample are close to the lower bound relative to these studies: while on average caregivers' education in these studies range from 1.8 to 9.8 years, in our sample it is 2.2 years. Notably, baseline preschool attendance ranges between 2% and 70% in these studies, while in our context it is nearly zero. Despite being implemented in a context of inexistent preschool eduction at baseline, the program we study has a stronger take-up of preschool education than other interventions. The DICIPE causes an increment of

[4]Relative to the studies surveyed by Holla et al. (2021), we only consider studies in medium and low income countries and add studies beyond 2023.

73.4 percentage points (pp) in preschool enrollment, while other preschool construction programs in the literature achieve take-up rates between 7.6pp and 25pp. These stark differences in baseline characteristics and preschool attendance are key factors contributing to the powerful impacts we document in our study.

In spite of our more vulnerable setting, we detect increased *primary school* enrollment and improved children skills at primary school age. While studies in higher income countries such as Berlinski et al. (2008, 2009) in Uruguay and Argentina, and Donald et al. (2023) in the Congo report positive impacts, others find small or null effects (e.g., Blimpo et al. (2022) in The Gambia and Castro and da Cruz (2024) in Brazil). Notably, Bouguen et al. (2018) suggests caution, as a study in Cambodia found negative cognitive impacts for those with the highest program exposure, likely due to substitution from primary school to preschool. The evidence is also mixed in studies using existing preschool infrastructure (Panel B of Table A1). In our study, we show that the high increase in preschool enrollment caused by the program—a distinctive feature of our intervention—is an important mediator for our large and significant impacts on primary school-age performance.

Of the studies listed in Panel A of Table A1, our paper is mostly related to Martinez et al. (2017), who evaluate a small-scale preschool construction program in Gaza, Mozambique. Our study differs in several key ways. First, the DICIPE program, inspired by the earlier intervention, has several distinctive characteristics that contribute to advancing knowledge on the scale-up and long-term effects of preschool construction programs. Specifically, DICIPE is larger in scale, covering five provinces (three in our evaluation), reaching 2.5 times more households, employing instructors with higher human capital (8.5 years of schooling, compared to 6.1 years in Martinez et al. 2017), and implemented through a formal partnership between the government and NGOs. Second, by expanding our sample, we study the impacts of a large-scale intervention on the outcomes of a more vulnerable population. Children in our sample have a lower average height-for-age z-score (-2.18 compared to -1.5), and caregivers are younger and have lower levels of human capital. Third, our evaluation captures longer-term outcomes, with follow-up data collected three years after the intervention, while Martinez et al. (2017) measured outcomes one year later, allowing us to assess the persistence of preschool effects through

children's primary education. Fourth, our study suggests that the DICIPE program was more successfully implemented: over 70% of treated households in our sample participated in preschool, compared to only 29% in Martinez et al. (2017).

We engage in the debate about why preschool programs have long-term effects despite medium-term fadeout (Elango et al., 2015; Yoshikawa et al., 2016). For instance, Gibbs et al. (2013); Bitler et al. (2014); Kline and Walters (2016) find that while the initial cognitive gains of the U.S. Head Start program fade by first grade, its long-term effects remain positive (Bailey et al., 2021). Unlike these studies, Holla et al. (2021) shows that preschool programs benefit children's cognitive and social-emotional outcomes into school age and adulthood. Some studies address this puzzle by highlighting skill formation as a dynamic, multi-skill process where skills complement each other (Heckman et al., 2010; Conti et al., 2016). We find evidence against medium-term fadeout, and, consistent with Holla et al. (2021), show that a preschool program with DICIPE's characteristics can have positive effects on medium-term outcomes, such as primary school performance and cognitive skills.

Finally, we provide an estimate of the cost-benefit of scaling a preschool intervention in a context of extreme deprivation. Previous evidence indicates that preschool programs in low- and middle-income countries can yield benefit-to-cost ratios ranging from 3.5 to 103.5 (Holla et al., 2021). Our benefit-cost ratio estimates, ranging from 6.4 to 33.8, suggest that preschool construction programs in settings of extreme deprivation can also be similarly cost-effective when compared with preschool interventions in less vulnerable settings.

3 The DICIPE Program: Components and Implementation

The Mozambique government launched the Early Childhood Development Program (DICIPE) as a national strategy aimed at expanding access to quality Early Childhood Development (ECD) services for children aged 3 to 5 years old. The program was implemented in rural communities in ten districts distributed in five provinces where no preschool services existed before. A relevant novelty of the DICIPE program is that its components and delivery mode offer the potential for scalability and sustainability, especially when government

implementation capacity is limited.

The DICIPE included two key components: (i) the construction of preschools ("escolinhas") staffed with local instructors or facilitators, and (ii) parenting education activities.

In the first component, the program built 350 low-cost preschools across the five provinces. Initially, the classrooms were designed as open structures with cement floors, straw walls, and aluminum roofs, along with outdoor latrines and safe water sources. The infrastructure was later adapted to more durable and longstanding construction methods while maintaining low costs. Educational activities utilized readily available and often recycled materials, such as bottle caps, rice bags, sticks, and other home-made educational materials. Furthermore, the program hired instructors who were members of the community. These instructors were selected by community leaders and residents, in coordination with the third party provider. A minimum level of 7th grade of education was required for the instructors and their teaching skills were supplemented with both upfront and in-service training. The planned training for the program included two weeks of initial training and at least one day of training per month. Instructor received stipends equivalent to approximately US$11 per month. The program required two instructors for each classroom, with up to 35 children per classroom and two classrooms per preschool.

The second component of the program consisted of parenting education activities. The program monitor and facilitators were expected to hold monthly meetings with parents to discuss critical areas for child growth and development, parenting practices, nutrition, and health care.

The DICIPE program was delivered through a partnership between the Ministry of Education and Human Development (MINEDH) and third-party providers. By the time of the program launch, the MINEDH's implementation capacity was constrained by a parallel rapid expansion in access to primary education and its almost no experience with ECD programs. Fortunately, there was substantial local capacity to implement ECD programs within international and local NGOs. In this sense, the delivery of the ECD package was operated by third-party providers, which were competitively selected and supervised by MINEDH. Furthermore, the communities played a vital role in the development and

maintenance of the preschools. A Community Coordinating Committee (CCC) with 10 community members, including the primary school principal, formally linked the ECD center to the community, serving both advocacy and coordinating roles.

Figure A1 presents the timeline of the intervention, along with the dates of our data collection activities—which we explain in more detail in Section 4. The preschools opened between May 2017 and May 2018 and operated for three hours a day and ten months every year, from their opening onward.

The preschool construction component was effectively implemented, as revealed by the summary statistics Table A2 (collected after various months of implementation through the *Endline* survey as illustrated in Figure A1). Specifically, each preschool had on average 4 instructors and 75-79 children enrolled in 2018 and 2019, respectively. An average of 47 children attended the preschools daily, implying a fairly small effective student-staff ratio (11.75 on average) considering the primary pupil-teacher ratio (above 60). Most preschools were built with a playground (94%) and provided educational games for children (76%). More than half of preschools also had notebooks or writing paper (56%), pens and pencils (55%), drawing books or cards (54%), leisure games (56%) and storybooks for children (57%). Instructors had, on average, 8.6 years of schooling, and for most of them, this was their only job.

On the other hand, the parental training component was not implemented as planned. In practice, parenting education sessions were held every three months on average, instead of monthly.

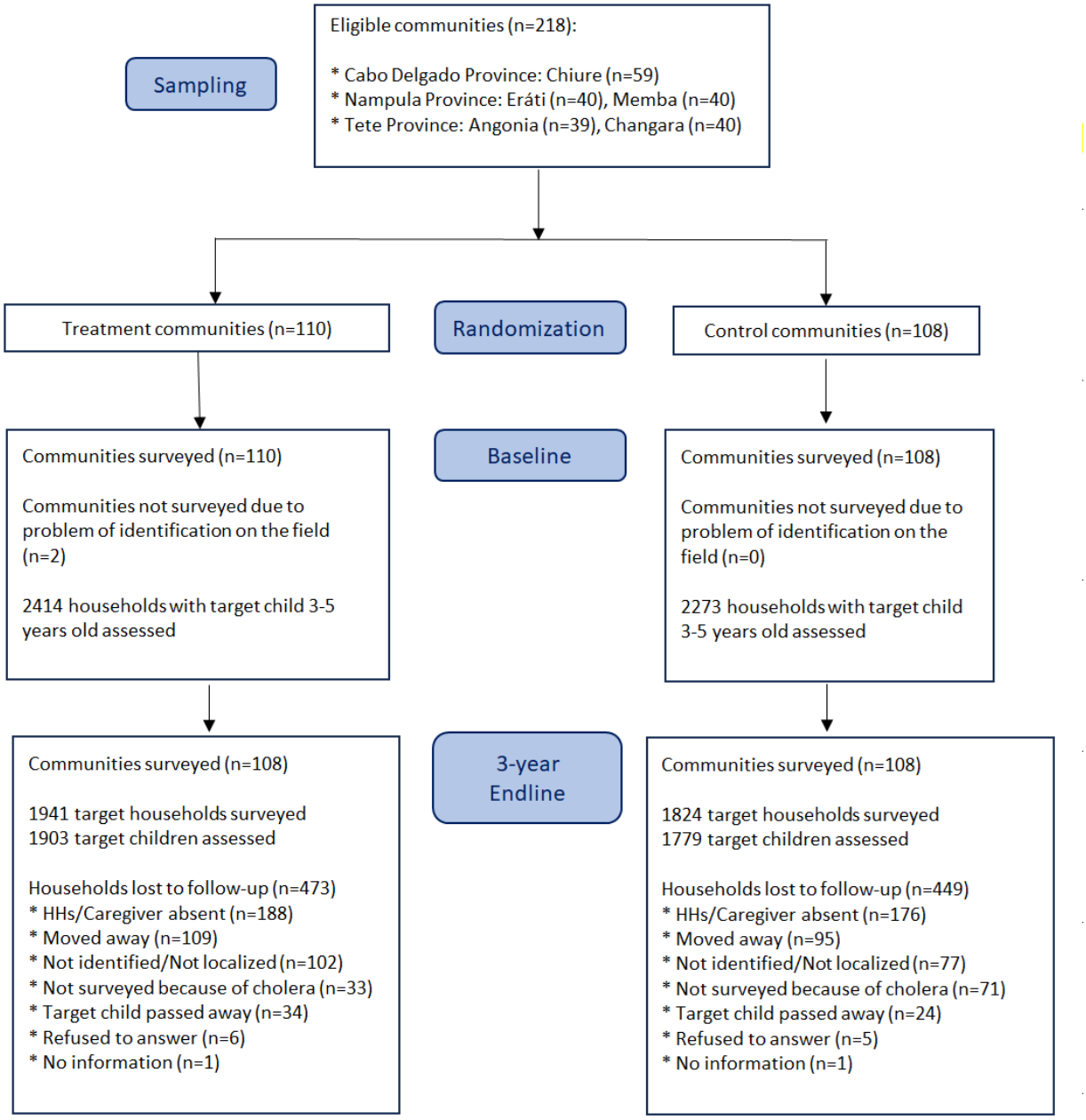
4 Research Design

To evaluate the DICIPE program, we design a randomized control trial, as described next.

4.1 Experimental Design and Data

The experimental design consisted of four main stages as illustrated in Figure 1.

Figure 1: Experimental Design and Data



Notes: The figure summarizes the experimental design and data for the study, including sampling, randomization, baseline and 3-year endline data collection. *n* refers to the number of observations.

The *Sampling* stage started with the selection of eligible communities. First, three provinces (out of five provinces participating in the overall DICIPE program) and the two districts within each province—Macomia and Chiúre (Cabo Delgado); Eráti and Memba (Nampula); Angonia and Changara (Tete)—were selected in collaboration with the MINEDH based on their vulnerability, relevance for the intervention, and the extent to which they

were representative based on geography and socio-cultural factors.[5] During the implementation of the program, however, the district Macomia in the Cabo Delgado province had to be dropped due to insurgent attacks in the area.[6] Thus, our final sample consisted of five districts in the three provinces. Appendix Figure A2, left panel, highlights the experimental provinces and districts in Mozambique (in dark brown and light blue, respectively). Second, we selected 218 communities in the five districts that met the following eligibility criteria: (i) located in a rural area; (ii) have a primary school; (iii) have more than thirty children between the ages of three and five; and (iv) benefit from no other preschool education intervention during the five years prior to baseline. For practical reasons relating to the construction of preschool facilities, eligible communities should also be accessible by a pickup truck for most of the year.

In the *Randomization* stage, we randomly assigned 218 eligible communities to receive the program (110 communities) or not (108 communities), stratifying at the district level. The right panels of Figure A2 display the location of treated (yellow circles) and control (blue triangles) communities across three provinces and five districts. The mean distance between treated and control communities within each district ranges from 27 to 47 km, with minimum distances varying from 2.5 to 4 km. While only children residing in the district of a particular *escolinha* were eligible to enroll, the risk of contamination in the control group is further minimized by the significant distances between control communities and preschools in this rural setting.

The last two stages, *Baseline* and *3-year Endline*, consisted of selecting households to be surveyed, determining the "target child" within each household, and collecting two rounds of data (before the intervention and three years later). As shown in Figure A1, the baseline data was collected between September and December 2016, while the endline data was measured approximately three years later, from December 2019 to April 2020. In both rounds, we adhered to best practices in survey protocols, and the study was

[5]The selection criteria included the following indicators: percentage of children aged 6 who were not enrolled in first grade; mortality of under-5 children; the number of children age five and younger; prevalence of malnutrition; and lack of access to safe water sources and sanitation.

[6]Of the 350 DICIPE preschools, 17 closed in 2018 due to these insurgent attacks.

approved by the National Bioethical Committee for Health in Mozambique (CNBS). All surveys were conducted in-person.

In each community, we randomly selected up to 24 households with at least one child aged 36 to 59 months during the baseline in late 2016. If a caregiver had multiple eligible children, the youngest child was chosen as the "target child" for the study. In communities with fewer than 24 eligible households, all households were included. Overall, we surveyed an average of 22 households per community at baseline whose children were eligible and consented to enroll in the study to collect their baseline data. This resulted in a sample of 4,687 households with at least one child aged 3 to 5 years. Of these, 2,414 households were in treatment communities and 2,273 in control communities. At endline, we revisited the same households and successfully collected data from 3,765 caregivers and their children (80.3% of the baseline sample).

4.2 Survey Instruments and Outcomes

Our survey instruments included modules to measure the program take-up (child's preschool enrollment), primary school-age outcomes (primary school enrollment, cognitive and social-emotional skills, and executive function) and outcomes on other household members (parental practices and engagement and school enrollment from siblings of the target child). Moreover for the communities in the treatment group, we collected endline information on child attendance, preschool infrastructure, and the educator's characteristics, such as their educational background. Table A3 summarizes the survey modules and the corresponding data collection stages. We next describe the variables used in our study.

Compliance

Preschool enrollment. We ask caregivers in the baseline and endline surveys if the target child formally enrolled in a *escolinha*. This outcome is measured as a dummy indicator that takes value 1 if the caregiver reported that the child was enrolled in a preschool center.

Participation in parenting education sessions. As part of a qualitative study conducted at endline and described in detail in Appendix B, we asked a random sample of caregivers in the treatment group if they ever attended a parenting education session.

Primary school-age Outcomes

Primary School Enrollment and Academic Achievement. We use our endline survey data to measure if, at the time of the survey, children were enrolled at primary school, whether they repeated a grade, and if they were at an appropriate grade for their age. "Primary school enrollment" is an indicator equal to 1 if the child is formally enrolled in school. "Repeated grade" is an indicator equal to 1 if the child had repeated a grade at least once during the past three years, i.e., since the project started. The variable "appropriate grade for age" is an indicator that takes the value 1 if the child is at a grade that corresponds to their age, while allowing children at the age limit to be in a lower grade.[7]

Child Cognitive and Social-Emotional Skills. At baseline, we measured pre-intervention child development in domains that are considered to play a key role in early development (Sabol and Pianta, 2012; Piek et al., 2008), can stimulate future learning abilities (Cunha and Heckman, 2007), and are potential predictors for cognitive outcomes later in life. Specifically, we used an adapted version of the Ages-and-Stages Questionnaire (ASQ) (Bricker et al., 1999) to collect child development measures relating to communication, gross and fine motor coordination, problem solving, and personal-social development. The ASQ was primarily administered by enumerators specially trained for this activity, with the exception of items relating to child behaviors, which are typically difficult to observe during a household visit. These items were reported by the primary caregiver of the target child. We report an aggregated ASQ score and scores for each of the domains. Scores are standardized using the means and standard deviations of the control group.

At endline, we measured child development using the direct assessment tool of the Measurement of Development Early Learning (MODEL) to asses the school readiness level of target children in our sample.[8] We collected information to measure domains

[7]Specifically, the variable takes value 1 if the child is up to 7 years old and is in at least preschool; 8 years old and at least in first grade; 9 years old and at least in second grade; or 10 years old and at least in third grade.

[8]The MODEL module was developed through the Measuring Early Learning Quality & Outcomes (MELQO) initiative (UNESCO et al., 2017) and has been used extensively around the world, including in Bangladesh, Kenya, Madagascar, Sudan, and Tanzania (Raikes et al., 2019). In contrast to the ASQ assessment used at baseline, the MODEL tool is not age-specific and all target children were administered the same items.

related to early literacy and math skills, executive function (working memory), social-emotional development, fine motor skills for writing, and interest in literacy. This assessment was performed at home in the presence of the primary caregiver. We estimate scores separately for each of these domains. Scores are standardized using the means and standard deviations of the control group.

Outcomes on other household members

Parental Practices. To measure the quality of parental practices, we used an adapted version of the UNICEF Multi-Indicator Cluster Surveys (MICS) and its Family Care Indicator (Hamadani et al., 2010; Kariger et al., 2012) to collect data on (i) the provision of stimulation for children and (ii) the home learning environment (home play activities). The two outcomes were collected at endline, and we also collected data on the stimulation provided by any member of the household at baseline. We estimate standardized indexes for each of these outcomes, using the means and standard deviations of the control group.

Parental Engagement with Primary School Staff. We also collected endline information on parental participation in school activities, such as meeting the principal of the primary school or the teacher of the target child, and being part of the school community. These outcomes are measured as dummy indicators that take the value 1 if the parent or other household members reported meeting the principal or teacher or being part of the school committee. Moreover, we also collected information on the intensive margin of parental involvement. Specifically, we also asked parents to report the number of meetings they or any other member of the family attended with the principal or teacher.

Sibling Enrollment. To study spillovers of the program on siblings, we use data on the preschool and primary school enrollment collected through the household roster. We include in the estimation sample all children aged 3 to 12 years that were the child, stepchild, or adopted child of the household head. The preschool and primary school enrollment outcomes of siblings are measured at endline as dummy indicators that take the value 1 if the main caregiver reported that each non-target child aged 3 to 12 living in their same household was enrolled in a preschool center or in primary school.

Other Measures

Quality of Program Key Components. Between June and July 2019, we conducted a qualitative study designed to assess the quality of the different components of the DICIPE program, including the quality of the physical environment and materials, qualification and training of facilitators, parenting education sessions and parental engagement, and classroom practices and interactions. We used an adapted Measure of Early Learning Environments (MELE) instrument. It was adapted by specialists to the Mozambique context and uses two approaches to measure the quality of early learning environments: a classroom observation tool and oral interviews to caregivers, facilitators, and school administrators (CCC member).[9] We collected data from a randomly selected sample of 40 communities across the provinces participating in the DICIPE program. We interviewed 320 caregivers, 139 facilitators and 40 members of the Community Coordination Committee (CCC). We also collected classroom observation data from the 40 *escolinhas* located in these communities. We describe this qualitative study in detail in Appendix B.

Distance to nearest preschool. We estimated the proximity to the nearest preschool using the geo-coordinates of households at baseline and preschools. First, we calculate the Euclidean distance in kilometers between each household and all preschools. Second, for each household, we select the shortest distance to a preschool. For treated households, the nearest preschool is the one constructed by DICIPE in their community, while for the vast majority of control households, the nearest preschool is outside of their district.[10] The average (standard deviation) distance to the nearest preschool is 1.2 (2.5) kilometers for treated households, which compares to 8.6 (5.7) kilometers for control households. This implies that control households are on average almost 7.5 kilometers farther from their nearest preschool than treated households, which points to the effective implementation of the program.

Other variables. In addition to recording the age and gender of the target child, we collected

[9]The MELE Classroom Observation Tool collects information about the activities and interactions that occur during a typical class session, including learning activities; classroom interactions and approaches to learning; classroom space and materials; and facilities and safety. Most items are based on an actual classroom observation and are scored on a 1-to-4-points scale, with higher scores reflecting higher levels of quality.

[10]Only 3.7% of the control group's caregivers declared in the endline survey that there is a preschool in their community.

anthropometric measures (height and weight) at baseline using internationally standardized procedures and measuring equipment (UNICEF, 2019). For the primary caregiver, we also gathered sociodemographic data including age, sex, education, employment status, and language spoken. Moreover, we collected information on household characteristics such as household size, number of children, receipt of remittances, child stimulation activities, and household assets. We estimate a household wealth index, using data on the presence of livestock (such as chickens, hens, goats), and durable goods or assets (such as tables, bicycles, motorcycles, watches, cell phones, solar panels, radios, among others).

4.3 Baseline Summary Statistics

Table 1 displays the mean and standard deviation (SD) at baseline for key characteristics of the target children, caregivers, and households in panels A, B and C, respectively. Columns (1) and (2) show these summary statistics for the control group, while columns (3) and (4) show them for the treatment group.

Panel A shows high levels of acute deprivation among the children in our sample. The average baseline age of the target children is 47 months. Figure A3 presents a histogram of the age distribution of the target children at baseline, depicting substantial variation in ages between 36 and 59 months. Anthropometric measurements indicate that the average target child is stunted, with a height-for-age more than two SD below the World Health Organization (WHO) child growth standards median. Additionally, almost none of the children had attended preschool at baseline.

Panel B additionally shows that caregivers of target children in our study are of extremely low human capital. The average primary caregiver is 32 years old, and only 15% speak Portuguese, the language of instruction in primary school. The majority of caregivers are women (84%) and illiterate (81%), with almost half (45%) having never attended school, which implies a mean level of completed schooling of just two years.

Finally, Panel C reveals that the average household in our sample consists of five members, three of whom are children and only 11% of them receive remittances.

Table 1: Baseline Summary Statistics

	(1)	(2)	(3)	(4)	(5)	(6)
	Control		Treatment		p-value	
Variable	Mean	SD	Mean	SD	(1)-(3)	N
Panel A. Target child's characteristics						
Female (%)	0.491	0.500	0.495	0.500	0.628	4,687
Age (months)	47.153	6.469	46.980	6.442	0.454	4,687
Height-for-age z-score	-2.183	1.128	-2.098	1.174	0.179	4,609
Attended preschool (%)	0.006	0.075	0.006	0.079	0.903	4,683
Total ASQ score	0.043	3.381	-0.041	3.349	0.605	4,682
ASQ Communication	-0.002	1.005	0.002	0.995	0.510	4,682
ASQ Gross Motor Coordination	-0.007	1.033	0.006	0.967	0.532	4,677
ASQ Fine Motor Coordination	0.002	1.005	-0.002	0.995	0.988	4,680
ASQ Problem Solving	0.033	1.007	-0.031	0.992	0.107	4,682
ASQ Socio-personal	0.013	0.991	-0.012	1.008	0.245	4,682
Panel B. Caregiver's characteristics						
Age (years)	31.969	8.924	31.874	9.223	0.991	4,666
Female (%)	0.840	0.366	0.833	0.373	0.569	4,686
Speaks Portuguese (%)	0.162	0.368	0.141	0.348	0.253	4,593
Is illiterate (%)	0.811	0.392	0.822	0.383	0.436	4,639
No schooling (%)	0.444	0.497	0.457	0.498	0.502	4,660
Years of schooling	2.239	2.592	2.220	2.611	0.736	4,642
Panel C. Household characteristics						
Household Size	5.135	1.537	5.083	1.578	0.540	4,687
Number of children aged 0-18	3.143	1.419	3.068	1.419	0.268	4,687
Number of children aged 3-5 in HH	1.081	0.277	1.063	0.247	0.022	4,687
Household receives remittances	0.113	0.317	0.098	0.297	0.264	4,678
Wealth index	0.000	1.000	-0.013	0.931	0.550	4,687
Stimulation Index (activities with children)	0.000	1.000	-0.064	0.998	0.497	4,687
	F Stat.		*P*-Value		N	
Joint F-test	1.287		0.190		4,256	

Notes: SD stands for *Standard Deviation* and *N* for the number of observations. *ASQ* refers to measures of skills from the standard Ages-and-Stages Questionnaire described in section 4.2

4.4 Treatment-control Balance and Attrition

Balance. Table 1 also tests for balance between the control and treatment groups at baseline, reporting p-values of differences between groups in column (5). Both groups are consistently well-balanced, which suggests that the randomization worked well in practice. One exception is the number of children in the household aged 3 to 5, for which we detect a statistically significant difference but of an economically negligible magnitude (on average, treated households have 0.018 fewer children aged 3 to 5). Importantly, we

test for joint orthogonality of baseline characteristics with treatment assignment using a linear probability model with all the variables listed in Table 1 as explanatory variables and the treatment status as the dependent variable. The p-value of the joint F-test is 0.19, which indicates that baseline characteristics jointly fail to predict the treatment status of the target children.

Attrition. We analyze the effect of attrition at endline on the relative composition of the treatment and control groups.[11] We consider two types of attrition: attrition from the child test, where a target child did not complete the assessment during the endline survey, and attrition from the household survey, where a household could not be located at endline. These two types of attrition are analyzed in columns (1) and (2) of Table A4, respectively. We find no evidence of differential attrition by treatment status. Therefore, the loss of children and households at endline does not affect the comparability of our samples, and we consider our experimental setting valid for causal analysis.

5 Main Results

To study the impacts of the DICIPE program, we estimate the following specification for child i residing in community c within district s:

$$Y_{ic} = \beta_0 + \beta_1 T_c + \gamma_{s_c} + \varepsilon_{ic} \tag{1}$$

where Y_{ic} refers to the outcome variable of interest for child (or household) i at endline; T_c is an indicator variable capturing the assignment of community c where child i was living to the treatment group; γ_{s_c} captures fixed effects for the district of community c (stratification variable); and ε_{ic} is an error term assumed uncorrelated with treatment given the randomization. The coefficient β_1 measures the difference in mean outcomes between children exposed to the treatment compared to the children in the control group and can

[11] Figure 1 shows the number of households lost between the baseline and the endline surveys by cause of attrition in both treatment and control groups.

be interpreted as the average intent-to-treat (ITT) effect of the preschool program.

Given the well-balanced treatment and control groups, we do not include control variables in our primary specification. As a robustness check, we conduct a Least Absolute Shrinkage and Selection Operator (LASSO) analysis to identify variables measured at baseline with strong relationships with Y_{ic}, to assess their suitability for inclusion as covariates in Equation (1).

In terms of our inference strategy, we estimate and report clustered standard errors at the community level to account for both the sampling design and the inherent correlation of outcomes within communities for unmeasured reasons.[12] As a robustness check, we follow a more agnostic approach to the structure of the standard errors (or a potential fuzzy clustering) and estimate randomization inference standard errors. Randomization inference gives us precise p-values based on the empirical distribution of all estimated treatment effects that could arise under our design and data (after randomly reassigning the treatment status 2,000 times) under the null hypothesis of no effect for any unit.

Finally, we address potential concerns related to multiple hypothesis testing in two ways. First, we report p-values adjusted using the free step-down resampling methodology of Westfall and Young (1993). This procedure controls the family-wise error rate and allows for dependence among p-values. 10,000 bootstrap replications were used. Second, we construct indices to aggregate families of outcomes using Kling et al. (2007). We orient child outcomes such that an increase in the index is always an improvement in the outcome of interest.

5.1 Program take-up: Preschool Enrollment

The DICIPE reduced the cost of access to preschool education through the construction of preschools and the provision of early childhood services in beneficiary communities. Thus, the first stage of our impact evaluation investigates whether DICIPE caused an increase in preschool enrollment.

[12] Additionally, we give each community equal weight in estimation.

Table 2: Preschool Enrollment & ITT Impacts on Primary School Enrollment

	Preschool	Primary School			
	(1) Enrolled at preschool	(2) Currently enrolled at school	(3) Repeated grade	(4) Appropriate grade for age	(5) Primary school enrollment index
Treatment	0.734***	0.060**	-0.030**	0.057**	0.159***
	(0.020)	(0.026)	(0.015)	(0.026)	(0.052)
	[0.000]	[0.045]	[0.055]	[0.054]	[0.008]
Observations	3764	3760	3742	3760	3680
Control mean	0.019	0.633	0.145	0.631	-0.000

Notes: All outcomes are measured at endline. All regressions include district fixed effects. The primary school enrollment index is constructed based on the factors shown in columns (2) to (4) following Kling et al. (2007). Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1% and ** 5%). Westfall and Young (1993) p-values are shown in square brackets.

Participation in the program was high in the treated communities. As shown in column (1) of Table 2, treated communities saw a 73.4 percentage point increase in the enrollment of the target children at preschool compared to the control group, which had a preschool enrollment rate of only 1.9% (35 target children, widely dispersed along 18 communities). This preschool enrollment rate in the control group is not due to proximity to preschools in treated communities, since, as discussed before, none of the ECD centers is located within a reasonable walking distance from the households in the control group. Instead, enrollment in the control group is mainly driven by short-term opportunities for informal childcare services.

Complementing this evidence, our qualitative survey to caregivers in treated communities reveals high levels of their children's school attendance and satisfaction with the services provided. In fact, 91% of the caregivers interviewed reported that their children attended the preschool center throughout the school year, and 89% reported that their children attended the escolinha 5 days a week. In addition, 95% of the caregivers interviewed reported that their child was happy to attend the escolinha.

5.2 Overall effects on primary-school success and skills

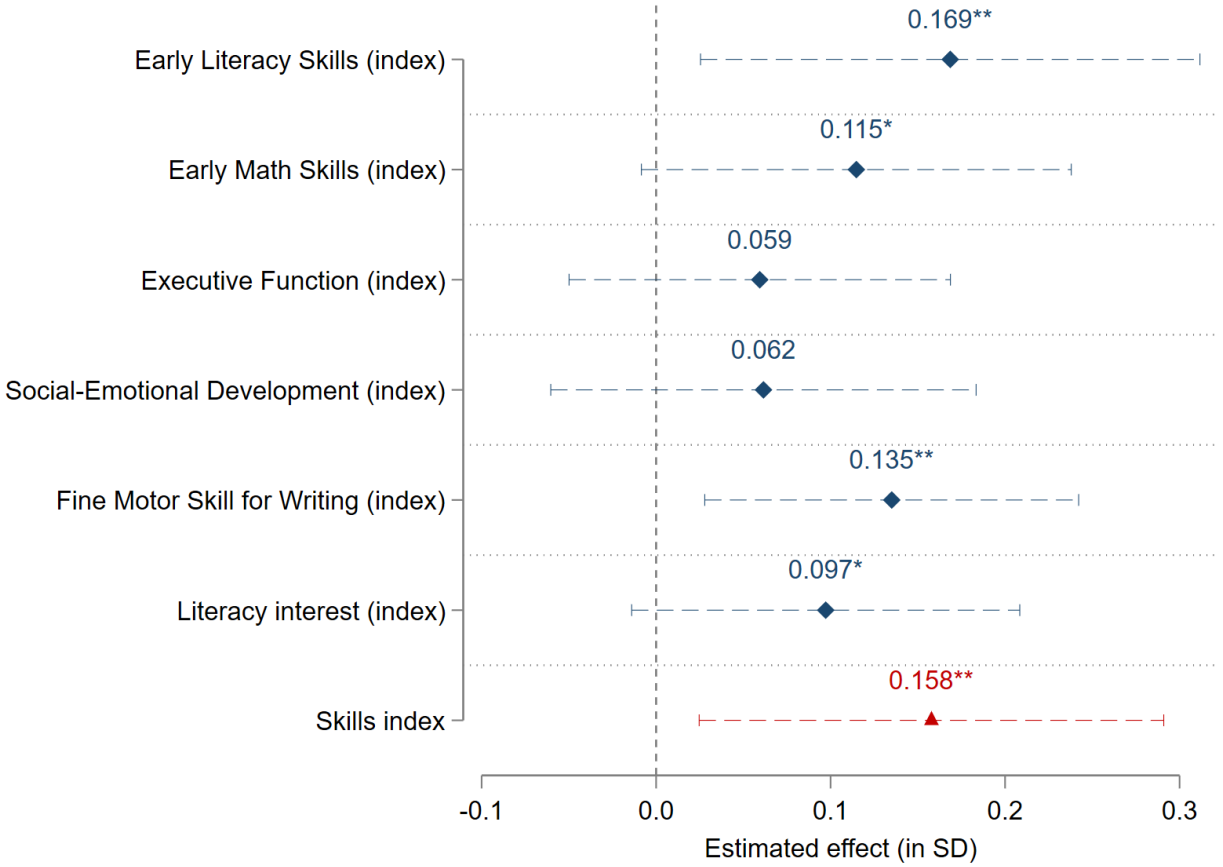
The DICIPE preschool construction program had large and positive impacts on primary school outcomes, as shown in Table 2. Children in treated communities are six percentage points more likely to enroll in primary school (Column (2)) and three percentage points less likely to repeat a school grade (Column (3)) than children in the control group. Moreover, Column (4) reports that treated children are 5.7 percentage points more likely than the control group to have the appropriate grade for age. All our estimates are statistically significant, with p-values adjusted for multiple hypotheses testing (henceforth MHT), using Westfall and Young (1993) procedure, ranging from 0 to 0.055.

In column (5) of Table 2, we present ITT impacts on a primary school enrollment index that was constructed over current primary school enrollment, grade repetition, and grade-for-age appropriateness. We find that overall, treated children have a primary school enrollment index that is 0.16 SD higher than control children—estimate which is significant at the 1% level after adjusting for MHT. Figure A4 in the Appendix shows the average primary school enrollment rate at each month of age by treatment status. Enrollment in the treatment group was higher than the control group at all ages, with children in treated communities enrolling significantly earlier.

Moreover, we find evidence that the DICIPE program significantly improved children's cognitive and social-emotional skills. Our results are summarized in Figure 2, which shows the estimate of coefficient β_1 in model (1) for each of the outcomes indicated in the vertical axis, along with 95% confidence intervals and significance indicators. The corresponding regression outputs are shown in Table A5. We estimate 0.17 SD ($p < 0.05$) and 0.11 SD ($p < 0.1$) improvements in early literacy and math skills, respectively, as well as 0.14 SD ($p < 0.05$) improvements in fine motor skills for writing. Furthermore, target children in treatment communities demonstrated a 0.10 SD ($p < 0.1$) higher interest in literacy. Overall, we estimate a statistically significant 0.16 SD improvement on a skills index constructed over the first six factor indices shown in the Figure. With the exception of early math skills, our estimates remain significant after adjusting for MHT (as reported in Table A5).

Our conclusions on the magnitude and significance of the impacts of the DICIPE preschool program on primary school enrollment and skills outcomes are robust to including control variables selected by LASSO in specification (1) (shown in Tables A6 and A7) and to using randomization inference in the estimation of standard errors.[13]

Figure 2: ITT Impacts on Child Cognitive and Social-Emotional Skills



Notes: The plot markers represent the point estimate of coefficient β_1 in model (1) for each of the outcomes indicated in the vertical axis. Dashed lines represent the 95% confidence interval of estimates and stars indicate the corresponding significance levels (** 5% and * 10%), both of which are based on standard errors clustered at the community level. All regressions include district fixed effects. The skills index is constructed based on the first six indices following Kling et al. (2007).

The estimated impact on skills is of magnitude consistent with but smaller than other early childhood interventions in the literature. For example, Bos et al. (2024) study a large-scale home visiting intervention in Bangladesh and estimate impacts ranging from 0.12–0.23 SD on child cognition, language, and social-emotional scores. Similarly, Berlinski

[13]Since in all our exercises randomization inference and Westfall and Young (1993) p-values are very similar, we do not show the former, but are available upon request.

et al. (2009) study a large expansion of universal pre-primary education in Argentina and estimate 0.23 SD impacts on third-grade test scores.

In addition to the ITT impacts presented, we also estimate Local Average Treatment Effects (LATE) using two-stage least squares instrumental variable estimation. We instrument for preschool enrollment using the treatment assignment. The LATE parameters are treatment effects for children induced by the intervention to enroll in preschool. The exclusion restriction requires that any impact of the treatment is acted on through preschool enrollment. LATE estimates of preschool enrollment on primary school and on skills outcomes are shown in Tables A8 and A9, respectively. These LATE estimates are slightly larger in magnitude relative to the ITT estimates, consistent with the lower than universal take-up of preschool enrollment.

5.3 Parental Time Investments

We explore the impacts of the DICIPE program on other outcomes related to parental time investments, motivated by the large bodies of work that highlight the role of parental investments in complementing early childhood interventions (Cunha and Heckman, 2007; Doepke et al., 2019; Attanasio et al., 2020b; Ravindran, 2021; Bos et al., 2024) or education interventions in general (see, for example, Yedomiffi 2024; de Walque and Valente 2023; Andrabi et al. 2017; Cerdan-Infantes and Filmer 2016; Avvisati et al. 2013). In our setting, parental investments can be directly linked to the program parenting education sessions, as these meetings were used to provide information to teach parents how to enhance their children's growth and development. Indirectly, the program also induced parents to be significantly engaged in the preschool activities.

First, we show that parents in treated communities improved their parental practices related to stimulation and home play relative to parents in control communities. Results shown in Columns (1) and (2) of Table 3 indicate that parents in treated communities provide a more stimulating environment for their children. Parents were more actively involved in stimulating their children (scoring 17.1% of SD higher than parents in the control group; $p < 0.01$) and the children of the treated communities participated more in

Table 3: Caregiver Time Investments

	Parental practices		Engagement with Primary School Staff				
	(1) Parental Stimulation (index)	(2) Home Play (index)	(3) Met with the principal	(4) # of meetings with the principal	(5) Met with the teacher	(6) # of meetings with the teacher	(7) Is part of the school committee
Treatment	0.171***	0.077*	0.067***	0.222***	0.009	0.138	0.014
	(0.054)	(0.045)	(0.021)	(0.058)	(0.029)	(0.100)	(0.015)
	[0.006]	[0.096]	[0.015]	[0.003]	[0.742]	[0.424]	[0.605]
Observations	3760	3763	3765	3760	2126	2122	3765
Control mean	0.000	0.000	0.212	0.398	0.321	0.624	0.138

Notes: All regressions include district fixed effects. The parental stimulation index in column (1) was constructed using 12 questions that asked parents about activities they did with the target child, including reading books, singing songs, telling stories, and playing games. The home play index in column (2) was constructed using 7 questions about items that the target child plays with at home, including homemade or store-bought toys and musical instruments. These indices were constructed following Kling et al. (2007). Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1% and * 10%). Westfall and Young (1993) p-values are shown in square brackets.

play at home (7.7% of a SD higher than in control households; $p < 0.1$).

Second, we find that parents of target children have greater engagement with the child's primary school. It is important to note that the parental education component of the DICIPE program promoted communication between parents and their *preschool*. What we find here is that parents' greater involvement with educators spills over to the primary school environment. These results are shown in Columns (3) to (7) of Table 3. Column (3) shows that parents and other household members in treated communities were 6.7 percentage points more likely to meet with the child's primary school principal in the past year relative to control communities ($p < 0.01$). Compared to a control mean of 21.2%, this is a sizable 32% increase. Column (4) shows that parents and other household members had 0.22 more meetings with the principal in the past year, compared to a control mean of 0.4 meetings (a 56% increase). Although the point estimates are positive, we do not observe statistically significant impacts on the engagement with the child's teacher in columns (5) and (6). We also explored whether parents or other household members in the treatment group were more likely to be part of the school committee. Here, column (7) shows a positive but statistically insignificant impact. These results and their corresponding statistical significance are robust to including control variables selected by LASSO in specification (1) (Table A10) and to using randomization inference in the estimation of standard errors.

Third, DICIPE causes a small reduction in the labor supply of parents in a context with

almost universal labor market participation. For example, 98.6% of mothers in control communities work and that fraction is only reduced by 1.3 percentage points for mothers of eligible children in treated areas. While most papers in the literature show that preschool or childcare programs can increase the labor market participation of (mostly female) caregivers (Berlinski and Galiani, 2007; Berlinski et al., 2011; Hojman and Boo, 2022; Donald et al., 2023; Halim et al., 2023; Mata, 2024),[14] these results on the reduction in the household labor supply of mothers are consistent with those of Krafft and Lassassi (2024), who find that pre-primary education may have decreased women's employment.[15]

Taken together, we find evidence that DICIPE increases parental time investments in children through stimulation, home play, and engagement with school principals and induces minimal reductions in the likelihood of working.

5.4 Impact on Siblings

The DICIPE shows important additional impacts on the younger siblings of the target children of our evaluation, which we report in Table A11. Indeed, younger siblings in the preschool age group 3 to 6 in the treatment group were 62 percentage points more likely to attend preschool relative to similar younger siblings in the control group—an effect that is about 85% of the estimated impact of DICIPE for the target children. These results are consistent with the timing of preschool construction and the ages of the target children and their siblings, and are not due to changes in fertility.[16] Furthermore, we do not observe statistically significant impacts on the primary school enrollment of sisters or brothers in the 6 to 12 primary school age group.[17]

[14] In a recent evidence review (Halim et al., 2023), the authors review 22 studies that plausibly identify the causal impact of childcare services on maternal labor market outcomes in lower and middle-income countries and find that all but one study report positive impacts on the extensive or intensive margin of maternal labor market outcomes.

[15] This small reduction in the labor supply of female caregivers may indicate that they are the ones investing more time in stimulation activities and with school engagement, being more likely to stay at home rather than participating in the labor market.

[16] The program has no significant effects on fertility, which implies that the number of younger siblings is not different between control and treated families—results available upon request.

[17] These results hold after including control variables selected by LASSO (Table A12) and to using randomization inference in the estimation of standard errors.

6 Mechanisms

In this section we explore what aspects of the context and the DICIPE program are likely important drivers of the observed gains in child development, in two ways. First, in Subsection 6.1 we explore how the main impacts differ across relevant groups identified in the literature. Second, in Subsection 6.2 we conduct a mediation analysis to study which of the two main program components—that is, preschool instruction and parental education—matter the most for the treatment effects.

6.1 Heterogeneous Impacts

We first investigate which groups of children benefit more from the preschool construction program. To do so, we test six hypotheses based on key components of the program and dimensions of heterogeneity documented in the existing literature (see, for example, Holla et al. (2021); Conti et al. (2016); Sylvia et al. (2021); Bos et al. (2024)). Specifically, we investigate heterogeneous treatment effects by (i) two child characteristics—child's gender and stunting status, (ii) caregiver's education, and (iii) three household characteristics—distance to the nearest preschool, household size, and wealth.

To test each of these hypotheses, we expand specification (1) by including an indicator for the characteristic of interest (D_{ic}) and an interaction term between this indicator and the treatment dummy ($T_c \times D_{ic}$), as follows:

$$Y_{ic} = \beta_0 + \beta_1 T_c + \beta_2 T_c \times D_{ic} + \beta_3 D_{ic} + \gamma_{s_c} + \varepsilon_{ic} \tag{2}$$

D_{ic} takes the following values depending on the characteristic tested: for gender, the indicator equals one if the target child is a girl; for stunting status, the indicator equals one if the child's height-for-age z-score at baseline was below -2.0 SD; for caregiver education, it equals one if the caregiver is illiterate; for distance to a preschool, it equals one if the distance to the nearest preschool is above the median; for household size, it equals one if the number of children aged 3-5 (excluding the target child) is above the median; and for

household wealth, it equals one if the wealth index is above the median.

In this model, β_1 represents the total effect for the subgroup where $D_{ic} = 0$ (e.g., boys), while $\beta_1 + \beta_2$ represents the total effect for the subgroup where $D_{ic} = 1$ (e.g., girls). Moreover, β_3 captures the association between the characteristic D_{ic} and the outcome of interest Y_{ic} for children in the control group.

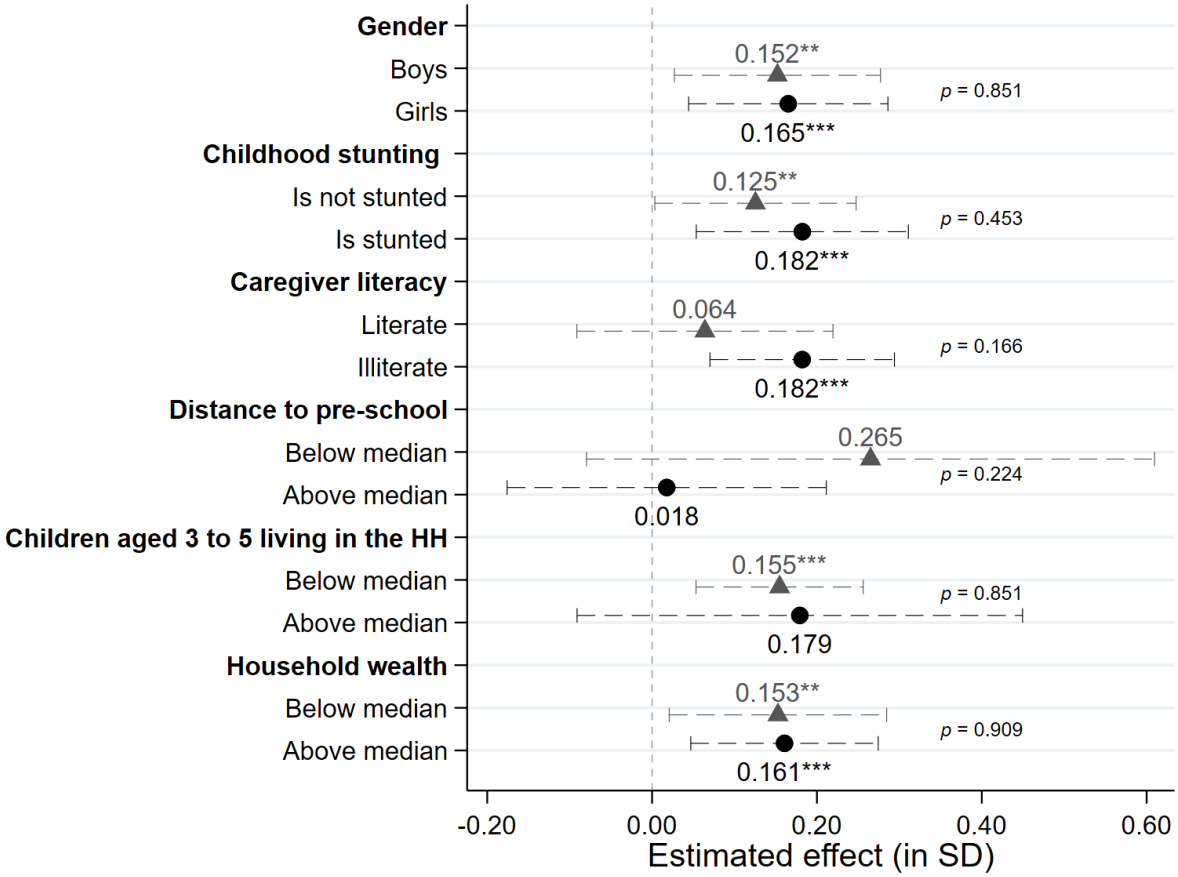
The heterogeneity results for the outcomes of Primary School Enrollment index and Child Skills index are presented in Figures 3 and 4, respectively. The figures indicate the considered dimension of heterogeneity in the vertical axis and our estimates of β_1 (triangle markers) and of $\beta_1 + \beta_2$ (circle markers). The dashed horizontal lines show corresponding 95% confidence intervals and the numbers to the right of the estimated effects show p-values for the test of differences in the average effects across the two subgroups within each characteristic. The regression outputs are show in Tables A13 and A14 in the Appendix, respectively for each index and for all of their factors.

Overall, our evidence suggests that the preschool construction program yielded higher benefits to children in wealthier households (in this remarkably low-wealth environment), with illiterate parents, and living closer to the newly constructed preschools.

In more detail, first, we do not find statistically significant heterogeneity in treatment effects for the overall primary school enrollment index along any of the dimensions studied (Figure 3). However, these results hide interesting variation in impacts across the components of the indices. Indeed, Table A13 shows larger positive impacts on the probability of being enrolled in primary school and being of the appropriate grade-for-age for children of illiterate caregivers ($p < 0.1$).

Second, we find differential effects of the DICIPE program on the overall skills index along several caregiver and household characteristics (Figure 4). The intervention has larger effects on the skills index for children of illiterate caregivers (0.196 SD, $p = 0.05$), compared to children of literate caregivers. Notably, the program helps mitigate the negative effects of low parental human capital (illiteracy) on children's skills (see $\hat{\beta}_3$ in Table A14). The program also has a larger impact on the skills index for children from wealthier households (0.214 SD, $p = 0.09$), compared to those from poorer households.

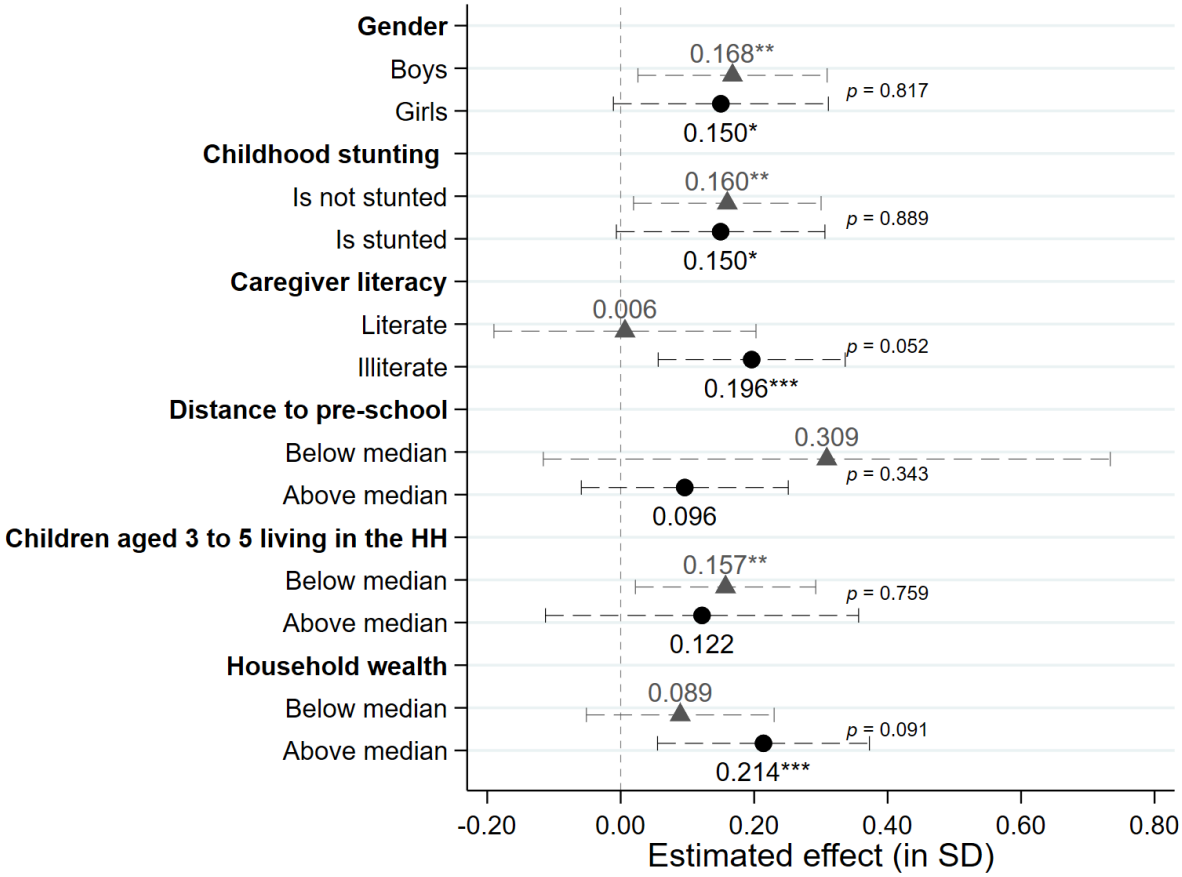
Figure 3: Heterogeneous Effects on Primary School Enrollment



Notes: The triangles and circles represent the total effect for each subgroup indicated in the vertical axis. The dashed whiskers capture 95% confidence intervals. *** and ** indicate statistically significant coefficients at 1% and 5%, respectively. The numbers to the right of the estimated effects show *p*-values for the test of differences in the average effects across the two subgroups within each characteristic tested. The associated regression outputs are presented in Table A13 (Column 4) in the Appendix. Standard errors are clustered at the community level. All regressions include district fixed effects.

These results align with existing evidence from low- and middle-income countries on how preschool programs can yield greater benefits to children from less disadvantaged or wealthier households (Berkes et al., 2024) and from less educated caregivers (Berlinski et al., 2008). It is noteworthy that while household wealth and caregiver literacy can influence the skills index, they affect different types of skills. As shown in Table A14, children of wealthier households in the treatment group saw significantly larger improvements in their early literacy and math skills, while children of illiterate caregivers in the treatment group saw significantly larger improvements in their social-emotional development and fine motor skills. This suggests that wealthier households may have more resources to support their children's cognitive development. In turn, a potential explanation for the

Figure 4: Heterogeneous Effects on Child Skills



Notes: The triangles and circles represent the total effect for each subgroup indicated in the vertical axis. The dashed whiskers capture 95% confidence intervals. ***, **, and * indicate statistically significant coefficients at 1%, 5%, and 10% respectively. The numbers to the right of the estimated effects show *p*-values for the test of differences in the average effects across the two subgroups within each characteristic tested. The associated regression outputs are presented in Table A14 (Column 7) in the Appendix. Standard errors are clustered at the community level. All regressions include district fixed effects.

positive impacts for children of illiterate parents may be that these parents may provide more levels of engagement to compensate for their low human capital, which more effectively affects the children's non-cognitive skills dimension.

Third, for both sets of outcomes, the positive treatment effects are higher for children who live within 3 kilometers of the nearest preschool at baseline (which is the median distance). The estimates of the impacts are imprecise, implying that we do not detect a statistically significant difference. However, it is worth noting that the magnitudes of the difference of impacts based on distance are big. A likely reason why children living closer to the preschools may benefit more when they are of primary school age is that the escolinhas were intentionally built in a location close to a primary school in order to create

positive synergies between the two.

Finally, we find no evidence for treatment heterogeneity by child characteristics such as gender and stunting. This is in line with recent evidence from Malawi, U.K., and the U.S. on inequality aversion and the value of equal opportunity by parents for their children (Berry et al., 2025). They are also in line with evaluations of other pre-primary education programs including Berlinski et al. (2009), who find no heterogeneous treatment effects by child gender.

Taken together, our findings highlight that the differential treatment impacts of DICIPE program's are along the dimensions of caregiver human capital and household wealth. This underscores the importance of designing preschool programs that are responsive to contextual differences, particularly in deprived and low-capacity settings.

6.2 Mediation analysis

We further investigate which of the two main components of the program—preschool construction and parental education sessions—contributed to the positive effects on child development outcomes. In Section 5 we showed that the program significantly increased enrollment in preschools (which relates to the construction component) and parental stimulation at home (which relates to the education component). We therefore explore whether the DICIPE had an effect mediated by these *endogenous* changes in household behavior.

We first need to stablish a causal relationship between the potential mediators and children's main outcomes. This is because both preschool *enrollment* and parental *stimulation* are choices that households may make not only induced by the random assignment to the program but also based on unobservable determinants of child development, which may explain both changes in behavior and children's primary-school-age performance.

To minimize the endogeneity concerns, we employ an instrumental variables strategy in which we exploit the possibility that preschool enrollment (hereafter, PE) and parental stimulation index (hereafter, PS) may vary by baseline households characteristics. However, since baseline characteristics may also directly affect our measures of child development, we use the interaction of treatment assignment and selected household's baseline

characteristics to instrument for each mediator. The identifying assumption is that households react differently based on their baseline characteristics and that the interaction between the treatment and these baseline characteristics is excluded from a model of child development. Importantly, we build closely on the similar strategy followed by Attanasio et al. (2020a) and Attanasio et al. (2022) and exploit baseline information on the distance between households and the preschools as part of the set of excluded instruments since one may think that the household distance to the construction site is random in a model of child development.[18] While they use distance in time, we measure distance in kilometers using geocoded data (as described in Section 4.2). It is important to note that our identifying assumption implies that any dimension of heterogeneity detected in the previous section would opearte through the mediators.

Formally, in a *first stage* we estimate the following models to predict Preschool Enrollment and Parental Stimulation Index, respectively:

$$PE_{ic} = a_0 + \sum_j a_M^j T_c \times X_i^j + \sum_j a_X^j X_{ic}^j + a_T T_c + a_{s_c} + \varepsilon_{ic} \tag{3}$$

$$PS_{ic} = b_0 + \sum_j b_M^j T_c \times Z_i^j + \sum_j b_Z^j Z_{ic}^j + b_T T_c + b_{s_c} + \varepsilon_{ic}. \tag{4}$$

In both models, T_c is the treatment indicator variable; X_i^j is a vector of relevant baseline characteristics to predict preschool enrollment; and Z_i^j is a vector of relevant baseline characteristics to predict parental stimulation. In practice, we use a LASSO model to select the interacting variables in each model X and Z and we consider first stage models with full effects of variables which interactions were selected by the LASSO model.

In a *second stage*, we estimate a model of child development outcomes, Y, on the pre-

[18] A caveat to this argument in our context is that the DICIPE intentionally constructed the preschools nearby the local primary school and households experiencing positive shocks to their child development objectives may decide to locate close to the primary schools irrespective of the program. Hence, we also use the interaction of distance with treatment assignment in our first stage models.

dicted values of the considered mediators—denoted by $\widehat{PE}$ and $\widehat{PS}$:

$$Y_{ic} = \beta_0 + \beta_T T_c + \sum_j \beta_X^j X_{ic}^j + \sum_j \beta_Z^j Z_{ic} + \beta_{PE}\widehat{PE_{ic}} + \beta_{PSI}\widehat{PS_{ic}} + \gamma_{s_c} + \varepsilon_{ic} \tag{5}$$

Importantly, we study whether DICIPE had a direct impact on children's outcomes or if its effects are mediated by receiving preschool education and/or changes in parental practices. To do so, we compare specifications that consider the treatment variable T as *excluded* from models (5) when PE or PS are included versus specifications in which the treatment is also directly relevant to explain outcomes Y.

First stages. Table A15 in the Appendix shows estimates of the models of potential mediators PE and PS. The table reports the effect of treatment assignment and the interactions of treatment assignment with the baseline characteristics selected by the LASSO. Both regressions also include the selected baseline characteristics which we do not report. The main takeaway from the table is that the test of joint significance of variables indicates that the predictors are jointly significant for both models, although the F-statistic is too low in the model of PS, which raises the concern of weak instruments. Therefore, we are cautious when interpreting this mediator.[19]

Mediators of Primary School Enrollment. Table 4 shows our mediation analysis for Primary School Enrollment. Columns (1) to (3) include treatment as a relevant variable while columns (4) to (6) assume that treatment only operates through preschool education and parental practices. We run overidentification tests when the treatment is an additional excluded instrument and we do not reject the null hypothesis of a correct specification. This suggests that for this outcome, DICIPE worked through the mediators. In effect, when including the predicted values of PE and PS in specifications (1) to (3) we observe that the effect of treatment significantly reduces relative to the effect reported in Table 2—column (5). Moreover, when we exclude treatment from a specification of primary school enrollment, preschool enrollment and parental stimulation become positive and signifi-

[19]We performed our mediation analysis with different specifications based on the literature—that performed worse in the first stage relative to the LASSO—and our conclusions remain unchanged.

Table 4: Mediators for Primary School Enrollment Index

	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	-0.214	0.122*	-0.181			
	(0.284)	(0.065)	(0.274)			
Predicted PE	0.513		0.438	0.221**		0.189*
	(0.412)		(0.412)	(0.089)		(0.097)
Predicted PS		0.205	0.138		0.480**	0.149
		(0.204)	(0.213)		(0.227)	(0.209)
Observations	3680	3677	3677	3680	3677	3677
Overidentification test p-value				0.865	0.813	0.896

Notes: PE stands for Preschool Enrollment and PS for Parental Stimulation. *Predicted PE* and *Predicted PS* are the fitted value from the first stage regressions (3) and (4), respectively, shown in Table A15. All regressions include district fixed effects and the baseline characteristics included in the corresponding first stage models. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1% and ** 5%).

cant explanatory variables. Taken together, our results suggest that attending preschool is the most important mechanism through which the DICIPE program affects progress in primary school.

Mediators of Skills Index. Our conclusions are weaker for the child development outcome of skill index. Appendix Table A16 shows the second stage results for this outcome. While in this case we are also not able to reject that the treatment assignment is a valid excluded instrument, the most important mediator is parental stimulation, which as said may suffer from a weak instrument problem. Therefore, we are more cautious when interpreting these results.

Interpretation of mediation analysis. Overall, we find support for preschool enrollment as an important driver of the DICIPE impacts on primary school performance but no support for the parental education component of the program. Our qualitative study may shed some light on these results.

First, the survey provides suggestive evidence on the particular aspects of the preschools that contributed to driving the program's impacts on primary school performance. Our analysis of the MELE instrument (described in Section 4.2) suggests that the quality of the interactions between teachers and children was high in the escolinhas. The results show that most facilitators (85%) had a medium or high engagement with the children: teachers were observed to show affection towards students and being welcoming and encourag-

ing to students' ideas and willingness to participate in class activities. Consistent with these observations, approximately 80% of the classrooms scored medium or high in their evaluation of children's engagement. Moreover, 93% of the facilitators used positive techniques to redirect or guide children's behavior and 73% of all teachers were observed to be rarely or never engaging in negative physical or verbal interactions with children (i.e., yelling, pinching, or striking). Lastly, even though the majority of preschools scored at a basic level in classroom practices for most subject areas, an exception was the assessment of *gross motor skills*, in which almost 70% of preschools scored a high level of quality in classroom practice.

Second, the qualitative study provides a likely important reason why parental practices do not act as a mediator in spite of being positively and significantly affected by the program (Table 3). Indeed, the parental education sessions suffered from low compliance—as we explain in detail in Appendix B. Not only were they held less frequently than planned, but also less than 50% of parents reported having ever attended a session. However, families strongly participated in other activities *in the preschool center*. For example, 81% of interviewed caregivers reported having attended meetings to learn about their children's academic performance at the preschool and 83% said they had supported the preschool through maintenance, cleaning, or in-kind contributions (such as donating food). Since these parental interactions happened at the preschools, we suspect that parental stimulation practices are, rather than a mediator, an outcome also directly affected by the preschool construction component. In addition, the majority of parents surveyed in the qualitative study report perceived improvements in their children's skills, such as increased communication (86%), social interactions (77%) and self-confidence (68%). This perception may have incentivized parents' change in parental practices.

7 Cost-effectiveness

We conduct a cost-effectiveness analysis by comparing the cost per child to an estimate of the gain in lifetime earnings the child would receive from an improvement in cognitive skills, following Holla et al. (2021). Table A17 outlines the assumptions underlying these

calculations, as well as data sources for parameters such as the labor force participation rate, nominal wages, real wage growth rate, and exchange rate. Specifically, we assume a labor force participation rate of 78.9%, an average monthly wage of US$195.60 (MZN 11,800), and real annual wage growth of 5.1%. The working age is defined as 22 to 55 years, a conservative assumption given that labor market participation often begins earlier than age 22 in low- and middle-income countries.[20] A discount rate of 3% is assumed in the baseline scenario. Based on these parameters, we estimate that the present value of total future earnings is US$118,264.

We then adjust the present value of earnings to account for the benefits of the DICIPE program. As in Holla et al. (2021), we apply an upper-bound value of 13% per standard deviation (SD) increase in cognitive skills estimated for the Head Start program in the United States (Kline and Walters, 2016) and a lower-bound value of 4.3% per SD increase estimated for lower-income countries (Galasso and Wagstaff, 2019).[21] We select the smallest and largest estimated treatment effects that are statistically different from zero from Table A5, that is, the estimated effect on the literacy interest index (0.097 SD) and the early literacy skills index (0.169 SD), respectively.[22]

Lastly, the annual cost per child of the DICIPE intervention is presented in the Table A17. The average cost of the DICIPE intervention per child across all provinces was US$76.83, which rises to US$81.51 when monitoring costs are included.

We present our cost-effectiveness analysis in Table 5. In the baseline scenario (Panel A), the comparison between the expected increase in salaries due to the program and the costs demonstrates that the DICIPE intervention is cost-effective. Using a 3% discount rate, the base case scenario shows substantial benefits, with a benefit-to-cost ratio ranging from 6.4 to 33.8, indicating that the benefits of the program significantly outweigh its costs. More-

[20] Holla et al. (2021) defines working age as 22 to 65 years. We define it as up to 55 years because life expectancy in Mozambique by 2021 was 57.7 years on average, 60.5 years for women and 54.8 years for men (WHO, 2021).

[21] For example, the present value of earnings is multiplied by 0.13 × estimated average treatment effect in SD to calculate the lifetime gain in earnings resulting from an increase in skills.

[22] Since we do not find statistically significant effects for social-emotional skills or executive function, we do not augment the estimate of individual gains in earnings stemming from improvements in social-emotional skills, as suggested in the literature on returns to social-emotional skills (Belfield et al., 2015).

over, the benefit-to-cost ratio is similar to or higher than other ratios estimated by Holla et al. (2021) for a preschool program that included the implementation of a game-based math curriculum and provision of materials in India (Dillon et al., 2017), a teacher professional development and parental engagement intervention in community-based childcare centers in Malawi (Özler et al., 2018), and access to one additional year of a preschool education program (The Early Years Preschool Program) in Bangladesh (Spier et al., 2020).

Table 5: Estimates of costs, lifetime earnings gains, and cost-benefit ratios of DICIPE

	(1) Discount rate (%)	(2) Annual real wage growth (%)	(3) Total cost per child (USD)	(4)	(5)	(6)	(7)	(8)	(9)
				Preschool augmentation to lifetime earnings (USD)				Benefit-to-cost ratio bounds	
								Lower	Upper
Panel A. Baseline scenario									
Baseline	3	5.1	76.83	1,491	493	2,598	859	6.4	33.8
Panel B. Alternative scenarios									
5% Discount rate	5	5.1	76.83	749	248	1,305	432	3.2	17.0
0% real wage growth	3	0	76.83	303	100	529	175	1.3	6.9
3% real wage growth	3	3	76.83	760	251	1,323	438	3.3	17.2
Including monitoring costs	3	5.1	81.51	1,491	493	2,598	859	6.1	31.9
High cognitive estimated effect (0.169 SD)				No	No	Yes	Yes		
High cognitive wage returns (13%)				Yes	No	Yes	No		

Notes: This table shows the cost-effectiveness estimation for the DICIPE program. Columns (1), (2), and (3) presents the parameters of discount rate, annual real wage growth, and the total annual cost per child of the program in USD. In Columns (4) to (7) we present the augmentation of lifetime earnings (in USD) that is driven by the exposure to the DICIPE program. To calculate gains to lifetime earnings from the DICIPE intervention, Column (4) uses the lowest treatment effect on skills (0.097 SD) and a return to skills of 13%; Column (5) uses a treatment effect of 0.097 SD and a return of 4.3% (the most conservative scenario); Column (6) uses a return of 13% and a estimated effect of 0.169 SD (the most optimistic scenario); and Column (7) uses a return of 4.3% and estimated effect of 0.169. In Columns (8) and (9), the lowest and largest potential ratios of benefits to costs for an individual child are reported. Specifically, values in Column (8) are estimated as the ratio between the largest value preschool augmentation to lifetime earnings across columns (4) to (7) and the cost per child.

We also explore alternative scenarios (Panel B) by varying key parameters (wage growth and discount rate), following Ganimian et al. (2024). These scenarios include assuming a more conservative discount rate of 5% and wage growth rates of 0% and 3%. Additionally, we incorporate a more conservative scenario using the higher cost estimate that includes monitoring costs. This adjustment is particularly relevant in settings where implementation is conducted by non-governmental organizations that require government monitoring. As shown in Table 5, the benefit-to-cost ratio in these alternative scenarios varies from 1.3 in the case of no real wage growth to 31.9 when assuming higher costs per child, including monitoring costs. In sum, this analysis highlights the substantial economic value generated by the DICIPE intervention, underscoring its effectiveness in improving cognitive skills and enhancing participants' future earnings and reinforcing the importance of

investing in preschool programs in resource-constrained settings.

8 Concluding Remarks

In this paper, we use a clustered randomized control trial to evaluate the Mozambique Early Childhood Development Project (DICIPE), a large-scale preschool construction and educational provision program targeting highly deprived communities.

Our analysis demonstrates that the program led to substantial improvements in preschool enrollment, with treated communities experiencing an increase of over 73 percentage points compared to the baseline enrollment of just 2% in control areas. Beyond preschool, our findings reveal significant positive effects on primary school outcomes, including higher enrollment rates, reduced grade repetition, and improved skills. Additionally, we find that treated families increased their parental investments in their children's human capital, as parents in treated communities invested more time in supporting their primary school-aged children. The program also benefited the next generation of children in early childhood since we detect increased preschool enrollment for younger siblings of children in the DICIPE founding cohort.

We also shed light on the mechanisms for these large positive impacts. The program's impact is not uniform across all households, with the largest effects concentrated among children of less educated parents, those from relatively wealthier households, and children living closer to the preschools. In line with these results, we show that preschool enrollment is a key mediator through which DICIPE improved later educational outcomes, while parental stimulation did not appear to play a significant role as a direct driver of child development in primary school-age.

This finding motivates an intriguing long-term research agenda. We detect that DICIPE significantly enhances parental stimulation with minimal effect on other time uses, such as labor supply. Consequently, the direct benefits of improved parental practices may become evident later in the lives of children who participate in DICIPE. Therefore, exploring the long-term impacts of DICIPE or similar preschool construction programs in highly

deprived settings remains an open important question for future research.

From a policy perspective, the success of DICIPE offers a promising model for both replication within Mozambique and expansion to other low-income countries facing similar challenges. We show that the intervention is cost-effective in addressing educational deficiencies in low-resource settings, despite only considering the direct effects on target students' outcomes and not the spillovers to younger siblings. This study, therefore, contributes to our understanding of how large-scale preschool programs can be implemented in a cost-effective way and improve educational outcomes and broader family dynamics in impoverished contexts. Our rigorous evidence indicates that this program may constitute an effective policy tool to help mitigate the adverse human capital effects of extreme poverty.

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Appendix

A Previous preschool interventions

Table A1 organizes the related literature on preschool interventions into two panels. Panel A reviews studies that evaluate preschool construction interventions and Panel B reviews those that study interventions using existing preschool infrastructure. The first three columns identify the paper. The *Intervention* column shows main component of the program being evaluated. The *Design of the study* column shows the main empirical strategy used in the evaluation. *Outcome period* refers to the life stage or age of the children in the sample when the study measured its outcomes. *Main results* displays the detected impacts by outcome. Finally, *Vulnerability measures* summarizes some information from the study's sample that characterizes the context in which the study is conducted in terms of key development measures.

Table A1: Preschool Education Interventions in the Literature

#	Country	Source	Intervention	Design of the study	Outcome period	Main results	Vulnerability measures
Panel A. Interventions that include preschool construction components							
1	Argentina	Berlinski et al. (2009)	Preschool construction	Diff-in-Diff $N = 417$ municipalities, 3,035 schools, 126,000 students	Primary (3rd grade)	Preschool attendance (+) 7.6 pp Math test scores (+) 0.24 SD Spanish test scores (+) 0.23 SD	Poverty rate (2001) 18.1% Preschool enrollment 49%
2	Cambodia	Berkes et al. (2024)	Preschool construction Community outreach Parental engagement	RCT N = 305 villages, 7,053 households	Preprimary (age 4)	Preschool attendance (+) 10.6 pp Cognitive development (+) 0.048 SD Socioemotional skills (+) 0.068 SD.	Preschool attendance (baseline) 15.3% Caregivers' education level: 4.7 years Share of stunted children: 34%
3	Cambodia	Bouguen et al. (2018)	Preschool construction Provision of staff Teacher training Provision of materials	RCT N = 45 villages, 1,399 households, 1,731 children	Preprimary (ages 4-6)	Preschool attendance (+) 25 pp Gross motor skills (+) 0.097 SD Problem solving (-) 0.133 SD Primary school attendance (-) 0.10 SD.	Preschool attendance (baseline) 2.3% Caregivers' education level: 2.1 years Share of illiterate caregivers: 58% Height-for-age z-score: -2.11 SD
4	Gambia	Blimpo et al. (2022)	Preschool construction Curriculum Teacher training	RCT N = 91 villages 1,186 children	Preprimary (age 5.5)	No statistically significant effects on cognitive and non-cognitive outcomes	ECD enrollment (baseline) 30% Caregivers' education level: 1.8 years Height-for-agez score: -1.45 SD
5	Indonesia	Brinkman et al. (2017)	Preschool construction Teacher Training Community outreach	IV and Diff-in-Diff N = 310 villages 1,440 children for IV and 1,260 children for Diff-in-Diff	Preprimary (age 5) & Primary (age 8)	*Preprimary*: Preschool enrollment (+) <= 23.6 pp Social competence (+) 0.22 SD Language & cognit. dev. (+) 0.13 SD *Primary*: Emotional maturity (+) 0.16 SD	ECD enrollment (baseline) 18% Mothers with primary education or less: 51.1%
6	Mozambique	Martinez et al. (2017)	Preschool construction Teacher training Parental engagement	RCT N = 76 communities, 2,000 households	Preprimary (age 5.5) and Primary (1st grade)	*Preprimary*: Cognitive development (+) 0.18 SD Receptive vocabulary (+) 0.13 SD *Primary*: Primary school enrollment (+) 8.2 pp Cognitive development (+) 0.43 SD Communication (+) 0.37 SD	Preschool attendance (baseline) 4% Caregivers' education level: 3.2 years Height-for-age score: -1.5 SD
7	Uruguay	Berlinski et al. (2008)	Preschool construction	IV N = 23,042 observations	Post-primary (age 15)	Preschool attendance (+) <= 76.5% School attendance (+) 27.4 pp Years of schooling (+) 0.79 years	Caregivers' education level: 9.8 years
8	Brazil	Castro and da Cruz (2024)	Preschool construction	DID 2,000 jurisdictions 11,000 students per period (approx).	Primary (5th grade)	Portuguese test scores (+) <=1.1% Math test scores (+) <=1.2%	Preschool attendance: 70.6%
9	Democratic Republic of Congo	Donald et al. (2023)	Preschool construction Provider training Provision of materials	RCT N = 110 villages 1,006 households	Preprimary (ages 3-7)	Early development index (+) 0.76 SD	Mothers' education level: 6.7 years
Panel B. Other preschool programs							
10	Gambia	Blimpo et al. (2022)	Curriculum Teacher training	RCT N = 53 villages	Preprimary (age 5.5)	No statistically significant effects on cognitive and non-cognitive outcomes	ECD enrollment (baseline) 90% Caregivers' education level: 1.9 years Heigh-for-age score: -1.32 SD
11	Colombia	Andrew et al. (2024)	Teacher Training Provision of staff	RCT 40 centers 1,987 children	Preprimary (age 5.5)	Fluid reasoning (+) 0.17 SD Expressive language (+) 0.15 SD School readiness (+) 0.19 SD	Mothers' education: 12.6 years
12	Ghana	Wolf (2019)	*Teacher Training* Parental engagement (PA)	RCT 240 schools 3,435 children	Primary (age 8)	Teacher training only: Literacy (+) 0.11 SD Social competence (+) 0.11 SD Cognitive flexibility (+) 0.12 SD Inhibitory control (+) 0.082 SD Behavior regulation (+) 0.15 SD. *Teacher training and PA:* Numeracy (-) -0.10 SD Behavior regulation (+) 0.14 SD	Male head of the household can read: 80%

13	Ghana	Wolf et al. (2019)	Teacher training Parental engagement (PA)	RCT 240 schools 3,435 children	Preprimary (age 5.5)	*Teacher training only:* School readiness (+) 0.13 SD Social-emotional skills (+) 0.13 SD Executive function (+) 0.11 SD *Teacher training and PA:* No effects on children's outcomes	Male head of the household can read: 80%
14	India	Dillon et al. (2017)	Curriculum Provision of materials	RCT 212 preschools 1,540 children	Primary (1st grade)	*Math-curriculum:* Math composite score (+) 0.138 SD. Nonsymbolic math score (+) 0.32 SD *Social curriculum:* No statistically significant effects	*No information*
15	India	Ganimian et al. (2024)	Provision of staff	RCT 320 preschool centers 4,675 children	Preprimary (age 5.5)	Math scores (+) 0.28 SD Language scores (+) 0.46 SD Executive function (+) 0.18 SD	Height-for-age: -1.52 SD Stunted: 34%
16	India	Meghir et al. (2023)	Curriculum Teacher Training Provision of Materials Parental engagement	RCT. N = 192 villages, 1,449 children.	Preprimary (age 4)	*Both interventions*: Congitive index (+) 0.24 SD School Readiness (+) 0.21 SD. *ES only:* Congitive index (+) 0.18 SD School Readiness (+) 0.13 SD. *EP only:* Congitive index (+) 0.17 SD School Readiness (+) 0.24 SD.	Mothers' education: 7.2 years
17	Indonesia	Hasan et al. (2019)	Community awareness Teacher training Subsidized or free access	RCT 310 villages 3,089 students	Preprimary (age 5) & Primary (age 8)	*Preprimary:* Physical health (+) 0.21 SD Emotional maturity (+) 0.12 SD *Primary*: Language - match picture (+) 0.13 SD Math - order numbers (+) 0.13 SD Communication skills (-) 0.14 SD	Mother's education (primary or less): 50%
18	Kenya	Gray-Lobe et al. (2022)	Curriculum Teacher training	RCT N = 4,844 children	Preprimary (ages 5-6)	Subject knowledge index (+) 0.51 SD Higher-order skills index (+) 0.28 SD Language knowledge index (+) 0.66 SD Timely grade progression (+) 6 pp Receptive vocabulary (+) 0.42 SD	Caregiver can read: 11%
19	Malawi	Özler et al. (2018)	Teacher training Teacher Payments Parental engagement	RCT N = 199 centers 2,120 children	Preprimary (age 5.5) & Primary (ages 8-9)	*Teacher training (TT) only*: Enrolled in Primary (-) 10.9 pp Fine motor skills (-) 0.107 SD Child difficulties in primary (-) 0.10 SD *TT + teacher incentives*: Enrolled in Primary (-) 9.7 pp Fine motor skills (-) 0.115 SD *TT + parenting training:* Enrolled in Primary (-) 7.5 pp Language skills (+) 0.19 SD Prosocial index (+) 0.25 SD	Height-for-age: -1.67 SD Stunted: 34%
20	Paraguay, Peru	Bando et al. (2019)	Teacher training Pedagogy change Provision of materials	RCT 631 schools 8,807 students	Preprimary (ages 4-5) & Primary (age 9)	*Preprimary, 1 year after (Both countries):* Math test scores (+) 0.17-0.20 SD Science test scores (+) 0.12-0.17 SD *Primary, 4 years after (Peru)*: Math test scores (+) 0.14 SD Science test scores (+) 0.23 SD	No information
21	Peru	Gallego et al. (2019)	Teacher training Pedagogy change Provision of materials	RCT 107 schools 2,926 children .	Preprimary (ages 4-5)	Math test scores (short-term) (+) 0.21 SD	Mother's education (high school graduate): 21% Preschool attendance at age 3 and 4: 90%

B Process evaluation

This appendix describes the methods and instruments used to conduct a process evaluation of the intervention and the main results from this process. Further details are presented in Heinzel et al. (2024).

B.1 Objective and approach

The process evaluation was designed with the objective of using qualitative results to assess the quality of the different components of the DICIPE program to use this as suggestive evidence for potential intervention mechanisms.

To carry out this qualitative work, we used the Measure of Early Learning Environments (MELE) instrument. The MELE is designed to assess the quality of group-based care in community centers, schools, and kindergartens, for children from age 3 to primary school entry. In this sense, the MELE module includes domains related to pedagogy, interactions, physical environment, parent and community engagement, personnel, play, and inclusion. The MELE module uses two approaches to measure the quality of early learning environments: classroom observation tool and oral interviews with caregivers, teachers (facilitators), and school administrators. Therefore, the MELE module is designed to take into account the classroom environment, as well as the level of support and engagement from parents, teachers, and communities (MELQO Report, 2017).

The MELE Classroom Observation Tool is designed to capture key activities throughout the day and organized to provide information about the activities and interactions that occur during a typical class session. The tool collects data on learning activities; classroom interactions and approaches to learning; classroom arrangement, space, and materials; and facilities and safety. Most items are based on an actual classroom observation and are scored on a 1-to-4 scale, with higher scores reflecting higher levels of quality. The MELE interviews collected information on pre- and in-service training of teachers; teacher qualifications; supports and training offered to caregivers; and feedback of the program among teachers, school coordinators, and caregivers; and parental engagement in the escolinha.

A team of international and national experts familiar with the DICIPE and Mozambique context reviewed and adapted both the MELE Classroom Observation tool and the three sets of interviews. This process involved reviewing the quality domains, discussing relevant items, and deciding upon a set of items that were viewed as accurately representing the goals of early learning settings in Mozambique specifically.

B.2 Selection of participants

We collected data from a sample of 40 escolinhas in all provinces participating in the study. In each of the 40 communities, we collected the following information: one classroom observation, eight parent or caregiver interviews, up to four facilitator interviews, and an interview from a school coordinator, which in this context is a member of the community coordination committee (CCC). In total, 320 caregivers were interviewed, along with 139 facilitators and 40 CCC members.

This qualitative data collection took place in 2019. We worked with five field teams. Each team was made up of the following five members: Supervisor, MELE classroom observer, and three enumerators to lead the interviews with caregivers and CCC. The MELE data collection team training was conducted in Maputo City between June 11 and June 18. The training lasted nine days of in-class training and one day in the field for a pilot exercise in the Boane District, Maputo Province. Twenty-five enumerators and supervisors attended the training. On June 20, a one-day pilot exercise was held at the Chinonanquila Escolinha, located in Boane District, Maputo Province.

The fieldwork for the qualitative study started on June 26 and lasted a total of 11 days. The data collection protocol was approved by the National Mozambique Review Board (*Comité Nacional de Bioética para a Saúde*), with an approval reference number 225/CNBS/18 and informed written consent was obtained from the respondents for the video recording.

B.3 Main Results Across Domains

This subsection summarizes the main results presented in Heinzel et al. (2024).

1. Physical environment

A key feature of the DICIPE program design is that escolinhas are considered community-based and should be located within a central area of the community, close to the primary school. The results show that almost 70% of the parents reported walking between 0 to 15 minutes from the family homes to the escolinha. In terms of space, results suggest that 98% of escolinhas have spaces with an adequate size so that all attending children can comfortably participate in all indoor activities and 93% of schools have schoolyard with adequate space for play and equipment for gross motor activities (for example, swings and slides). In general, escolinhas were found to have satisfactory access to toilet facilities. 95% of all the escolinhas visited had composting toilets and 78% of all toilets were ranked highly satisfactory having met basic conditions in terms of cleanliness, separation of gender, and being appropriately child-sized.

2. Materials in the classroom.

The DICIPE program aimed to promote the use or readily available, often recycled materials. Results from interviews to facilitators show that 92% of them reported using locally produced materials or a combination of locally and commercially produced materials. 63% of schools visited had writing utensils and close to half of the escolinhas had books. The maximum number of books per escolinha was three.

3. Facilitators qualification and training

The DICIPE program required that the instructors had a minimum level of education (7th grade) and they should participate in upfront and ongoing training. Results from the facilitators interviews show that 96% of them completed at least 7th grade. Moreover, results also show that the majority of facilitators received both types of training. In fact, 80% of facilitators had received pre-service training and 70% received in-service training. However, the number of training days received was lower than originally planned. We also explored facilitators' satisfaction with the level of support and resources they receive. In the survey, we asked facilitators to rate on a 1-5 scale how much they agreed with statements such as "I am satisfied with my job" and "I have adequate resources to carry out my duties," and we find that teachers felt fairly well supported and resourced, with a mean rating of 3.2.

4. Parenting education sessions and parental engagement

The DICIPE project design stipulated that parenting educational meetings should be held once a month. However, the number of parenting educational sessions per community held was, on average, only one every three months. In addition, almost 50% of caregivers reported that they had never attended a parental education class at the escolinha. Despite this low participation of caregivers in the parenting education activities, families strongly engaged in other activities in the escolinha, including participating in the functioning of the escolinha. For example, 81% of all interviewed caregivers reported attending meetings to learn about their children's academic performance at the escolinha. Moreover, more than 60% of caregivers support the escolinha with services such as overall maintenance and cleaning of the escolinha and 23% provide in-kind contributions (i.e., providing food) on a regular basis. Lastly, we also document high satisfaction of caregivers with the services provided at the escolinha. We asked caregivers to rate on a 1-5 scale how much they agreed with statements such as, "I am satisfied with the quality of education my child receives", "As a parent I feel involved in the school," and "As a parent I feel my opinion matter". The mean rating for these items was 4.04, indicating that caregivers felt well supported and thought positively about school.

5. Classroom practices

The MELE Classroom Observations collected key information on instruction practices employed by teachers to teach specific subject areas (i.e. numeracy, literacy, language skills, fine motor skills, etc.). Scoring took into consideration the type of lessons, activities, and or experiences geared towards introducing, practicing, and mastering skills in each particular area. Each item was rated on a 1 to 4-points scale, indicating 1 = learning activity did not occur; 2 = basic level (lesson taught using rote learning); 3 = medium level (some play-based cleaning, connections to concrete objects, etc.); 4 = high level (play-based, open ended questions, real-life connections). The majority of escolinhas scored a basic level for most of the subject areas, except in gross motor skills, under which 70% of all escolinhas scored a high level. Lastly, we find that 43% of all learning activities were done in a whole group/entire class, instead of varying the grouping structure.

6. Classroom interactions

Interactions refer to the type and quality of interactions between teachers and children, and between children and their peers. We also collected data on classroom interactions and approaches to learning using the classroom observation tool. We gathered data on how the facilitator engaged with students, disciplinary methods, children engagement, and other key concepts. The observation items were scored on a 1-to-4-points scale, with higher scores indicating high levels of quality (i.e. 1 = lowest level of quality, 2 = basic level of quality, 3 = medium level of quality, 4 = highest level of quality). Results show that the majority of facilitators (85%) had a medium or high engagement with the children, indicating that they genuinely appeared to enjoy teaching, showed affection towards students, and were welcoming and encouraging of student ideas and participation. Moreover, approximately 80% of classrooms scored medium or high level of children engagement, indicating that most of children observed were engaged throughout the observation. Moreover, 75% of all classrooms reported children never waiting more than 10 minutes with no specific activity. Lastly, 93% of facilitators scored a 3 or 4 on use of disciplinary methods which means that the vast majority of teachers used positive techniques for redirecting or guiding children's behavior. In addition, 73% of all teachers were observed as rarely or never engaging in negative physical or verbal interactions with children (i.e. yelling, pinching, striking, etc.)

7. Other results

To complement the impacts of the intervention on preschool enrollment, we asked caregivers to report their children's school attendance and satisfaction with the services provided. Overall, we find that 91% of caregivers interviewed reported that their children always attend escolinha (i.e. throughout the entire school year) and 89% reported that their children attend the escolinha 5 days a week. Moreover, we also find high levels of satisfaction with attending school. Specifically, 95% of caregivers reported that their child was happy to attend the escolinha.

C Supporting Figures

Figure A1: Timeline of Intervention and Data Collection

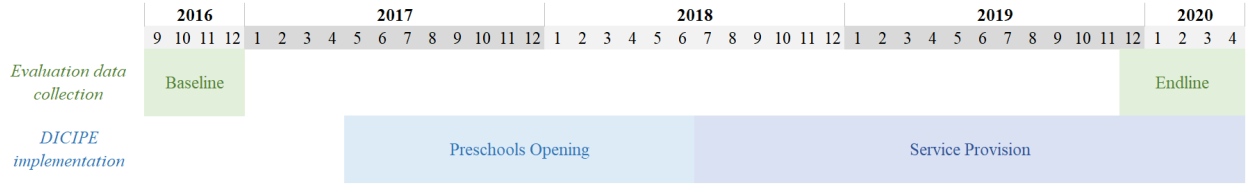
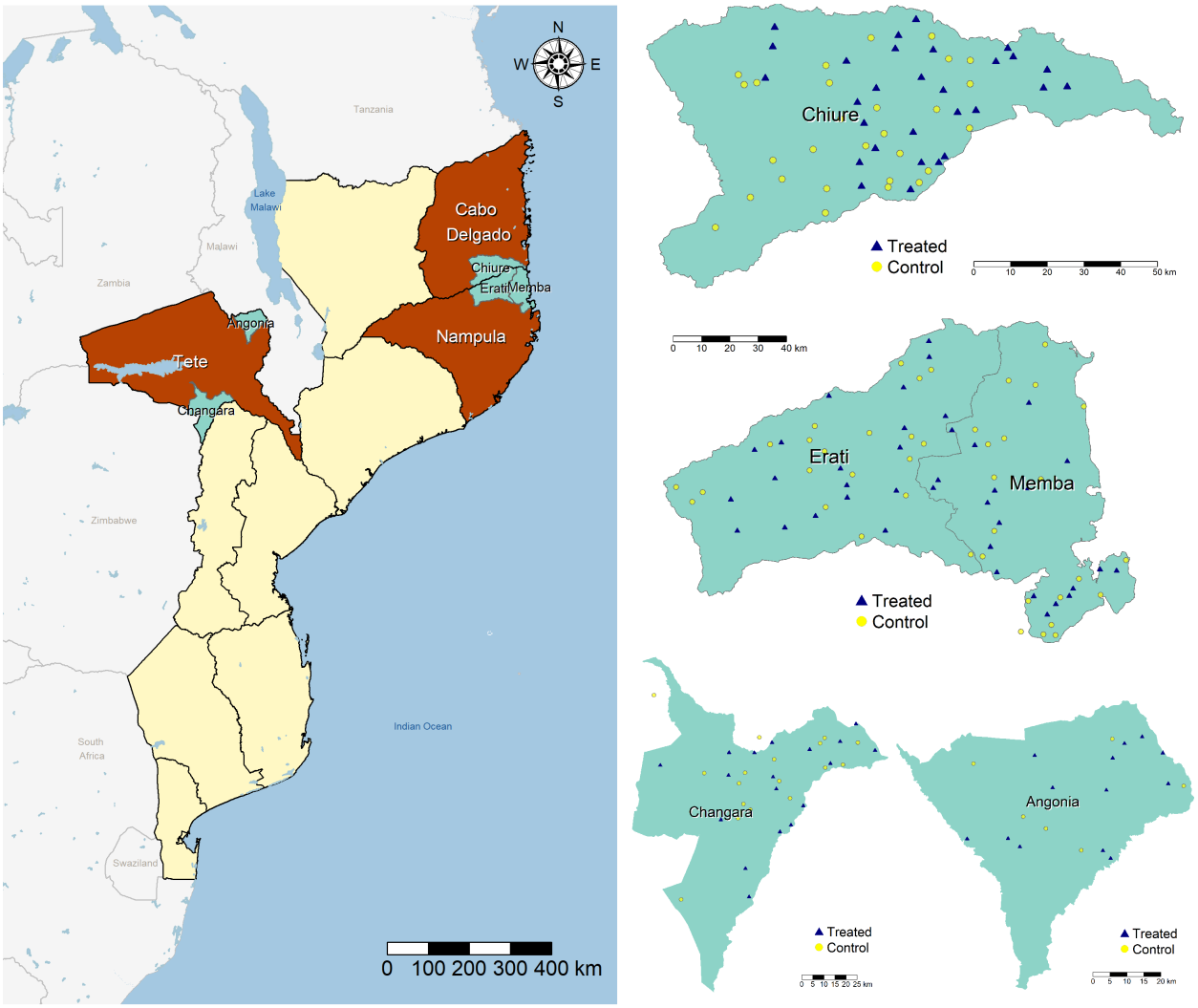


Figure A2: Location of Experimental Provinces and Districts (left), and Treated and Control Communities (right)



Notes: The left panel shows the map of Mozambique, with the three implementation provinces in dark brown and the implementation districts within them in light blue. The right panels show the location of treated (yellow circles) and control (blue triangles) communities by district.

Figure A3: Distribution of Ages for Target Children at Baseline

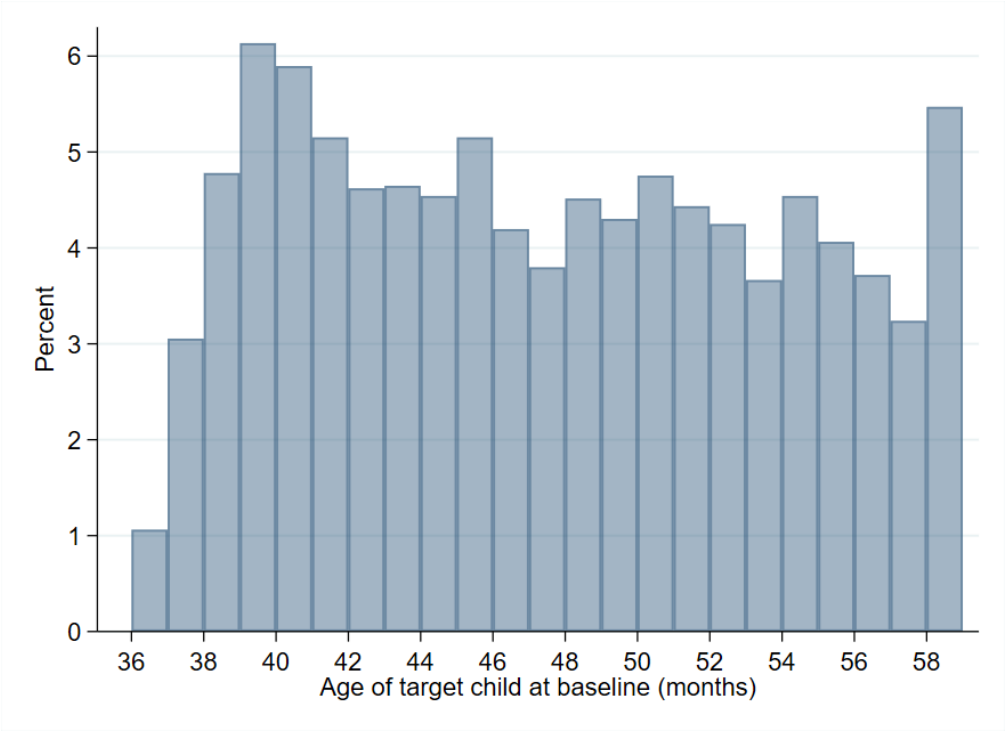
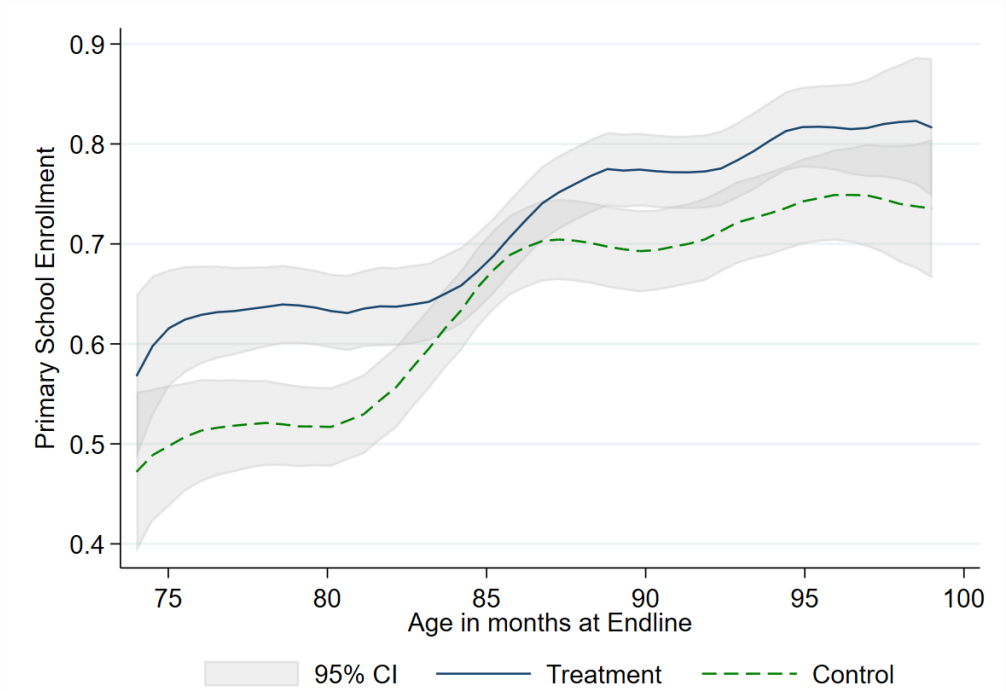


Figure A4: Primary School Enrollment at Each Age by Treatment Status



Notes: The plots show the Kernel weighted local polynomial smooth of primary school enrollment conditional on age (in months) with confidence intervals.

D Supporting Tables

Table A2: Preschool and Facilitator Summary Statistics (Endline - Treatment Only)

Variable	(1) Mean	(2) SD	(3) N
Panel A. Preschool characteristics			
Number of instructors	3.661	0.812	112
Enrollment in 2019 (Number of children)	74.723	16.134	112
Enrollment in 2018 (Number of children)	79.375	23.147	112
Daily attendance (Number of children)	46.795	15.735	112
Panel B. School equipment and infrastructure			
Presence of:			
Blackboard	0.429	0.497	112
Chalks	0.411	0.494	112
Notebooks or writing paper	0.562	0.498	112
Pens/Pencils	0.554	0.499	112
Drawing Books/Cards	0.536	0.501	112
Card Games	0.286	0.454	112
Building blocks	0.339	0.476	112
Leisure Games (Dolls, stuffed animals, dress-up clothes, etc.)	0.562	0.498	112
Educational Games or Mathematics Materials	0.759	0.430	112
Storybooks (Books with pictures and text)	0.571	0.497	112
Musical instruments	0.295	0.458	112
Playground with swing, ladder, or ramp/slide	0.938	0.243	112
Potable water	0.491	0.502	112
Panel C. Instructor characteristics			
Years of schooling	8.572	1.740	402
Teaches at preschool and has another job	0.266	0.442	410

Notes: This table displays summary statistics for key characteristics of the preschool (including equipment and infrastructure) and facilitators as measured at endline for the treatment group only.

Table A3: Data Collection Instruments

	Round of data collection	
Measure/Instrument	Baseline	Endline
Anthropometric measures: Height and weight	X	
Ages-and-stages Questionnaire (ASQ)	X	
Measure of Development and Early Learning (MODEL)		X
Parenting and Learning environment module (MICS)	X	X
Quality of program components module (MELE)		X

Table A4: Balance in Attrition Rates across Treated and Control Individuals

	(1) Child test score attrition	(2) Household interview attrition
Treatment	-0.002	0.004
	(0.022)	(0.021)
Observations	4687	4687
Control mean	0.213	0.192

Notes: "Child test score attrition" is a dummy variable equal to 1 if we could not conduct the child test with the target child at endline. "Household interview attrition" is a dummy variable equal to 1 if we could not conduct the household interview at endline. All regressions include district fixed effects. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1% and * 10%).

Table A5: ITT Impacts on Child Cognitive and Social-Emotional Skills

	(1) Early Literacy Skills (index)	(2) Early Math Skills (index)	(3) Executive Function (index)	(4) Social-Emotional Development (index)	(5) Fine Motor Skill for Writing (index)	(6) Literacy interest (index)	(7) Skills index
Treatment	0.169**	0.115*	0.059	0.062	0.135**	0.097*	0.158**
	(0.073)	(0.062)	(0.055)	(0.062)	(0.054)	(0.056)	(0.068)
	[0.071]	[0.166]	[0.474]	[0.474]	[0.064]	[0.098]	[0.021]
Observations	3682	3682	3682	3682	3682	3682	3682
Control mean	-0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000

Notes: All regressions include district fixed effects. The skills index is constructed over columns (1) to (6) following Kling et al. (2007). Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1% and ** 5%). Westfall and Young (1993) *p*-values are shown in square brackets.

Table A6: Preschool Enrollment & ITT Impacts on Primary School Enrollment (Controls)

	Preschool	Primary School			
	(1) Enrolled at preschool	(2) Currently enrolled at school	(3) Repeated grade	(4) Appropriate grade for age	(5) Primary school enrollment index
Treatment	0.736***	0.061**	-0.031**	0.059**	0.164***
	(0.019)	(0.025)	(0.015)	(0.025)	(0.052)
	[0.000]	[0.033]	[0.043]	[0.043]	[0.005]
Observations	3764	3760	3742	3760	3680
Control mean	0.019	0.633	0.145	0.631	-0.000

Notes: All outcomes are measured at endline. The primary school enrollment index is constructed based on the factors shown in columns (2) to (4) following Kling et al. (2007). All regressions include district fixed effects and a vector of control variables selected by LASSO. When the control variables have missing values, continuous variables were imputed with the mean of the interest group (i.e. caregiver, target child or household), and the median for the dummy variables. In this case, the 13 baseline variables selected were: household size, a dummy if the household receives remittances, age (years), years of schooling of the caregiver, a dummy if the caregiver is illiterate, ASQ communication score, ASQ fine motor coordination score, ASQ problem solving score, ASQ socio-personal score, a dummy if the caregiver speaks Portuguese, parental stimulation index, wealth index, and height-for-age z-score of the target child. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1% and ** 5%). Westfall and Young (1993) *p*-values are shown in square brackets.

Table A7: ITT Impacts on Child Cognitive and Social-Emotional Skills (Controls)

	(1) Early Literacy Skills (index)	(2) Early Math Skills (index)	(3) Executive Function (index)	(4) Social-Emotional Development (index)	(5) Fine Motor Skill for Writing (index)	(6) Literacy interest (index)	(7) Skills index
Treatment	0.175**	0.123**	0.065	0.068	0.141***	0.100*	0.167**
	(0.072)	(0.060)	(0.055)	(0.060)	(0.054)	(0.056)	(0.066)
	[0.058]	[0.114]	[0.404]	[0.404]	[0.047]	[0.081]	[0.012]
Observations	3682	3682	3682	3682	3682	3682	3682
Control mean	-0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000

Notes: The skills index is constructed over columns (1) to (6) following Kling et al. (2007). All regressions include district fixed effects and a vector of control variables selected by LASSO. When the control variables have missing values, continuous variables were imputed with the mean of the interest group (i.e. caregiver, target child or household), and the median for the dummy variables. In this case, the 13 baseline variables selected were: household size, a dummy if the household receives remittances, age (years), years of schooling of the caregiver, a dummy if the caregiver is illiterate, ASQ communication score, ASQ fine motor coordination score, ASQ problem solving score, ASQ socio-personal score, a dummy if the caregiver speaks Portuguese, parental stimulation index, wealth index, and height-for-age z-score of the target child. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1%, ** 5%, and * 10%). Westfall and Young (1993) p-values are shown in square brackets.

Table A8: Local Average Treatment Effect (LATE) Impacts on Primary School Enrollment

	(1) Currently enrolled at school	(2) Repeated grade	(3) Appropriate grade for age	(4) Primary school enrollment index
Enrolled at preschool	0.081**	-0.041**	0.078**	0.215***
	(0.035)	(0.020)	(0.035)	(0.070)
	[0.051]	[0.062]	[0.062]	[0.010]
Observations	3760	3742	3760	3680
Control mean	0.633	0.145	0.631	0.000

Notes: All regressions include district fixed effects. The primary school enrollment index is constructed based on the factors shown in columns (1) to (3) following Kling et al. (2007). We instrument for "Enrolled at preschool" using the treatment assignment. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1%). Westfall and Young (1993) p-values are shown in square brackets.

Table A9: LATE Impacts on Child Cognitive and Social-Emotional Skills

	(1) Early Literacy Skills (index)	(2) Early Math Skills (index)	(3) Executive Function (index)	(4) Social-Emotional Development (index)	(5) Fine Motor Skill for Writting (index)	(6) Literacy interest (index)	(7) Skills index
Enrolled at preschool	0.229**	0.156*	0.081	0.084	0.183**	0.132*	0.214**
	(0.098)	(0.085)	(0.075)	(0.084)	(0.074)	(0.077)	(0.092)
	[0.081]	[0.181]	[0.483]	[0.483]	[0.075]	[0.105]	[0.026]
Observations	3682	3682	3682	3682	3682	3682	3682
Control mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: The skills index is constructed over columns (1) to (6) following Kling et al. (2007). All regressions include district fixed effects. We instrument for "Enrolled at preschool" using the treatment assignment. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (** 5% and * 10%). Westfall and Young (1993) p-values are shown in square brackets.

Table A10: Caregiver Time Investments (Controls)

	Parental practices		Engagement with Primary School Staff				
	(1) Parental Stimulation (index)	(2) Home Play (index)	(3) Met with the principal	(4) # of meetings with the principal	(5) Met with the teacher child	(6) # of meetings with the teacher	(7) Is part of the school committee
Treatment	0.172***	0.070	0.070***	0.248***	0.012	0.160	0.009
	(0.054)	(0.046)	(0.020)	(0.058)	(0.028)	(0.104)	(0.016)
	[0.006]	[0.142]	[0.007]	[0.001]	[0.834]	[0.346]	[0.834]
Observations	3384	3386	3388	3383	1968	1973	3388
Control mean	0.000	-0.000	0.212	0.398	0.321	0.624	0.138

Notes: The parental stimulation index in column (1) was constructed using 12 questions that asked parents about activities they did with the target child, including reading books, singing songs, telling stories, and playing games. The home play index in column (2) was constructed using 7 questions about items that the target child plays with at home, including homemade or store-bought toys and musical instruments. These indices were constructed following Kling et al. (2007). All regressions include district fixed effects and a vector of control variables selected by LASSO. When the control variables have missing values, continuous variables were imputed with the mean of the interest group (i.e. caregiver, target child or household), and the median for the dummy variables. In this case, the 13 baseline variables selected were: household size, a dummy if the household receives remittances, years of schooling of the caregiver, a dummy if the caregiver is illiterate, ASQ communication score, ASQ fine motor coordination score, ASQ problem solving score, ASQ socio-personal score, a dummy if the caregiver speaks Portuguese, parental stimulation index, wealth index, height-for-age z-score of the target child, and a dummy if female. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1% and * 10%). Westfall and Young (1993) *p*-values are shown in square brackets.

Table A11: Preschool & Primary School Enrollment Spillovers on Siblings

	Went to preschool (siblings aged 3 to 6)	Currently enrolled at school (sisters aged 6 to 12)	Currently enrolled at school (brothers aged 6 to 12)
Treatment	0.620***	0.031	-0.013
	(0.025)	(0.023)	(0.021)
	[0.000]	[0.180]	[0.525]
Observations	1788	1345	1487
Control mean	0.007	0.823	0.826

Notes: OLS estimates at the sibling-level are presented using outcomes reported by the caregiver at endline. All regressions include district fixed effects. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1%). Westfall and Young (1993) *p*-values are shown in square brackets.

Table A12: Preschool & Primary School Enrollment Spillovers on Siblings (Controls)

	(1) Went to preschool (siblings aged 3 to 6)	(2) Currently enrolled at school (sisters aged 6 to 12)	(3) Currently enrolled at school (brothers aged 6 to 12)
Treatment	0.484***	0.036	-0.013
	(0.020)	(0.022)	(0.021)
	[0.000]	[0.324]	[0.525]
Observations	2902	1345	1487
Control mean	0.007	0.823	0.826

Notes: OLS estimates at the sibling-level are presented using outcomes reported by the caregiver at endline. All regressions include district fixed effects. All regressions include a vector of control variables selected by LASSO. When the control variables have missing values, continuous variables were imputed with the mean of the interest group (i.e. caregiver, target child or household), and the median for the dummy variables. In this case, 10 variables were selected including: education level in years of caregiver, a dummy if caregiver is illiterate, number of children aged 0-18 living in the household, a dummy if caregiver speaks Portuguese, stimulation index, wealth index, household size, a dummy if household receives remittances, height-for-age z-score of target 3-5 and age (years). Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1%). Westfall and Young (1993) *p*-values are shown in square brackets.

Table A13: Heterogeneous Impacts on Primary School Enrollment

	(1) Currently enrolled at school	(2) Repeated grade	(3) Appropriate grade for age	(4) Primary School Enrollment Index
Panel A: Target child's gender				
Treatment	0.068**	-0.014	0.065**	0.152**
	(0.031)	(0.018)	(0.031)	(0.064)
Female	0.020	0.029	0.020	-0.008
	(0.023)	(0.017)	(0.023)	(0.050)
Treatment × Female	-0.017	-0.032	-0.016	0.013
	(0.032)	(0.023)	(0.032)	(0.070)
Observations	3760	3742	3760	3680
Outcome mean (Control Group)	0.633	0.145	0.631	-0.000
Treatment + Treatment × Female	0.051*	-0.046**	0.049*	0.165***
Panel B: Childhood Stunting				
Treatment	0.064**	-0.005	0.060**	0.125**
	(0.029)	(0.020)	(0.029)	(0.062)
Target child is stunted	-0.054***	-0.004	-0.056***	-0.118**
	(0.020)	(0.019)	(0.020)	(0.049)
Treatment × Target child is stunted	-0.011	-0.048**	-0.010	0.057
	(0.032)	(0.023)	(0.032)	(0.076)
Observations	3697	3680	3697	3621
Mean control	0.633	0.145	0.631	-0.000
Treatment + Treatment × Target child is stunted	0.052*	-0.053***	0.051	0.182***
Panel C: Caregiver's education				
Treatment	0.002	-0.049	0.002	0.064
	(0.038)	(0.030)	(0.038)	(0.079)
Caregiver is illiterate	-0.091***	-0.047**	-0.088***	-0.117**
	(0.029)	(0.023)	(0.028)	(0.059)
Treatment × Caregiver is illiterate	0.072*	0.024	0.069*	0.118
	(0.042)	(0.032)	(0.042)	(0.085)
Observations	3722	3706	3722	3644
Outcome mean (Control Group)	0.633	0.145	0.631	-0.000
Treatment + Treatment × Caregiver is illiterate	0.074***	-0.025	0.071**	0.182***
Panel D: Household wealth				
Treatment	0.051	-0.035*	0.047	0.153**
	(0.032)	(0.019)	(0.032)	(0.067)
Wealth index above median	0.041*	0.006	0.036*	0.072
	(0.021)	(0.016)	(0.022)	(0.047)
Treatment × Wealth index above the median	0.014	0.009	0.018	0.008
	(0.032)	(0.021)	(0.032)	(0.070)
Observations	3760	3742	3760	3680
Outcome mean (Control Group)	0.633	0.145	0.631	-0.000
Treatment + Treatment × Wealth index above the median	0.066**	-0.026	0.065**	0.161***
Panel E: Household distance to a pre-school				
Treatment	0.068	-0.082	0.064	0.265
	(0.072)	(0.069)	(0.072)	(0.176)
Distance above the median	0.002	-0.057	-0.000	0.100
	(0.072)	(0.069)	(0.071)	(0.177)
Treatment × Distance above the median	-0.086	0.032	-0.088	-0.247
	(0.088)	(0.072)	(0.087)	(0.203)
Observations	3760	3742	3760	3680
Outcome mean (Control Group)	0.633	0.145	0.631	-0.000
Treatment + Treatment × Distance above the median	-0.018	-0.050**	-0.024	0.018
Panel F: Children aged 3 to 5 living in the household				
Treatment	0.058**	-0.030*	0.056**	0.155***
	(0.025)	(0.016)	(0.025)	(0.052)
Number of children aged 3 to 5 above median	-0.079**	-0.018	-0.077*	-0.148*
	(0.039)	(0.027)	(0.039)	(0.077)
Treatment × Number of children aged 3 to 5 above median	0.004	-0.003	-0.001	0.025
	(0.064)	(0.038)	(0.064)	(0.126)
Observations	3760	3742	3760	3680
Outcome mean (Control Group)	0.633	0.145	0.631	-0.000
Treatment + Treatment × Number of children aged 3 to 5 above median	0.062	-0.033	0.055	0.180

Notes: This table presents the estimated heterogeneous effects of the DICIPE program on target child's primary school enrollment outcomes. These coefficients are estimated using specification (2) and following the approach we describe in Section 6.1. All regressions include district fixed effects. The primary school enrollment index is constructed over columns (2) to (4) following Kling et al. (2007). Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1%, ** 5%, and * 10%).

Table A14: Heterogeneous Impacts on Child Cognitive and Social-Emotional Skills

	(1) Early Literacy Skills (index)	(2) Early Math Skills (index)	(3) Executive Function (index)	(4) Social-Emotional Develop-ment (index)	(5) Fine Motor Skill for Writting (index)	(6) Literacy interest (index)	(7) Skills index
Panel A: Target child's gender							
Treatment	0.230***	0.141**	0.084	0.023	0.074	0.124*	0.168**
	(0.075)	(0.069)	(0.068)	(0.067)	(0.064)	(0.065)	(0.072)
Female	0.041	-0.047	-0.113**	-0.107**	-0.093*	-0.012	-0.082
	(0.057)	(0.053)	(0.052)	(0.052)	(0.049)	(0.051)	(0.053)
Treatment × Female	-0.123	-0.051	-0.046	0.080	0.123*	-0.054	-0.017
	(0.079)	(0.076)	(0.074)	(0.067)	(0.070)	(0.072)	(0.075)
Observations	3682	3682	3682	3682	3682	3682	3682
Mean control	-0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000
Treatment + Treatment × Female	0.107	0.090	0.038	0.102	0.198***	0.071	0.150*
Panel B: Childhood stunting							
Treatment	0.179**	0.139**	0.061	0.094	0.147**	0.024	0.160**
	(0.070)	(0.070)	(0.069)	(0.066)	(0.064)	(0.070)	(0.072)
Target child is stunted	-0.076	-0.048	-0.061	-0.014	-0.067	-0.098*	-0.090*
	(0.049)	(0.052)	(0.047)	(0.052)	(0.049)	(0.053)	(0.050)
Treatment × Target child is stunted	-0.016	-0.048	-0.004	-0.060	-0.034	0.121*	-0.010
	(0.075)	(0.072)	(0.066)	(0.069)	(0.066)	(0.072)	(0.071)
Observations	3623	3623	3623	3623	3623	3623	3623
Mean control	-0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000
Treatment + Treatment × Target child is stunted	0.163*	0.091	0.057	0.034	0.114*	0.145**	0.150*
Panel C: Caregiver's education							
Treatment	0.149	-0.012	0.008	-0.145	-0.041	0.067	0.006
	(0.114)	(0.099)	(0.097)	(0.089)	(0.086)	(0.092)	(0.100)
Caregiver is illiterate	-0.170**	-0.276***	-0.148**	-0.195***	-0.225***	-0.118*	-0.281***
	(0.068)	(0.073)	(0.065)	(0.060)	(0.072)	(0.065)	(0.070)
Treatment × Caregiver is illiterate	0.027	0.156	0.066	0.257***	0.220**	0.041	0.190*
	(0.101)	(0.097)	(0.092)	(0.089)	(0.096)	(0.094)	(0.097)
Observations	3646	3646	3646	3646	3646	3646	3646
Mean control	-0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000
Treatment + Treatment × Caregiver is illiterate	0.176**	0.144**	0.074	0.111*	0.179***	0.108*	0.196***
Panel D: Household wealth							
Treatment	0.080	0.031	0.042	0.063	0.086	0.059	0.089
	(0.076)	(0.067)	(0.063)	(0.072)	(0.065)	(0.066)	(0.072)
Wealth index above median	0.004	0.102*	0.120**	0.139**	0.119**	0.072	0.138**
	(0.054)	(0.055)	(0.051)	(0.056)	(0.054)	(0.053)	(0.054)
Treatment × Wealth index above median	0.169**	0.156**	0.028	-0.008	0.089	0.070	0.125*
	(0.075)	(0.073)	(0.067)	(0.078)	(0.075)	(0.071)	(0.074)
Observations	3682	3682	3682	3682	3682	3682	3682
Mean control	-0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000
Treatment + Treatment × Wealth index above median	0.249***	0.187**	0.070	0.054	0.175***	0.129*	0.214***
Panel E: Household distance to a pre-school							
Treatment	0.417*	0.331**	0.288**	0.195	0.084	-0.070	0.309
	(0.222)	(0.146)	(0.115)	(0.287)	(0.113)	(0.245)	(0.217)
Distance above the median	0.254	0.230*	0.245**	0.133	-0.064	-0.178	0.154
	(0.211)	(0.138)	(0.111)	(0.282)	(0.112)	(0.242)	(0.209)
Treatment × Distance above the median	-0.330	-0.189	-0.162	-0.234	-0.081	0.137	-0.213
	(0.239)	(0.174)	(0.134)	(0.300)	(0.144)	(0.250)	(0.224)
Observations	3682	3682	3682	3682	3682	3682	3682
Mean control	-0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000
Treatment + Treatment × Distance above the median	0.087	0.142	0.126*	-0.038	0.003	0.067	0.096
Panel F: Children aged 3 to 5 living in the household							
Treatment	0.169**	0.118*	0.055	0.063	0.125**	0.101*	0.156**
	(0.074)	(0.063)	(0.056)	(0.064)	(0.055)	(0.059)	(0.069)
Number of children aged 3 to 5 above median	-0.080	-0.146*	-0.162**	-0.117	-0.172**	-0.052	-0.181**
	(0.058)	(0.080)	(0.071)	(0.080)	(0.083)	(0.090)	(0.075)
Treatment × Number of children aged 3 to 5 above median	-0.029	-0.077	0.037	-0.044	0.111	-0.066	-0.017
	(0.112)	(0.111)	(0.108)	(0.121)	(0.118)	(0.129)	(0.112)
Observations	3682	3682	3682	3682	3682	3682	3682
Mean control	-0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000
Treatment + Treatment × Number of children aged 3 to 5 above median	0.140	0.040	0.092	0.019	0.236*	0.035	0.139

Notes: This table presents the estimated heterogeneous effects of the DICIPE program on target child's cognitive and social-emotional skills. These coefficients are estimated using specification (2) and following the approach we describe in Section 6.1. Estimated Standard errors clustered at the community level are shown in parentheses. All regressions include district fixed effects. The skills index is constructed over columns (1) to (6) following Kling et al. (2007). Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1%, ** 5%, and * 10%).

Table A15: First stage for mediation analysis

	(1) PE	(2) PS
Treatment	1.229***	-0.072
	(0.163)	(0.472)
Treatment ×		
Household Size	-0.005	-0.050**
	(0.022)	(0.022)
Age (years)	-0.105***	0.071
	(0.022)	(0.058)
Distance to nearest preschool	-0.014	-0.029*
	(0.011)	(0.015)
Years of schooling of caregiver	0.001	-0.003
	(0.009)	(0.025)
Female	0.006	0.048
	(0.020)	(0.067)
Caregiver is illiterate	0.065*	0.129
	(0.035)	(0.122)
# children aged 3-5 living in the HH	-0.019	-0.047
	(0.041)	(0.126)
# children aged 0-18 living in the HH	0.027	
	(0.024)	
Caregiver has no schooling	-0.049	-0.027
	(0.037)	(0.108)
Stimulation (index) [zi]	0.005	-0.001
	(0.003)	(0.010)
Wealth index	0.001	0.040**
	(0.007)	(0.018)
Height-for-age z-score of Target 3-5	-0.039***	-0.020
	(0.009)	(0.030)
Household receives remittances		-0.180*
		(0.105)
Observations	3764	3760
F-Stat.	111.483	4.794

Notes: PE stands for Preschool Enrollment and PS for Parental Stimulation. All regressions include district fixed effects and the baseline characteristics which interactions are shown. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1%, ** 5%, and * 10%).

Table A16: Mediators for Skills Index

	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.236	0.085	0.227			
	(0.279)	(0.081)	(0.285)			
Predicted PE	-0.147		-0.206	0.174		0.105
	(0.416)		(0.420)	(0.120)		(0.116)
Predicted PS		0.303	0.343		0.495*	0.330
		(0.223)	(0.224)		(0.287)	(0.226)
Observations	3682	3679	3679	3682	3679	3679
Overidentification test p-value				0.330	0.582	0.427

Notes: PE stands for Preschool Enrollment and PS for Parental Stimulation. *Predicted PE* and *Predicted PS* are the fitted value from the first stage regressions (3) and (4), respectively, shown in Table A15. All regressions include district fixed effects and the baseline characteristics included in the corresponding first stage models. Standard errors clustered at the community level are shown in parentheses and stars indicate the corresponding significance levels (*** 1%).

Table A17: Parameter Values and Data Sources for the Cost-Benefit Analysis

	Value	Source
	(1)	(2)
Labor force participation rate (2017)	78.9	World Bank Indicators
Average nominal monthly wage (in MZN)	$ 11,800	2019 Inquérito Sobre Orçamento Familiar (IOF)
Annual real wage growth (%, 2019)	5.1	2019 Inquérito Sobre Orçamento Familiar (IOF)
Exchange rate (MZN/USD)	60.33	IMF International Financial Statistics.
Lowest treatment effect on cognitive skills (SD)	0.097	Estimated effects shown in Figure 2
Largest treatment effect on cognitive skills (SD)	0.169	Estimated effects shown in Figure 2
Annual Cost per Child	$76.83	Financial records of the project implementation