IDB WORKING PAPER SERIES Nº IDB-WP-01284

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Inter-American Development Bank
Social Sector
Education Division

January 2022

IDB
Inter-American
Development Bank

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Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library
Closing early childhood development gaps in times of COVID-19: experimental evidence on parental networks and SMS messages / Juan Manuel Hernández-Agramonte, Olga Namen, Emma Näslund-Hadley, María Loreto Biehl.
p. cm. — (IDB Working Paper Series ; 1284)
1. Child development. 2. Early childhood education. 3. Cognitive learning. 4. Text messages (Cell phone systems). I. Hernández Agramonte, Juan Manuel. II. Namen, Olga. III. Näslund-Hadley, Emma. IV. Biehl, María Loreto. V. Inter-American Development Bank. Education Division. VI. Série.
IDB-WP-1284

Improving Early Childhood Development Outcomes in Times of COVID-19: Experimental Evidence on Parental Networks and SMS Messages*

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Abstract

This paper describes a policy experiment implemented in Costa Rica to increase learning during the COVID-19 pandemic. The experiment provided parents of preschool students with text messages to support their children's learning at home. After 15 weeks of intervention, the cognitive skills of children whose parents received the text messages rose 0.11–0.12 standard deviations. An increase in parental involvement through the proposed activities drove the effect. No evidence was found that information is transferred within parental networks.

Keywords: Education, Early Childhood Development, Text Messages, Parenting, COVID-19.
JEL classification: C93, I21, J13, O15

* We gratefully acknowledge support from Melania Brenes and Guisselle Alpızar at the Ministry of Public Education of Costa Rica. We also thank Carina Castro for her valuable input on the design of the text message campaign. Joaquin Armas, Carmen Mira-Alonso, Kelly Montaño, Rayssa Ruiz, Carolina Saavedra, and Carlos Urrutia provided outstanding research assistance. Innovations for Poverty Action assisted with the project management, field work, and Institutional Review Board (IRB) review. This research was funded by the Inter-American Development Bank (IDB). AEA RCT Registration Number: AEARCTR-0006955. IPA IRB Protocol: 15517. The opinions expressed are those of the authors and do not necessarily reflect the views of the IDB, its board of directors, or the countries they represent.
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1 Introduction

School closures because of the COVID-19 pandemic forced education worldwide to shift from classroom-based instruction to entirely remote learning strategies, in which education occurs in the student's home. The consequences for education outcomes are dramatic, particularly in developing countries, where connectivity and household resources are limited. Lichand et al. (2021) find that school closures in Brazil were associated with a 0.32 standard deviation decline in learning and a 365% increase in the risk of dropping out.

Educating very young students poses an additional challenge, as they require active support from their parents to access and use distance education resources. Preschool students in low-income households may be particularly adversely affected by school closures because their parents often have fewer resources and skills and face greater economic and psychological impacts from the pandemic (Näslund-Hadley et al., 2020).

This paper describes the impacts of a policy experiment implemented in Costa Rica to increase learning during the COVID-19 pandemic. In response to the pandemic, Costa Rica closed schools in March 2020. Together with the Ministry of Public Education of Costa Rica, we designed and implemented a text message program to support preschool students' learning at home. The program targeted parents of four- and five-year-old preschool students from public schools across the country. The text messages were designed to increase parental engagement with their children's education by providing simple learning activities and encouraging parents to use the national distance education program. In addition to the educational content, the program sought to create a more conducive environment for learning at home by addressing various dimensions of parenting, such as parenting style, time management, and healthy habits. The program was framed as part of efforts by the Ministry of Public Education to provide support to education at home during the pandemic.

As school closed, most communication between the education providers and parents was done through phone calls and WhatsApp groups. Several countries in Latin American and the Caribbean adopted this strategy (Näslund-Hadley et al., 2020). With the support of the Ministry of Education, we used these channels of communication to collect baseline information and recruit

parents through an online survey. The response was astonishing: 19,706 parents—representing 19 percent of national preschool enrollment, covering all regions of Costa Rica—answered the survey in a period of two weeks.

Teachers created parental networks by setting up WhatsApp groups for their classrooms, through which they shared information and resources. A feasible channel for spillover effects is that parents may have shared the messages with other parents or with their child's teacher. For example, York, Loeb, and Doss (2018) find that parents who received text messages intended to increase preschool children's early literacy were 0.28 standard deviations more likely to share the messages than parents who received placebo messages. In our setting, spillover effects cannot be explained by peer effects between children in the classroom, as all children were educated at home.

We ran a two-stage experiment to evaluate whether parents shared information and resources within the networks defined by groups that share a preschool teacher. The sample included 691 parental networks and 4,496 students. In the first stage, we randomly assigned networks to either a treatment group or a pure control group. In the second stage, we randomly assigned half of the parents in each treatment network to either receive the text messaging intervention (treated group) or not to receive the intervention (untreated group). This experimental design with three groups of parents—treated, untreated, and pure control—allows us to estimate spillover effects within the networks as well as the direct effect of the text messaging campaign.

As school closures imposed limitations on face-to-face assessments, we developed an innovative remote assessment to measure early cognitive skills over the phone. We adapted the Early Grade Mathematical Assessment (EGMA) and the Measuring Early Learning Quality and Outcomes (MELQO) tests. Validation of the assessment showed adequate psychometric properties (Hernandez-Agramonte et al., 2021). The assessment was administered over the phone, to overcome potential Internet connectivity restrictions. We also collected baseline and follow-up data on parents and household characteristics through online surveys, which allowed us to measure changes in parental investments and home environment.

The results show a 0.11– 0.12 standard deviation improvement in the cognitive skills of students whose parents were assigned to the text message campaign. The effect is explained mainly

by improvement in early numeracy skills. Parents increased the number of activities they performed with their children proposed by the text messages by 0.23 standard deviations. Parents also reported being more likely to complement the distance education program with additional activities. Consistent with the improvement in students' cognitive skills, we find that parents were more likely to update their beliefs about their children's skills. We do not find evidence of parents increasing their perceived capacity to guide the student learning process or their self-efficacy. These results suggest that the effect was driven by an increase in parent involvement through the proposed activities from the text messaging campaign. The short-term impacts are compelling, taking in account especially given that intervention lasted just 15 weeks.

Demand for the intervention was high, with 94 percent of parents in the treatment group declaring their interest in continuing with the program. Parents in the treatment group also reported greater interest in the national distance program continuing the following year. This result suggests that the text message campaign changed parents' perceptions about the national education policy. This result is to some extent expected, as parents recall the program as part of the Ministry of Education's activities.

We find no evidence that parents shared resources with each other or the teacher. We find no spillover effects in learning for students whose parents shared the same network but did not receive the messages. Interestingly, we find a negative effect on the report of parents accessing government distance education program resources. This result suggests that parents that did not receive the text message may have felt that their access to distance learning resources was limited.

Our results contribute to several strands of the literature. Some research in high-income countries has studied the effectiveness of online strategies to support student learning. Carlana and Ferrera (2020) evaluate a low-cost online tutoring program targeting teenage students in Italy. They find improvements in learning (0.26 standard deviations), soft skills (0.14 standard deviations), and psychological well-being (0.17 standard deviations). Hardt, Nagler, and Rincke (2020) evaluate an online peer mentoring program in Germany focused on providing students with self-organization and study techniques. They find similar effects as Carlana and Ferrara (2020), with impacts on motivation, studying behavior, and exam registration but no effect on credit acquisition.

Less research has been done in middle- and low-income countries settings, where high-technology solutions are less scalable, given the limited access to the Internet and digital devices. Crawfurd et al. (2021) study the effect of live tutoring calls from teachers. They find an increase in children's engagement with educational activities but no effect on learning.

Our paper is closest to the work of Angrist et al. (2020), who evaluate a low-tech approach in Botswana that used text messages and phone calls to support parents in educating their children. Their program focused on math and targeted students in grades 3–5. The combined approach increased students' scores by 0.12 standard deviations; on its own, the text message intervention had no effect on learning. The program increased parental demand for the intervention and their engagement with students' education, helped parents update their beliefs about their children's learning level, and increased parent self-efficacy in supporting their children's education.

We contribute to this research area by providing evidence on the effectiveness of a text message campaign targeting parents of preschool students on increasing cognitive skills. Our results differ from those of Angrist et al. (2020), suggesting that large-scale automatized text message–based instruction can be effective in increasing parental engagement with preschool student's education and learning when schooling is disrupted. The intervention is highly cost-effective, with a total cost of just US$1 per parent.

Our results are also relevant to the literature on providing parenting advice via text message on children's cognitive outcomes in early childhood. Several studies have evaluated the impact of text message interventions in the United States. They find increases in parental engagement (Hurwitz et al., 2015) and early literacy skills (York et al., 2019; Doss et al., 2019; Cortes et al., 2021). Less research has been done in low- and middle-income countries. Barrera et al. (2020) study the impact of sending text messages about parenting practices on early childhood development in Nicaragua. They find that the intervention was associated with an increase in self-reported parenting practices but had no impact on children's cognitive development. We contribute to this literature by providing evidence of the positive effect of a text message intervention on early numeracy outcomes in settings where schooling is disrupted.

This paper also contributes to the literature on programs spillovers within educational settings. Some studies have explored how programs implemented in classrooms or schools can affect individuals who do not receive the intervention. Berlinski et al. (2021) exploit the randomization of different shares of students whose parents receive a text message campaign in the same classroom. They find a larger effect on educational outcomes in large-share classrooms, suggesting that the program had positive spillovers on students whose parents were not part of the program. We contribute to this literature by exploring how parents share information on promoting children's cognitive development at home in a setting of virtual service provision where school childcare centers are closed and most communication takes place remotely.

The paper is organized as follows: Section 2 describes the recruitment of participants, the experimental design, and the intervention. Section 3 discusses the instruments, data, and estimation strategy. Section 4 analyzes the internal validity of the experiment and discusses the main results. Section 5 explores the mechanisms behind the effects. Section 6 discusses the cost-effectiveness of the program. Section 7 presents our conclusions.

2 Intervention and study design

2.1 Institutional background

Costa Rica was one of the first countries in Latin America to adopt COVID-19 pandemic preventive measures, closing its schools on March 12, 2020. To continue with the school year, the Ministry of Public Education (MEP) launched the national remote learning program Aprendo en Casa (AeC). The program combined printed materials and technology-based solutions to address heterogeneous household access to telecommunications, aiming to reach the largest share of students. Educational content was uploaded to MEP's website and adapted to be broadcast in TV and radio. Teachers were instructed to communicate with their students' families and provide additional materials and guidance, usually through phone calls and WhatsApp groups, where Internet was available.

According to our baseline data, 98% of teachers established a communication channel with families and students, 68% were able to communicate with all of their families, and 25% were able to communicate with more than half of their families. The main purpose of this communication

was to supervise how parents and students progressed with their study materials (90%), to solve doubts (84%), and to support parents in providing learning guidance to their children (84%).

MEP was quick to provide an alternative to school-based education, but the strategy faced several challenges. For preschool students, adults need to help their children access the strategy materials and guide them through the learning process, but few parents have the training or experience to guide their children's formal education at home. MEP provided weekly support to parents; 84% of parents reported that someone at MEP had communicated with them. The main purposes of these calls was to discuss AeC (73%) and support/motivate parents to support their children's learning (53%). This interaction was mainly through WhatsApp messages (73%), video call software (17%), and phone calls (8%). Parents found that supporting their children's education at home was challenging, with 57% reporting that they needed more help. Their main requests were receiving more activities to implement at home and more directions on how to implement those activities.

Adding to the challenges of implementing the remote educational process was the fact the pandemic had severe effects on the home environment. About 73% of households reported having lost part of their income, and 65% reported that at least one of their members lost their job (Näslund-Hadley et al., 2020). These economic losses took a mental health toll. Our survey data show that 89% of parents presented at least one symptom of mental health deterioration. These dimensions are out of the programmatic scope of the ministries of education of the region, but many of them have acknowledged the need to include components that address home environments in their remote education programs (Näslund-Hadley et al., 2020)

2.2 Intervention

The text message campaign was implemented over a period of 15 weeks (August 25–December 5, 2020) (figure A.1 in the annex provides a timeline of the project). Parents in the treatment group received a series of 3–4 weekly messages, up to a total of 68 messages. Text messages were prescheduled to be sent on particular days and times of the week between 3 pm and 5 pm, using a bulk messaging platform. The messages aimed to increase parental involvement in child education

by providing parents with simple numeracy and literacy activities.[1] The activities were based on MEP's preschool curriculum and designed to be implemented at home with no additional support materials. For example, *"Let's do addition! Ask your child: If you have four bananas and I give you two more, how many bananas will you have? Practice every day with different quantities."* The messages also aimed to increase the engagement of parents and children with the national distance learning program (AeC), by providing information on the program and encouraging parents to communicate with their child's teacher. The learning activities were combined with a weekly motivational message that prompted parents to implement the activities.[2]

The pandemic adversely affected the psychological well-being of parents and children. To address the problem, the campaign complemented the educational and motivational messages with advice on positive parenting, time management, and healthy habits.[3] Parents in the untreated and control groups received a shorter information campaign with eight simple messages reminding parents about channels for accessing AeC.

2.3 Experimental design

We worked with the preschool education unit of MEP to recruit parents and design the text message campaign. Taking advantage of the fact that teachers and parents used WhatsApp groups to communicate with each other during school closure, we conducted a national online survey using this channel. The survey invited parents of preschool children to join the study and captured baseline information. We collected 19,706 surveys, representing 19 percent of national preschool enrollment, covering all regions of Costa Rica. Figure A.2 in the appendix shows the distribution of survey responses across the country.

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[1] The messages used behavioral tools to address common parent biases regarding early education. They included information on the returns to early childhood development to address inaccurate beliefs about the importance of early ages learning. Messages with positive affirmations of parents' ability to ensure children learning were also included. Some of these messages were combined with a loss aversion framing.

[2] Numeracy skills included counting, adding, subtracting, comparing, and sequencing. Literacy skills included oral comprehension, expressive vocabulary, and breaking words into syllables.

[3] The positive parenting messages included nonviolent parenting and effective parent–children interactions. The healthy habits messages provided tips for addressing adults' and children's physical and mental health. These messages recommended physical activity, peer interactions, stress management, and avoidance of long hours in front of screens.

We conducted a two-stage randomized experiment to quantify the direct and spillover effects of providing the text message campaign. First, we conducted a group-level randomization at the parental network level to divide then sample into pure control networks and treated networks. Second, we conducted individual-level randomization within treated networks to randomly assign half of the parents to either receive the text message intervention (treated group) or not receive the intervention (untreated group). This experimental design allowed us to estimate spillover effects as the difference in outcomes between untreated parents in treated networks and parents in pure control networks. We estimated direct effects as the difference in outcomes between treated parents in treated networks and parents in pure control networks.[6] We defined a network as a group of parents that share the same preschool teacher.

The experimental design required networks in which at least two parents consented to participate. The intervention focused on parents with four- or five-year-old children,[4] reducing the experimental sample to 4,496 parents. We stratified by province, class size, and level of interaction between parents and teacher within the network.[5]

Of the 691 parental networks in the study, 338 (2,174 parents) were in the pure control group and 353 (2,322 parents) were in the treatment group. Within the treatment group, 1,072 parents received the text messaging intervention (treated group), and 1,250 did not receive it (untreated group).

3 Data and empirical strategy

We relied on three main sources of information: (i) online surveys administered to teachers and parents at baseline to recruit participants and capture pretreatment characteristics; (ii) a follow-up online survey with parents; and (iii) a phone-based student assessment to measure cognitive skills, including early numeracy and communication skills.[6]

[4] Parents of six- and seven-year-old children also completed the baseline survey. MEP asked that they be included to obtain information on the transition from preschool to primary school during COVID-19.

[5] The level of interaction was measured based on teacher report of the level of communication with parents.

[6] For more information about partial population designs, see Moffit (2001), Duflo and Saez (2003), and Vazquez-Bare (2020).

3.1 Parent and teacher survey

We collected baseline information on teachers and parents by leveraging the existing communication channels between the Ministry of Education, preschool teachers, and students' parents. During the pandemic, teachers used different means to communicate with parents and coordinate the implementation of the remote education strategy. One of the most common channels was WhatsApp groups, which enabled teachers to interact with parents using a variety of formats, including text, audio, images, and videos. We asked teachers to share with parents an online survey together with a short introduction to the project. The survey requested consent from parents to join the study and collected information on pretreatment characteristics, including household demographics and socioeconomic information and baseline information on mechanisms.

Once the intervention was completed, we collected endline information on parents through an online survey sent to them by text message. The message was sent before a surveyor called to schedule the child's assessment. During the call, the surveyor asked the parent to fill out the form. The survey captured information on the main mechanisms through which we expected the intervention might affect children's skills. They included changes in parents' behaviors related to the engagement with the text message campaign and the government distance learning program. We used a modified version of UNICEF's Family Care Indicators to capture the activities parents performed at home with their children.[7]

In addition, as the intervention included text messages that addressed the student's home learning environment, we collected measures of dimensions of parenting and the psychological welfare of students and parents. We included a modified version of the Parenting Sense of Competence Scale to measure parents' satisfaction and efficacy. To measure nonviolent parenting, we used the Child Discipline Module of the Multiple Indicator Cluster Survey. To measure student and parent well-being, we used a modified version of the Child Behavioral Check List and the Center for Epidemiologic Studies Depression Scale Revised. These outcomes were added to a summary score and standardized to have a mean of zero and a standard deviation of one in the pure control group.

[7] Activities included reading a book, telling stories, singing, playing with toys, drawing, engaging in physical exercise, counting objects, comparing numbers, adding and subtracting, naming objects, and breaking words into syllables.

3.2 Children's cognitive skills

Our main outcome of interest is children's cognitive skills. During implementation of this evaluation, Costa Rica was under a strict lockdown that prevented face-to-face standardized testing. We therefore used a validated phone-based skill assessment that was adapted from the Early Grade Mathematical Assessment (EGMA) and Measuring Early Learning Quality and Outcomes (MELQO) tests (Hernandez-Agramonte et al., 2021). The assessment was administered over the phone to overcome Internet connectivity restrictions. The phone-based assessment consists of multiple numeracy questions, including questions on spatial reasoning, oral counting, addition, subtraction, sequences, and comparisons. The assessment also measured a set of early literacy skills, including expressive vocabulary, syllabication, and oral comprehension.

The test was administered by enumerators who called the parents to schedule a time to test their child. During the call, parents were provided support to set up the phone call in speaker mode. We incorporated a series of procedures to increase the reliability of the measures collected. We instructed parents to prepare a place for their child to take the test without distractions. Parents were told that the test was low-stakes, in order to minimize their interventions, and were instructed not to interrupt or help the child during the test. We used reminders in different parts of the assessment asking parents not to intervene during the call. The assessment scores were standardized so that the pure control group has a mean of zero and a standard deviation of one.

3.3 Empirical strategy

To evaluate the direct and spillover effects of providing information through a text message campaign, we estimate the following ordinary least squares (OLS) regression:

$$Y_{ic} = \alpha + \beta_1 D_{ic} + \beta_2 (1 - D_{ic}) x T_c + \delta \mathbf{X}_{ic} + \gamma_s + \epsilon_{ic} \quad (1)$$

where Y_{ic} is the outcome for each individual $_i$ (child or parent) in network $_c$; D_{ic} is an indicator of whether the individual was assigned to receive the text message campaign (treated group); and $(1 - D_{ic}) x T_c$ is an interaction term that indicates individuals that belong to a treated network but where themselves not assigned to receive the text messages (untreated group). Individuals in the pure control networks are the omitted category; $\mathbf{X}_{ic}$ is a matrix of parents' and students' baseline characteristics, including students' age, gender, and baseline well-being; parents' age, gender,

education, baseline investment behavior, access to distance education program, nonviolent parenting, psychological well-being, and stress; and the number of children the parents care for, the number of assets in the household, and whether parents work remotely. The γ_s are the randomization strata fixed effects; ϵ_{ic} is the error term. We cluster standard errors at the network level, allowing for correlation between disturbances of students and parents under the same teacher. Parameter 1 is interpreted as the direct effect of being selected to receive the text message campaign. Parameter 2 corresponds to the spillover effect of being part of a parental network in which other parents were selected to receive the text message campaign.

3.4 Balance and attrition

We use baseline data to assess the sample balance across treatment status. Table 1 shows the average and standard deviations for pre-intervention characteristics by group. The average age of students was four and a half, and 48% were girls. Among parents, 96% were women, and 53% had completed high school or a higher level of education. The average number of children they took care of was two. Use of the government's remote education program was very high, with 93% of parents reporting using it. Only 16% of households in the sample worked remotely.

Table S.1 shows the same information at endline. Experimental groups do not differ based on observable characteristics of children and parents, except in one variable: access to the government's distance learning program. To account for possible finite sample imbalances, we control for this covariate in the regressions.

Attrition in the outcomes collected from students at the endline averaged 58% for the treated group, 59% for the untreated group, and 57% for the pure control group. For the parent survey, attrition was 44% for the treatment group, 44% for the untreated group, and 40% for the pure control group. The main reason for the loss of respondents was that parents changed their phone numbers or the phone was deactivated. Attrition is correlated with some observable characteristics (table 2), but the coefficients are very small in most cases, and attrition is not correlated with the treatment assignment, providing evidence of the internal validity of the results.

4 Results

4.1 Delivery and sharing of text messages

Table 3 shows the estimates obtained from equation (1) for parents' survey responses on the delivery and sharing of the text message campaign. Parents in the treatment group were 47 percentage points more likely to recall having received the text messages than parents in the pure control group. Among parents that recalled the messages, parents in the treatment group were also more likely to identify the Ministry of Education as the sender (11 percentage point difference) and to recall the frequency and content of the messages (53 and 29 percentage point differences, respectively).

We find no evidence that parents shared the text messages with other parents or the teacher. In addition, parents that belonged to a treated network but were not assigned to receive the text messages did not report recalling the text messages more than the pure control group. This finding suggests that communication channels between teachers and parents may work in a vertical direction (teacher to parent) rather than upward (parent to teacher) or horizontally (parent to parent). These networks were created by the Ministry of Education to respond to school closures; they may not coincide with other networks in which parents may interact more actively. The same is true of results from baseline data that only 27% of parents reported communicating with other parents. The main reason to talk to another parent was to discuss AeC (40%), support each other on guiding their children's education (36%), and share information strategies to teach their children (27%). We find similarly low levels of communication between parents at endline, with only 18% having talked to another parent (62% had talked to their teacher).

4.2 Effects on cognitive skills

Table 4 presents the results for our primary outcomes. Column 1 shows the estimate for cognitive skills for the sample of children that took the cognitive test. Column 2 restricts the sample to children whose parent completed the survey and for whom we studied the treatment mechanisms. Columns 3 and 4 provides the estimates controlling for covariates.

For parents assigned to receive the text message campaign, we find a 0.11 standard deviation (p = 0.049) increase in their children's cognitive skills after 15 weeks. When we restrict the sample to students whose parents completed the survey, the effect size grows to 0.18 standard deviations (p = 0.018). The results are similar when we include covariates: Standard errors decline and the point estimates are slightly larger, with 0.12 standard deviations (p = 0.027) and 0.19 standard deviations (p = 0.011). Table 5 presents estimates for each of the test sections. The results appear to be driven mainly by an increase in numeracy skills, such as oral counting, comparison, and sequences.

Across all specifications, on average we find no effects on children whose parents belonged to a treated network but were not assigned to receive the text messages. This result is not surprising given previous evidence that parents did not seem to share the text messages within the network.

Table S.6 presents inverse-probability weighting estimates of treatment effects as a robustness check. The estimated effects are very similar to the ones found using the OLS approach.

5 Mechanisms

5.1 Parental engagement with their children's education

The intervention targeted parental engagement with their children's education in two areas: (i) types of activities that parents do with their children and (iii) parents' and children's involvement with the Ministry of Education's distance learning program. By providing parents with tips on simple numeracy and literacy activities, the intervention seeks to increase the types and number of activities that parents engaged in with their children in these domains. Column 1 in table 6 presents the results of the parents' survey for the number of activities parents reported performing with their children in the previous three days. Parents in the treatment group report a 0.24 standard deviation higher engagement with the proposed activities (p = 0.001).

The text message campaign was implemented during the school year, during which parents and students were following the Ministry of Education's distance learning program (AeC). The text message campaign complemented AeC by providing simple learning activities related to the preschool curriculum. It also included additional information on the AeC strategy and encouraged parents to reach out to the teacher for support. Columns 2–6 in table 6 present parents' responses

to questions about AeC: access to resources, whether they complemented it with additional activities, their ability to support their children during AeC activities, their engagement with teachers, and their interest in AeC continuing the following year. The intervention was not associated with changes in how parents engaged with the distance learning program or parents' reported capacity to guide their children's education. As expected, treated parents reported being more likely to complement AeC with other activities. They also increased their interest in the program continuing the following school year. Parents that did not receive the text messages reported being less likely to access AeC resources. The text message program was framed as part of AeC; if parents that did not receive the text messages were aware of the campaign, it could have negatively affected their perception of access.

5.2 Parents' beliefs and a positive home environment

Increasing parental engagement in activities with their children allows parents to access new information on their children skills and update their beliefs (Angrist et al., 2020). It could also increase their sense of self-efficacy.

Table 7 shows that parents did update their beliefs about the level of skills their children have. This result is consistent with the effects on children's skills and the increase in parental involvement in the student learning process. The increase in parent–student interaction did not translate into a greater sense of parental self-efficacy, however.

The program included messages on positive parenting, time management, and healthy habits, intended to help parents create a conducive home environment for learning. Table 7 presents parents' survey responses on changes in related behavior at home. Together with increasing their involvement with educational activities, parents performed some of the noneducational activities the program proposed. Children in the treatment group were 8 percentage points more likely to have talked with another classmate. There appears to have been no effect on the use of discipline or parents' ability to maintain a routine and follow a schedule.

5.3 Cost-effectiveness

The intervention was associated with a 0.11-0.12 standard deviation increase in children's numeracy skills. This effect is similar to other low-cost interventions implemented during the first year of the pandemic. Angrist et al. (2020) show that a program that combined phone calls and text messages to primary school students in Botswana was associated with a 0.12 standard deviation increase in the ability to perform numerical operations.

The intervention is low cost, with the cost per text message of about US$0.014 (8 Colones). A total of 68 SMS were sent to 1,072 parents, leading to a total cost of US$1,021. The cost per parent was about US$1 (544 Colones). Based on the average effect, the average cost per student for a 0.01 standard deviation increase in learning was thus US$0.08.

The text message campaign is more cost-effective than other interventions aiming to increase early numeracy skills. Bando et al. (2019) review 10 interventions implemented in Latin America with an average cost of US$181.20 per student. They achieved a 0.10 standard deviation increase in achievement in math. These interventions were implemented at the school level before the pandemic, which involved higher logistical costs. For remote interventions implemented during the pandemic, Angrist et al. (2020) report a gain of 0.89 standard deviations per US$100 for children that received both texts and phone calls.

6 Conclusion

This paper presents some of the first evidence on supporting preschool student learning during the COVID-19 pandemic. It describes a two-stage randomized experiment to quantify the direct and spillover effects of providing parents of preschool students with a text message program to support their learning at home. The results show that text messages can be effective in increasing preschool children's cognitive skills. After 15 weeks of intervention, cognitive skills increased by 0.11–0.12 standard deviation. The effect is explained mainly by an increase in numeracy skills.

Parents who participated in the program reported being more likely to complement the distance education program with additional activities, but there is no evidence that parents increased their capacity to guide the student learning process or their self-efficacy. These results

suggest that the effect was driven by an increase in parent involvement through the proposed activities.

This paper is one of the first to study how parents interact with peers during school closure. We examined whether the text message campaign produced spillovers effects on untreated parents in a treated network. We find no evidence that parents shared the text messages with other parents in the same classroom. This finding suggests that existing communication channels may work in a vertical direction (teacher to parent) rather than upward (parent to teacher) or horizontally (parent to parent).

The results are promising for education policy in developing countries during school disruptions. Cell phone coverage in these countries is wide, making text message programs highly scalable. The intervention is very cost-effective, with a cost of US$0.08 per student for a 0.01 standard deviation gain in learning.

7 References

Angrist, Noam, Peter Bergman, and Moitshepi Matsheng. 2020. "School's Out: Experimental Evidence on Limiting Learning Loss Using 'Low-Tech' in a Pandemic." NBER Working Paper 28205, National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w28205.

Bando, Rosangela, Gertler, Paul, and Näslund-Hadley, Emma. 2019. "Inquiry and Problem Based Pedagogy: Evidence from 10 Field Experiments". IDB Working Paper. https://publications.iadb.org/en/inquiry-and-problem-based-pedagogy-evidence-10-field-experiments.

Barrera, Oscar, Karen Macours, Patrick Premand, and Renos Vakis. 2020. "Texting Parents about Early Child Development: Behavioral Changes and Unintended Social Effects." Policy Research Working Paper 9492, World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/34914.

Berlinski, Samuel, Matias Busso, Taryn Dinkelman, and Claudia Martínez A. 2021. "Reducing Parent-School Information Gaps and Improving Education Outcomes: Evidence from High- Frequency Text Messages." NBER Working Paper 28581, National Bureau of Economic Research, Cambridge, MA. https://www.nber.org/papers/w28581.

Carlana, Michela, and Eliana La Ferrara. 2021. "Apart but Connected: Online Tutoring and Student Outcomes During the COVID-19 Pandemic." *SSRN Electronic Journal*.

Cortes, Kalena, Fircke, Hans, Loeb, Susanna, Song, David., 2021. "Too little or too much? Actionable advice in an early-childhood text messaging experiment". *Education Finance and Policy.*

Crawfurd, Lee, David Evans, Susannah Hares, and Justin Sandefur. 2021. "Teaching and Testing by Phone in a Pandemic." Working Paper 591, Center for Global Development, Washington, DC.

Doss, Christopher, Fahle, Erin, Loeb, Susanna, York, Benjamin, 2019. More Than Just a Nudge: Supporting Kindergarten Parents with Differentiated and Personalized Text Messages. *Journal of Human Resources* 54 (3): 567-603.

Duflo, E., and E. Saez. 2003. "The Role of Information and Social Interactions in Retirement Plan Decisions: Evidence from a Randomized Experiment." *Quarterly Journal of Economics* 118 (3): 815–42.

Hardt, David, Markus Nagler, and Johannes Rincke. 2020. "Can Peer Mentoring Improve Online Teaching Effectiveness? An RCT During the COVID-19 Pandemic " CESifo Working Paper 8671. https://www.cesifo.org/DocDL/cesifo1_wp8671.pdf.

Hernandez-Agramonte, Juan Manuel, Namen, Olga, Näslund-Hadley, Emma. 2021. Remote Assessment of Early Childhood Cognitive Skills. Working Paper.

Hurwitz, Lisa, Lauricella, Alexis, Hanson, Ann, Raden, Anthony, Warterlla, Ellen. 2015. Supporting Head Start parents: impact of a text message intervention on parent–child activity engagement. *Early Child Development and Care* 185 (9): 1373-1389.

Lichand, Guilherme, D´oria, Carlos Alberto, Leal, Onıcio, and Cossi, João. 2021. "The Impacts of Remote Learning in Secondary Education: Evidence from Brazil During the Pandemic." https://publications.iadb.org/en/impacts-remote-learning-secondary-education-evidence-brazil-During-pandemic.

Moffit, R. 2001. "Policy Interventions, Low-level Equilibria and Social Interactions." In *Social Dynamics*, ed. S.N. Durlauf and P. Young, 45–82. Cambridge, MA: MIT Press.

Näslund-Hadley, Emma, Juan Manuel Hernández Agramonte, Kelly Montaño, Olga Namen, Guiselle Alpizar, Úrsula Luna, Laura Ochoa, Juan Felipe García, Brunilda Peña de Osorio, María Loreto Biehl, Juan Maragall, Carolina Méndez, Jennelle Thompson. 2020. "Remote Initial Education and Mental Health During the COVID-19 Pandemic." Education Policy Brief 4, Latin American and the Caribbean, Education Division, Social Sector. Washington, DC: Inter-American Development Bank. https://publications.iadb.org/en/education-policy-brief-latin-america-and-caribbean-4-remote-initial-education-and-mental-health.

Vazquez-Bare, G. 2020. "Identification and Estimation of Spillover Effects in Randomized Experiments." https://arxiv.org/pdf/1711.02745.pdf.

York, Benjamin N., Susanna Loeb, and Christopher Doss. 2019. "One Step at a Time: The Effects of an Early Literacy Text-Messaging Program for Parents of Preschoolers." *Journal of Human Resources* 54, no. 3: 537–66.

8 Tables

Table 1: Baseline characteristics of sample, by treatment status

Characteristic	(1) Control	(2) Treated	(3) Untreated	*F*-test for joint orthogonality	Observations
Child					
Female	0.48	0.47	0.48	0.86	4,496
	(0.01)	(0.01)	(0.01)		
Age	4.48	4.47	4.47	0.79	4,496
	(0.01)	(0.01)	(0.01)		
Well-being	-0.01	0.01	0.00	0.88	4,496
	(0.02)	(0.03)	(0.03)		
Parent					
Female	0.96	0.96	0.96	0.51	4,496
	(0.00)	(0.01)	(0.01)		
Age	31.17	31.01	31.13	0.79	4,496
	(0.14)	(0.19)	(0.20)		
Completed high school	0.53	0.55	0.53	0.57	4,496
	(0.01)	(0.02)	(0.02)		
Number of children	1.99	2.02	1.97	0.44	4,496
	(0.02)	(0.03)	(0.03)		
Stress	-0.01	0.04	-0.02	0.38	4,496
	(0.02)	(0.03)	(0.03)		
Well-being	-0.01	-0.01	0.03	0.54	4,496
	(0.02)	(0.03)	(0.03)		
Types of activities	-0.00	0.01	-0.00	0.93	4,496
	(0.02)	(0.03)	(0.03)		
Violent parenting	-0.01	-0.01	0.03	0.48	4,496
	(0.02)	(0.03)	(0.03)		
Accesses Aprendo en Casa	0.93	0.93	0.92	0.48	4,496
	(0.01)	(0.01)	(0.01)		
Number of household assets	7.36	7.32	7.33	0.82	4,496
	(0.04)	(0.06)	(0.05)		
Works remotely	0.19	0.18	0.18	0.66	4,496
	(0.01)	(0.01)	(0.01)		
Networks	338	353	353		

Note: The values displayed for *t*-tests are the differences in the means across groups. Standard errors are clustered at the network level. All estimation regressions include fixed effects using variable strata. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table 2: Attrition between baseline and endline

Characteristic	(1) Child's test	(2) Parent survey	(3) Child's test	(4) Parent survey
Treatment status				
Treated	0.01	0.03	0.01	0.03
	(0.63)	(1.22)	(0.68)	(1.18)
Untreated	0.01	0.04	0.02	0.04
	(0.75)	(1.51)	(0.79)	(1.41)
Student				
Female			-0.03**	-0.03
			(-2.33)	(-1.31)
Age			-0.01	0.01
			(-0.39)	(0.67)
Well-being			0.01	-0.00
			(0.80)	(-0.08)
Parent				
Age			-0.00	-0.00*
			(-0.54)	(-1.87)
Female			-0.03	-0.12**
			(-0.78)	(-2.06)
Completed high school			0.03*	-0.04*
			(1.72)	(-1.76)
Number of children			-0.02***	0.00
			(-3.02)	(0.20)
Stress			-0.00	0.01
			(-0.55)	(0.51)
Well-being			-0.01	-0.02
			(-0.54)	(-1.17)
Types of activities			0.01*	-0.02
			(1.72)	(-1.47)
Violent parenting			-0.02***	0.00
			(-2.72)	(0.33)
Accesses Aprendo en Casa			-0.05*	-0.05
			(-1.68)	(-1.00)
Number of household assets			0.00	-0.01
			(0.86)	(-0.66)
Works remotely			0.07***	0.05
			(3.31)	(1.30)
Covariates	No	No	Yes	Yes
Observations	4,496	1,893	4,496	1,893
Networks	691	642	691	642

Note: Table shows coefficients of an ordinary least squares regression. The dependent variable measures the probability of attrition for the parent survey and the child assessment. All models include strata fixed effects. Standard clustered errors at the network level are in parenthesis. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table 3: Treatment effects on SMS compliance

	(1) Received SMS	(2) MoE sent SMS	(3) Weekly Delivered	(4) Recall content	(5) Teacher shared SMS with parents	(6) Parent received SMS from another parent	(7) Parent shared SMS with another parent	(8) Parent shared SMS with Teacher
Treated	0.47***	0.11***	0.53***	0.29***	-0.20***	-0.01*	-0.00	-0.05
	(15.56)	(4.48)	(12.99)	(6.24)	(-5.72)	(-1.70)	(-0.04)	(-1.54)
Untreated	-0.02	-0.00	0.09*	-0.00	-0.02	0.02	-0.02	-0.01
	(-0.50)	(-0.02)	(1.69)	(-0.04)	(-0.41)	(0.89)	(-0.56)	(-0.29)
Control mean	0.39	0.87	0.29	0.42	0.27	0.01	0.14	0.09
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,095	551	551	551	551	551	495	450
Networks	548	370	370	370	370	370	344	319

Note: Table shows the estimated treatment effects on the reception of the text message campaign and parent sharing behavior. It compares the treated parents in the treatment network (treated) with control parents in the pure control network and spillover parents in the treatment network (untreated) with parents in the pure control network. The table presents estimates adding controls for covariates, as described in the empirical strategy section. Supplemental table S.2 reveals that the results are the same without controls. All respondents were asked to indicate whether they recalled receiving a text message (column 1). Only parents who recalled receiving the message were asked to answer the questions in column 2– 8. Therefore, the number of observations is different. All models include strata fixed effects. Standard clustered errors at the network level in parenthesis. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table 4: Treatment effects on children's cognitive skills

	(1) Cognitive Skills	(2) Cognitive Skills	(3) Cognitive Skills	(4) Cognitive Skills
Treated	0.11**	0.18**	0.12**	0.18**
	(0.06)	(0.08)	(0.05)	(0.07)
Untreated	0.02	0.07	0.03	0.10
	(0.06)	(0.07)	(0.05)	(0.07)
Control mean	-0.00	-0.00	-0.00	-0.00
Covariates	No	No	Yes	Yes
Observations	1,893	1,095	1,893	1,095
Networks	642	548	642	548

Note: Table shows estimated treatment effects on students' cognitive, early numeracy, and literacy skills test scores. It compares treated parents in the treatment network (treated) with control parents in the pure control network and spillover parents in the treatment network (untreated) with parents in the pure control network. Scores are normalized to the distribution of the control group. The mean in the control group is thus zero. Columns 1 and 2 present estimates without controls. Columns 3 and 4 control for students' age and gender, parents' age and gender, parental investment index, use of the Ministry of Education's distance learning strategy, the number of assets, and the number of children being cared for. All models include strata fixed effects. Standard clustered errors at the network level in parenthesis. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table 5: Treatment effect on cognitive skills

Item	(1) Spatial	(2) Counting	(3) Comparing numbers	(4) Adding	(5) Sequencing	(6) Comparing weight and size	(7) Dividing words into syllables	(8) Oral comprehension	(9) Vocabulary
Treated	0.10	0.19***	0.22***	0.05	0.14*	0.10	0.04	0.12*	0.08
	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)	(0.08)
Untreated	0.11*	0.07	0.07	0.14*	0.12	0.12*	-0.09	0.06	0.03
	(0.06)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)	(0.08)	(0.07)	(0.07)
Control mean	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095	1,095
Networks	548	548	548	548	548	548	548	548	548

Note: Table shows estimated treatment effects on students' cognitive skills test scores. It compares treated parents in the treatment network (treated) with control parents in the pure control network and spillover parents in the treatment network (untreated) with parents in the pure control network. Scores are normalized to the distribution of the control group. The mean in the control group is thus zero. Estimates are presented with controls for students' age and gender, parents' age and gender, parental investment index, use of the Ministry of Education's distance learning strategy, the number of assets, and the number of children being cared for. All models include strata fixed effects. Standard clustered errors at the network level in parenthesis. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table 6: Treatment effects on parental engagement with their children's education

	(1) Types of activities	(2) Combines AeC	(3) Ability to support children	(4) Access to AeC	(5) Parent calls teacher	(6) AeC should continue next year
Treated	0.24***	0.04*	0.04	0.01	0.03	0.05**
	(3.63)	(1.96)	(0.70)	(0.45)	(0.76)	(2.43)
Untreated	0.09	0.02	-0.03	-0.08***	-0.01	0.03
	(1.28)	(0.74)	(-0.70)	(-2.78)	(-0.36)	(1.58)
Control mean	0.00	0.90	1.75	0.87	0.62	0.88
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,095	943	1,095	1,088	1,095	1,095
Networks	548	502	548	548	548	548

Note: Table shows the estimated treatment effects on parental engagement in education. It compares treated parents in the treatment network (treated) with parents in the pure control network and spillover parents in the treatment network (untreated) with parents in the pure control network. The table presents estimates adding controls for covariates, as described in the empirical strategy section. Appendix table S.4 shows that the results remain the same without controls. Column 1 presents an index showing the number of types of activities that adults in the household engaged in with their children in the previous three days. The activities captured by the index include both pedagogic and non-pedagogical activities: reading a book, telling stories, singing songs, playing with a toy, naming or drawing things, engaging in physical exercise, counting objects, comparing the size of objects, adding and subtracting, and dividing words into syllables. This index is normalized to the distribution of the control group; the mean of the control group is thus zero. All models include strata fixed effects. Standard clustered errors at the teacher level in parenthesis. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table 7: Parents' beliefs, self-efficacy, and a positive home environment

	(1) Parent perception on children's skills	(2) Parent Self-efficacy	(3) Children talk to peers	(4) Violent parenting	(5) Maintain schedule
Treated	0.14*	-0.00	0.08**	-0.02	-0.05
	(1.93)	(-0.05)	(2.26)	(-0.42)	(-1.61)
Untreated	-0.01	-0.02	0.02	0.07	-0.02
	(-0.09)	(-0.29)	(0.76)	(1.14)	(-0.67)
Control mean	-0.00	0.00	0.26	0.00	0.84
Covariates	Yes	Yes	Yes	Yes	Yes
Observations	1,095	1,095	1,095	1,095	1,095
Networks	548	548	548	548	548

Note: Table shows the estimated treatment effects on parental engagement in education. It compares treated parents in the treatment network (treated) with parents in the pure control network and spillover parents in the treatment network (untreated) with parents in the pure control network. The table presents estimates adding controls for covariates, as described in the empirical strategy section. Appendix table S.5 shows that the results remain the same without controls, except for the indicator "maintaining schedule." Columns 1, 2, and 4 present an index for perceived skills, parental self-efficacy, and violent parenting. These indexes are normalized to the distribution of the control group. The mean in the control group is thus zero. All models include strata fixed effects. Standard clustered errors at the teacher level in parenthesis. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

9 Appendix

Figure 1: Geographic distribution of sample households in Costa Rica

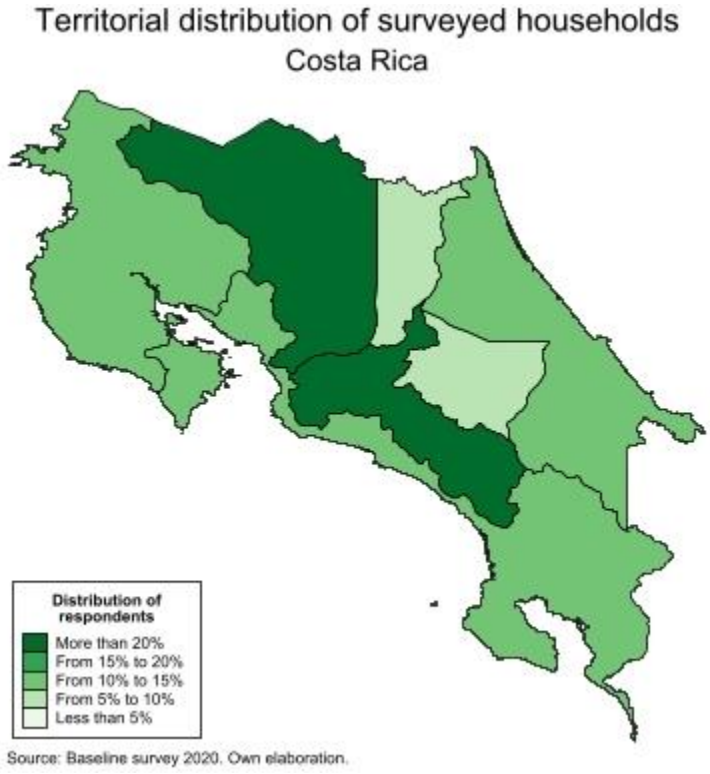
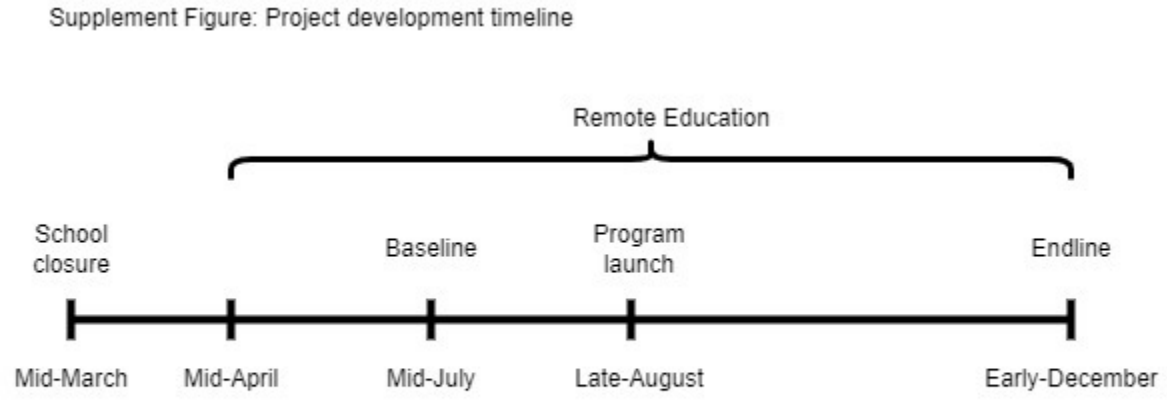


Figure 2. Project timeline, 2020



Notes: All dates refer to the year 2020.

Table S.1: Baseline characteristics of endline sample, by treatment status

Characteristic	(1) Control	(2) Treated	(3) Untreated	F-test for joint orthogonality	Observations
Child					
Female	0.51	0.49	0.50	0.76	1,893
	(0.01)	(0.02)	(0.02)		
Age	4.49	4.47	4.46	0.54	1,893
	(0.02)	(0.02)	(0.02)		
Well-being	-0.02	0.06	-0.02	0.41	1,893
	(0.04)	(0.05)	(0.04)		
Parents					
Female	0.98	0.95	0.96	0.23	1,095
	(0.01)	(0.01)	(0.01)		
Age	31.48	31.18	31.42	0.85	1,095
	(0.27)	(0.44)	(0.36)		
Completed high school	0.52	0.55	0.50	0.47	1,095
	(0.02)	(0.03)	(0.03)		
Number of children	2.05	1.99	2.12	0.22	1,095
	(0.04)	(0.06)	(0.05)		
Stress	0.03	0.10	-0.07	0.16	1,095
	(0.04)	(0.06)	(0.06)		
Well-being	0.01	0.08	0.06	0.57	1,095
	(0.04)	(0.07)	(0.06)		
Types of activities	-0.02	0.03	-0.01	0.78	1,09
	(0.04)	(0.06)	(0.06)		
Violent parenting	0.09	-0.01	-0.04	0.11	1,095
	(0.04)	(0.06)	(0.05)		
Accesses Aprendo en Casa	0.96	0.92	0.92	0.01***	1,095
	(0.01)	(0.02)	(0.01)		
Number of household assets	7.26	7.38	7.25	0.45	1,095
	(0.06)	(0.09)	(0.10)		
Works remotely	0.14	0.19	0.15	0.22	1,095
	(0.01)	(0.03)	(0.02)		
Number of clusters	318	261	261		

Note: The values displayed for *t*-tests are the differences in the means across the groups. Standard errors are clustered at network level. All estimation regressions include fixed effects using variable strata. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table S.2: Treatment effects on text message compliance

	(1) Received SMS	(2) MoE sent SMS	(3) Weekly Delivered	(4) Recall content	(5) Teacher shared SMS with parents	(6) Parent received SMS from another parent	(7) Parent shared SMS with another parent	(8) Parent shared SMS with Teacher
Treated	0.48***	0.11***	0.52***	0.31***	-0.20***	-0.01*	-0.00	-0.05
	(16.26)	(4.58)	(12.91)	(6.64)	(-5.91)	(-1.78)	(-0.02)	(-1.60)
Untreated	-0.03	-0.00	0.10*	0.00	-0.02	0.02	-0.02	-0.01
	(-0.76)	(-0.05)	(1.71)	(0.05)	(-0.43)	(0.85)	(-0.35)	(-0.22)
Control mean	0.39	0.87	0.29	0.42	0.27	0.01	0.14	0.09
Covariates	No	No	No	No	No	No	No	No
Observations	1,095	551	551	551	551	551	495	450
Networks	548	370	370	370	370	370	344	319

Note: Tables shows estimated treatment effects on the reception of the SMS text message campaign and parent sharing behavior. It compares treated parents in the treatment network (treated) with parents in the pure control network and spillover parents in the treatment network (untreated) with parents in the pure control network. The table presents estimates without controlling for covariates. All respondents were asked to indicate whether they recalled receiving a text message, as shown in column 1. Only parents that recalled receiving the text message were asked to answer the questions in columns 2– 8). The number of observations is therefore different in each column. All models include strata fixed effects. Standard clustered errors at the network level in parenthesis. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table S.3: Treatment effect on cognitive skills

	(1) Spatial	(2) Counting	(3) Comparing numbers	(4) Adding	(5) Sequencing	(6) Comparing weight and size	(7) Dividing words into syllables	(8) Oral comprehension	(9) Vocabulary
Treated	0.08	0.13**	0.12**	0.04	0.11*	0.03	0.03	0.07	0.10*
	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.06)
Untreated	0.07	0.01	-0.00	0.08	0.07	0.11**	-0.08	0.04	-0.08
	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.05)	(0.05)
Control mean	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,893	1,893	1,893	1,893	1,893	1,893	1,893	1,893	1,893
	642	642	642	642	642	642	642	642	642

Note: Table shows estimated treatment effects on students' cognitive skills test scores. It compares treated parents in the treatment network (treated) with control parents in the pure control network and spillover parents in the treatment network (untreated) with parents in the pure control network. Scores are normalized to the distribution of the control group. The mean in the control group is thus zero. Estimates are presented with controls for students' age and gender, parents' age and gender, parental investment index, use of the Ministry of Education's distance learning strategy, the number of assets, and the number of children being cared for. All models include strata fixed effects. Standard clustered errors at the network level in parenthesis. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table S.4: Treatment effects on parental engagement with child education

	(1) Types of activities	(2) Combines AeC	(3) Ability to support children	(4) Access to AeC	(5) Parent calls teacher	(6) AeC should continue next year
Treated	0.23***	0.04**	0.04	0.01	0.03	0.05***
	(3.42)	(2.03)	(0.72)	(0.47)	(0.68)	(2.66)
Untreated	0.08	0.02	-0.04	-0.08***	-0.02	0.03
	(1.16)	(0.76)	(-0.79)	(-2.67)	(-0.49)	(1.47)
Control mean	0.00	0.90	1.75	0.87	0.62	0.88
Covariates	No	No	No	No	No	No
Observations	1,095	943	1,095	1,088	1,095	1,095
Networks	548	502	548	548	548	548

Note: Table shows estimated treatment effects on parental engagement in education. It compares treated parents in the treatment network (treated) to control parents in the pure control network and the spillover parents in the treatment network (untreated) with parents in the pure control network. The table presents estimates without controlling for covariates. Column 1 presents an index showing the number of types of activities adults in the household engaged in with their children in the past three days. The activities captured by the index includes both pedagogic and non-pedagogical activities: reading a book, telling stories, singing songs, playing with a toy, naming or drawing things, engaging in physical exercise, counting objects, comparing the size of objects, adding and subtracting, and dividing words into syllables. This index is normalized to the distribution of the control group. The mean in the control group is thus zero. All models include strata fixed effects. Standard clustered errors at the teacher level in parenthesis. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.

Table S.5: Parents' beliefs and a positive environment

	(1) Parent perception on children's skills	(2) Parent Self-efficacy	(3) Children talk to peers	(4) Violent parenting	(5) Maintain schedule
Treated	0.15**	0.01	0.08**	-0.06	-0.05*
	(2.04)	(0.09)	(2.36)	(-0.90)	(-1.78)
Untreated	-0.02	0.01	0.02	0.00	-0.02
	(-0.30)	(0.17)	(0.72)	(0.04)	(-0.65)
Control mean	-0.00	0.00	0.26	0.00	0.84
Covariates	No	No	No	No	No
Observations	1,095	1,095	1,095	1,095	1,095
Networks	548	548	548	548	548

Note: Table shows the estimated treatment effects on parental engagement in education. It compares treated parents in the treatment network (treated) with control parents in the pure control network and spillover parents in the treatment network (untreated) with parents in the pure control network. The table presents estimates without controlling for covariates. Column 1, 2, and 4 presents an index for perceived skills, parental self-efficacy, and violent parenting. These indexes are normalized to the distribution of the control group. The mean in the control group is thus zero. All models include strata fixed effects. Standard clustered errors at the teacher level are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level

Table S6: Treatment effects on children's cognitive skills: Robustness check

	Cognitive
Treated	0.13**
	0.05
Untreated	0.03
	-0.00

Note: Treatment effects were estimated using inverse-probability-weighting. Results include all standard controls. * Statistically significant at the 10 percent level; ** at the 5 percent level; *** at the 1 percent level.