Improving preschool services: Experimental evidence on a technology-aided intervention in India *

Ajinkya Keskar[†] Mauricio Romero[‡] Abhijeet Singh[§]

Karthik Muralidharan[¶]

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Abstract

We use a randomized controlled trial to assess the impact of a large-scale technology-aided intervention involving a digital home simulation program to enhance parent-child interaction and improve the quality of preschool services for children aged 3-5. Results from the base experiment indicate that, although the program successfully delivered and managed to engage parents on the digital platform, there was no improvement in children's mathematics and language learning outcomes. A refined version of the intervention, with an additional arm delivering a more intense version of the program, increased parental engagement on the platform and improved children's learning outcomes by 0.12σ for the relevant sample of children who were part of the preschool system. At a total cost of \$1.17 (97.11 rupees) per child, these findings demonstrate the efficacy of a highly cost-effective program in improving children's learning outcomes in low- and middle-income countries at scale.

Keywords: Preschool, Early childhood, Education Technology, India

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⁺Binghamton University (SUNY) ;E-mail: akeskar@binghamton.edu

[‡]ITAM; J-PAL; E-mail: mtromero@itam.mx

[§]Stockholm School of Economics; J-PAL; E-mail: abhijeet.singh@hhs.se

[¶]UC San Diego; NBER; J-PAL; E-mail: kamurali@ucsd.edu

1 Introduction

Over 250 million children under 5, most in South Asia and sub-Saharan Africa, do not fulfill their cognitive potential (Engle et al., 2007; Grantham-McGregor et al., 2007; Black et al., 2017). They receive limited cognitive stimulation at home and, given low quality and resource constraints, public preschools often fail to remediate this lack (Behrman et al., 2013). However, although ensuring access to quality preschool education is now an explicit global policy goal, how to achieve this remains substantially unclear. Despite substantial evidence that high-quality home visiting programs can improve cognitive stimulation at home, scaling these to serve millions of children has been difficult due to sharp declines in quality at larger scales (Araujo et al., 2021; List et al., 2018).¹ Augmenting staff capacity in preschools also may have high returns for child development (Ganimian et al., 2024; Andrew et al., 2024), but it is unclear that governments will manage to increase staff capacity sufficiently.²

In this paper, we evaluate multiple iterations of a large-scale intervention to improve child development in Indian preschools. The program reflects fundamental insights from the studies above while front-loading delivery concerns at scale. The intervention, developed by an Indian non-profit company (Rocket Learning, henceforth RL), offers structured activities to support children's cognitive development to parents and preschool workers. These activities are sent using WhatsApp groups, which include all parents and the preschool worker in each preschool center (anganwadi center, AWC). Parents are encouraged to report the completion of activities in the group, e.g., by posting images or videos. The content of activities was inspired by previously evaluated home visitation programs, and the delivery reflected the importance of group-based interactions and feedback for delivering and sustaining such interventions effectively (e.g., Grantham-McGregor and Smith (2016)). The program features multiple (automated) behavioral nudges based on a sophisticated tech-enabled back-end to encourage usage. Implementation is done in partnership with state governments, and protocols build upon existing government supervision mechanisms to facilitate initial adoption and compliance. In 2022-23, the intervention reached 1.5 million children across 7 Indian states.

¹For promising evidence on home visitation programs, see, e.g., Attanasio et al. (2020) in Colombia, Andrew et al. (2020) in India, Zhou et al. (2021) in China, Bos et al. (2024) in Bangladesh, and Blimpo et al. (2016) in Gambia.

²This reflects concerns of both financing and implementation. Specifically, as **Bold et al.** (2018) highlights, governments face substantially different constraints for large-scale hiring than those faced by NGOs. Recruiting, potentially, hundreds of thousands of childhood education educators requires solving sequential issues of budget allocation, procurement, and political economy constraints in the public sector.

We evaluated this program using two successive large-scale field experiments, implemented between 2021 and 2023, in the state of Maharashtra (population \sim 123 million, (UIDAI, 2021)). Our study is based in one district (Amravati), with a study universe of 2017 preschool centres with a total reported enrollment of \sim 67,000 students in 2019.

The first experiment was set up as the program was being rolled out across the district. Reflecting the organization of preschool centres in the state, we randomized program assignment across clusters of AWCs (called "beats") — of a total of 85 beats in the sample, we randomly allocated 45 beats to treatment status and 40 beats to control status. In treatment centers, the program was delivered by Rocket Learning using the same protocols as in currently-universalized programs in other districts in Maharashtra. In control centers, students received "business-as-usual" inputs, which included other pre-existing phone-based support in some centers that was started during the pandemic.³ Program implementation started in November 2021, and we collected independent measures of program implementation and learning outcomes in July 2022 in a subsample of AWCs, surveying preschool workers, parents, and students. We administered learning assessments designed to be appropriate for students aged 3-5 years.

These independently collected data suggest that the program was delivered successfully and changed parent-child interactions. Compared to the control group, parents in the treatment group were 14.1 percentage points (70%) more likely to receive educational messages on a WhatsApp group and 15.5 percentage points (316.3%) more likely to receive educational messages 4-5 times a week. Parents in the treatment group were 14 percentage points (64%) more likely to share educational messages with their children than parents in the control group, and 11 percentage points (52%) more likely to engage with their children using the delivered educational content. However, nine months after the launch of the intervention, we see no effect of the program on our primary outcome of interest, children's learning outcomes.

Null results on learning outcomes after the first nine months are consistent with multiple explanations, including (i) the curricular content was ineffective, (ii) the program duration was inadequate, and/or (iii) the intensity of program delivery was inadequate. In the second year of the experiment, we modified the experiment to enable us to distinguish between these competing explanations to allow for program iteration.

³Thus, the evaluation design matches the criteria for experimentation at scale laid out by Muralidharan and Niehaus (2017), with a study population representative of a larger population, an intervention that is delivered at scale, and where randomization is at a large unit to accommodate possible spillovers directly.

The principal modification was to develop an "intensive" variant of the intervention that would increase the program's potency and evaluate it using a further experimental arm. This enhanced program variant increased the frequency and personalization of messages to parents regarding their child's learning progress, as well as nudges and encouragement to set and achieve weekly learning goals. Preschool workers in the intensive group were provided with more content, guidance, and peer support activities. They also participated in more frequent training sessions and were involved in efforts to boost parental engagement through phone calls and parent-teacher meetings (see Section 2.2.2 for details). Notably, although the intensive variant of the program is more input-heavy than the regular implementation, all additional features were selected so that they could be deployed at much larger scales if shown to be effective. The intensive program variant was developed in the first quarter of 2023, program assignment was randomized in April 2023, and rolled out in May 2023 to randomly assigned AWCs.

In this second year, we aimed to assess if (i) the regular intervention maintained the delivery of the program material and usage, (ii) whether the intensive variant succeeded in raising program voltage, and (iii), whether either arm improved the learning outcomes of students compared to "business-as-usual". Of the 255 AWCs sampled for data collection in the first year, we retained the 120 control AWCs in control status and randomly assigned 90 AWCs (out of the 135 treatment AWCs) to receive the intensive intervention.⁴ Additionally, we drew a further random sample of 90 AWCs in the treated beats to ensure we were adequately powered to detect modest treatment effects.⁵ Between September and November 2023 — i.e., roughly 14 months after our previous survey and 5 months after the start of the intensive program — we collected independent data collection in all 345 centers from preschool workers, parents, and students.

The regular intervention continued to demonstrate similar levels of program delivery as observed in the first midline survey, indicating that the regular treatment intensity was sustainable over time. Compared to the control group, parents in the regular intervention were 12.3 percentage points (115%) more likely to receive educational messages via a WhatsApp group. Parents also remained significantly more likely to report receiving materials, sharing those materials with their children, and sharing their children's progress on WhatsApp groups. These findings were further corroborated by field sur-

⁴The program continued being implemented in all treatment AWCs, including those not in our survey sample, as per the original protocols after our first survey. Thus, AWCs in our intensive variant received the regular variant of the program from November 2021 to April 2023 and the intensive variant afterward.

⁵Note that these AWCs were treated for an identical duration and with the same protocols as AWCs in the regular intervention arm in our surveys. Results remain qualitatively unchanged, on excluding the 90 AWCS and restricting the analysis to the set of AWCs present both in the midline and the endline.

veyors' direct observations of the WhatsApp groups in all AWCs. However, we found no impact of the regular intervention on children's learning outcomes approximately two years after the launch of the base intervention. Thus, while the regular RL program successfully sustained parental engagement on the WhatsApp groups, it was unable to improve children's learning outcomes, despite the increased duration of exposure.

Program intensity, or "voltage," increased sharply on all measures in the intensive variant. We report our main results for the intensive variant using the relevant subsample of children who were part of the anganwadi system during the 2022-2023 or 2023-2024 academic years, around the time the refined intervention was launched.⁶ Compared to the regular variant, parents in the intensive variant were 17.2 percentage points (74%) more likely to report receiving educational material via WhatsApp, with similar results across all forms of WhatsApp-based messages, including videos, audio messages, activities, and homework. WhatsApp groups were more likely to be active and included more members. This increase in engagement translated into additional usage: households in the intensive group were 14 percentage points (79%) more likely to report sharing content back on the WhatsApp group, a result also confirmed by data from the backend RL servers, which maintained a real-time log of all interactions on the WhatsApp groups. Parents in the intensive treatment were also significantly more likely to report sharing educational content with their children than those in the regular intervention. They were also more likely to report that the program benefited their children and that their children enjoyed the activities.

Results on children's learning outcomes indicate that the intensive variant led to significant learning gains of approximately 0.12σ for students exposed to the intensive version of the program. Restricting the sample to students who were still enrolled in AWCs at the time of our survey in 2023 increased the estimated effect size to $\sim 0.2\sigma$. This effect is significant in aggregate, as well as separately for both language and mathematics. While coefficients for executive functioning are positive, they are not statistically significant. Overall, we interpret our results as suggesting that the modifications made to the regular intervention were successful in substantially increasing the intensity of the program and, consequently, its efficacy. These modifications were inexpensive to implement and designed to be scalable (with several features already incorporated into further program expansions), suggesting that they may enhance program effectiveness in other contexts as well. We discuss cost-effectiveness and concerns around scaling in Section 6.

⁶In the appendix, we report the results for the entire sample and confirm that the results remain qualitatively unchanged.

The principal contribution of our experiment is to demonstrate promising evidence of scalable models to improve school readiness in public preschools in middle-income countries. In particular, we demonstrate how now widespread mobile telephony and cheap internet can substantially lower delivery costs of home visitation programs while maintaining efficacy. Further expansion of research into such models may have the potential to solve a substantial global problem of school readiness.⁷

Our experiment builds upon insights from three distinct strands of economics research. The first is a substantial literature on the effectiveness of improving cognitive stimulation in early childhood in low-resource environments. While influential studies focused on small high-intensity trials in particularly disadvantaged communities tracked to adulthood (Heckman et al., 2010; Conti et al., 2016; Gertler et al., 2014), recent trials have shown promising evidence of improved cognition also in programs delivered at larger scales in low- and middle-income countries (Attanasio et al., 2020). Yet, delivering these programs using volunteers or preschool workers has been hard to scale up with efficacy (Araujo et al., 2021).

The second strand is a parallel literature on education technology in developing countries (Escueta et al., 2017; Rodriguez-Segura, 2022). Much of this literature has focused on solutions for school-going students, such as personalized computer-aided learning or the provision of laptops (cite OLPC). There is, however, a growing body of work on the use of mobile telephones to deliver pedagogical material (see, e.g., experiments that provide individual tutoring via mobile phones, (Conti et al., 2016; Bergman, 2021; Angrist et al., 2022; Hassan et al., 2024)). Our experiment demonstrates how a similar approach could yield substantial gains at low marginal costs for preschool programs. We further demonstrate how it can be set up to build on existing supervisory and administrative structures, thus increasing the possibility of adoption and efficacy.

Finally, we relate directly to the literature on scaling social programs effectively (List et al., 2018; List, 2022; Muralidharan and Niehaus, 2017; Agostinelli et al., 2021). In particular, we offer an illustration of how an experimental approach to "problem driven iterative adaptation" (Andrews et al., 2013) can be used to improve programs even when they are already at scale but with the possibility of adaptation.

The rest of the paper is organized as follows: Sections 2 and 3 describe the intervention and data; Sections 4 and 5 present results for the base and refined interventions; Sections 6 and 7 provides a detailed discussion of the results and conclude.

⁷Ravindran (2021); Nandi et al. (2020); Hazarika and Viren (2013) provide evidence showing that the *aganwadi* system significantly affects children's school readiness.

2 Intervention and Experiment Design

2.1 Context

Our intervention takes place within India's Integrated Child Development Services (ICDS) infrastructure, which provides health and educational services to over 30 million children aged 3-6 at preschool centers known as *anganwadi* centers, through frontline workers referred to as *anganwadi* workers. The ICDS is structured as follows: each state in India comprises a group of districts led by a district collector. Each district is further divided into projects or blocks, overseen by a child development project officer (CDPO). A supervisor manages a group of approximately 20 *anganwadi* centers within each project. At the local level, each *anganwadi* center serves a catchment area of 400-800 people, staffed by one *anganwadi* worker and one *anganwadi* helper (see Ganimian et al. (2024) for an in-depth overview of the functioning of *anganwadi* centers and the various responsibilities of the *anganwadi* worker).

In India, the academic year typically begins in June and ends in April of the following year, with summer holidays in April and May. As a result, five-year-olds usually exit the AWC system in April of a given academic year, and a new group of three-year-olds begins attending *anganwadi* centers in June. From the *anganwadi* system, students typically transition to first grade; however, transitions to private preschools are also common. Table 1 provides details on these transitions in our study sample. Of the 2,793 children enrolled in the *anganwadi* system for the 2022-2023 academic year, 927 (33.2%) continued in the *anganwadi* system for the 2023-2024 academic year, 1,158 (41.5%) transitioned to first grade or higher, 703 (25.2%) transitioned to private preschools, and 5 (0.1%) dropped out.

Private preschools tend to place greater emphasis on early childhood education (ECE) than *anganwadis* (Singh, 2014). Children attending AWCs receive limited educational instruction from *anganwadi* workers, with an average of 38 minutes of instructional time per day, while the remainder of the time is devoted to nutritional, health-related activities, and administrative duties (Ganimian et al., 2024).

2.2 Intervention

The program was implemented by Rocket Learning (RL), a nonprofit organization in partnership with the Maharashtra state government, leveraging the existing Integrated

Childhood Development Services (ICDS) infrastructure. By operating within the ICDS framework, RL aims to enhance children's cognitive skills by effectively utilizing technology to connect *anganwadi* centers and government schools with parents. As of 2024, RL has reached approximately 3 million parents in 10 states in India.

Our study was conducted in the district of Amravati, which has a population of 2.8 million and is the ninth-largest city in Maharashtra. Figure 1 outlines the program timeline, and Figure A4 in the Appendix provides the consort flow diagram for the entire experiment. The base intervention with the regular version of the RL program began in November 2021, and we conducted a survey to measure relevant outcomes in July 2022. A refined intervention, with an intensive version of the RL program as an additional experimental arm, began in May 2023, and the final survey was collected from September to November 2023 to measure the relevant outcomes. Below, we detail the two interventions.

2.2.1 Base intervention

The core theory of change underlying the base intervention was to improve learning outcomes for children aged three to six by strengthening the educational support provided to parents and *anganwadi* workers (preschool teachers), given the limited cognitive simulation at home, and the lack of resource-constrained preschools to remediate the issue (Behrman et al., 2013). In this age group, children from low socio-economic status (SES) households typically attend government-operated preschool centers known as *anganwadis* and receive limited educational instruction from *anganwadi* workers.

The intervention protocol was as follows: first, a WhatsApp group for each cohort was set up by the *anganwadi* worker.⁸ All the parents of the children in this cohort and the *anganwadi* worker were added to this group. Next, the *anganwadi* worker added a central number belonging to the Rocket Learning back-end system to the group. Rocket Learning uses this number to send parents a standard set of activities (with videos) to do with their children. A weekly schedule is sent to parents, and activities are arranged around a theme. The videos (and the play-based activities they link to) are meant to be simple and easy to do with children in a limited time. The activities cover the broad domains of literacy, numeracy, motor, cognitive, and socio-emotional skills (see Appendix, Section A.2 for details on the content delivered). Parents were encouraged, but *not* required to

⁸WhatsApp is an instant messaging service owned by an American company, Meta Platforms. WhatsApp has around 2.78 billion active users worldwide, with India having the highest monthly active users at 535.8 million.

upload their responses to the activities to the group (typically as an image or a video of them performing the activity with the child). Parents were also encouraged to ask questions and get answers from their peers and the *anganwadi* worker. The primary role of the *anganwadi* worker in the RL program was to encourage parents to engage on the WhatsApp group. It is important to note that the *anganwadi* worker was not expected to send educational content independently on the WhatsApp group. The program deliberately aimed to avoid increasing the workload of the *anganwadi* workers, who are already recognized as being overburdened.

2.2.2 Intensive intervention

In May 2023, Rocket Learning introduced an intensive version of its regular program. The intensive version contained elements previously absent from the regular version or elements whose potency was amplified over and above the regular version. This intensive program built upon the existing program and incorporated several additional components targeted at children, parents, and *anganwadi* workers. Below are the details regarding the different components of the intensive RL program:

1. Digital Content and WhatsApp-based Nudges: This component consisted of five elements. First, sending daily content on a separate WhatsApp group for the angan*wadi* teachers over and above the content sent on the WhatsApp group for parents. RL sent 3 pieces of educational content daily and worksheets for revisions, which could be used for in-class instructions. This was done both in the regular and the intensive group of the intervention; however, anganwadi workers in the intensive group received much more content and guidance on the teacher groups compared to the regular group. Additionally, in the regular arm, this was done as one-way information dissemination, whereas in the intensive arm, anganwadi workers were encouraged to send photos/videos of them using the RL content on the WhatsApp group for the *anganwadi* teachers. Second, parents in the intensive group were provided real-time nudges based on their activity level on the WhatsApp groups. The RL backend team acknowledged and sent appreciative messages to those engaging with the content on the WhatsApp group. This feature was not available to users in the regular group. Third, efforts were made to foster engagement and peer support among the anganwadi workers. On a weekly basis, every anganwadi worker in the intensive group nudged two of her colleagues to engage with the RL content and send photos of educational activities performed by her at the AWCs. Fourth,

in the intensive group, RL provided personalized messages to parents regarding their child's learning level and corrective activities for the skills the child is lacking. Lastly, parents in the intensive group were encouraged to set a learning goal for their child at the beginning of the week. Direct messages were sent to parents, encouraging them to meet this goal, and celebratory messages were sent if the goal was met. This feature was unavailable to users in the regular group.

- 2. Phone-call based nudges and Online training: This component consisted of two elements. First, RL conducted training sessions that encouraged the anganwadi workers to increase parental engagement, which was their primary responsibility on the WhatsApp groups, and also provided sessions aimed at enhancing the anganwadi workers' skills and knowledge of early childhood education. These training sessions were typically conducted two times a year in the regular group; however, for the anganwadi workers in the intensive group, the frequency of the training was increased to quarterly. Second, in the intensive group, phone calls were made to parents with low activity levels on the WhatsApp groups to boost engagement.
- 3. *Organized offline events*: This component consisted of two elements. First, in the intensive group, parent-teacher meetings were organized two times during the intervention, which served three purposes: 1) Onboarding parents on the RL WhatsApp group who still needed to join. 2) Inform parents of the importance of engaging with the educational activities provided on the WhatsApp groups and provide them with a workbook designed by RL for revising the educational content. 3) Orient *anganwadi* workers to drive parental engagement on the WhatsApp groups. Second, participation certificates were distributed to parents, students, and *anganwadi* workers in the intensive group for partaking in the RL program.

2.3 Experiment design

The experiment consists of a base intervention designed to examine the impact of the regular Rocket Learning (RL) program on student learning outcomes. This was followed by a refined intervention, which introduced an intensive version of the RL program to assess its effects on student learning outcomes. This section outlines the randomization process and sampling methodology.

2.3.1 Randomization

The study universe comprises 13 administrative blocks (referred to as projects) within the district of Amravati. Each block was subdivided into clusters of *anganwadi* centers (AWCs), referred to as beats, as defined by Rocket Learning. The 13 projects included a total of 88 beats. The randomization for the base intervention, which commenced in November 2021, was conducted at the beat level. The randomization protocol was as follows: First, beats with fewer than three *anganwadi* centers (AWCs) were excluded, leaving a total of 85 beats. Second, the 85 remaining beats were randomized into treatment and control groups, clustered at the project level. A total of 45 beats were assigned to the treatment group, which received the regular RL program, while 40 beats were assigned to the control group. Third, we randomly selected three *anganwadi* centers (AWCs) within each beat, stratified by enrollment, dividing the universe into terciles. As a result, the treatment group consisted of 135 AWCs across 45 beats, while the control group consisted of 120 AWCs across 40 beats.

The randomization for the refined intervention, which commenced in May 2023, following the base intervention, was conducted at the anganwadi level and introduced the intensive version of the RL program as an additional experimental arm. Note that AWCs in our intensive variant received the regular variant of the program from November 2021 to April 2023 and the intensive variant afterward. The randomization protocol was as follows: First, out of the 135 AWCs that were part of the treatment group for the base intervention, 90 were randomly assigned to receive the intensive version of the RL program, while the remaining 45 continued to receive the regular RL program. Randomization was clustered at the beat level, with two AWCs per beat assigned to the intensive program and one AWC assigned to the regular program. Second, an additional 45 AWCs were randomly selected from the universe of AWCs within the 45 treatment beats that were not included in the base intervention and were assigned to the regular RL program. This assignment was also clustered at the beat level, with one AWC per beat assigned to the regular RL program. Third, the 120 AWCs across the 40 control beats continued to remain in the control group. In summary, for the refined intervention, the regular RL group consisted of 135 anganwadis, the intensive RL group consisted of 90 anganwadis, and the control group consisted of 120 anganwadis.

2.3.2 Sampling

The sample of students for the study was drawn from the enrollment registers of the *anganwadi* centers. For each round of the intervention, we conducted a household-level survey, a child assessment survey, and an *anganwadi* worker survey. Below, we detail the sampling protocol for both the base and refined interventions.

For the base intervention, within each of the randomly selected *anganwadi* centers, we randomly sampled 67% of the enrolled children for assessment. Out of the 3,569 households initially targeted, our final sample consists of 1,281 households (656 households in the treatment group and 625 households in the control group) with complete household and child assessment surveys.⁹ There is no differential attrition across groups. The difference in mean household and child assessment compliance is statistically insignificant between the treatment and control groups (see Tables A1 and A2 in the Appendix).

From the universe of 255 randomly selected AWCs, we completed the *anganwadi* worker survey for 221 centers.¹⁰ Table A3 in the Appendix indicates a slight imbalance in the attrition rate for the *anganwadi* worker survey, with a higher rate of completion in the control group compared to the treatment group. However, in terms of student enrollment and *anganwadi* worker experience, the difference between the two groups is statistically insignificant.

We find no significant differences between the treatment and control groups in most household and child characteristics (see Table A4 in the Appendix). However, households in the treatment group have a 4.5 percentage point higher probability of owning their home than the control group (p-value < 0.1). All regression specifications include fixed effects for children's year of birth. We present our results unconditionally and con-

⁹From the universe of 255 *anganwadi* centers (135 AWCs in the treatment group and 120 AWCs in the control group), we attempted to survey 3,569 households associated with 245 *anganwadis*. We were unable to attempt 10 *anganwadis* due to accessibility issues or weather conditions. We successfully completed the household survey in 1,839 households (51.5%). In 36 cases, consent for the survey was refused. Among the 1,694 incomplete household surveys: 464 households (13%) were locked, parents were not at home in 227 households (6%), the child was not in the 3–5 age group in 941 households (26%), and the wrong child's home was listed in the roster in 12 households (0.3%). Of the 1,839 completed household surveys, we were able to complete child assessments in 1,281 households (70%). In 12 households (0.6%), consent for the child assessment was refused. Among the remaining 558 incomplete child assessments: the child was unavailable in 167 households (9%), the child did not speak Marathi in 347 households (19%), the assessment could not be attempted in 21 households (1%), the child dropped out during the evaluation in 10 households (0.5%), and for one household (0.05%), the reason remains unknown.

¹⁰Of the 255 *anganwadis*, survey consent was refused in one AWC. In 27 AWCs, we were unable to attempt the survey due to accessibility issues or weather conditions. In 4 AWCs, the center was locked or the *anganwadi* worker was not present. For 2 *anganwadis*, the reason for non-completion was listed as "others" (details available upon request).

ditional on covariates, which include a homeownership indicator and fixed effects for parental education level.

For the intensive RL intervention, in the randomly selected *anganwadi* centers, all children aged 4 and 5 on March 31, 2023, whose names were present in the enrollment register were included in the survey.¹¹ In total, we attempted to survey 8,410 households associated with 345 *anganwadi* centers. The final sample comprises 3,934 households with complete household and child assessment surveys.¹²

There is no differential attrition across groups. The difference in mean household and child assessment compliance rates is statistically insignificant between the experiment's intensive, regular, and control arms. We also find no significant difference in the like-lihood of the child not knowing Marathi or the presence of the mother/father during the survey (see Table A9 and A10 in the Appendix). Lastly, we completed the *anganwadi* survey at all the 345 centers in our sample. We find no significant differences in the likelihood of the *anganwadi* center being open or the average number of children registered at the center (see Table A11 in the Appendix). On average, 24 children in the 4-6 age group are registered at an *anganwadi* center, and more than 85% of the *anganwadi* workers have more than 5 years of work experience.

Table A12 in the Appendix presents differences in household and child characteristics between the intensive, regular, and control groups for the refined intervention. The Ftest of joint significance indicates no significant differences between the groups across a range of characteristics. However, we observe a slight imbalance in parental education and children's age. As a result, we report all results, both conditional and unconditional, on parental education, and we include the child's age in all specifications.

¹¹Due to a complex field error, children aged six were also sampled, and children aged three were missed.

¹²We attempted 6,811 household surveys; in 4,276 households, we completed the household survey. 46 households refused consent. Of the 2489 incomplete household surveys, 1356 households, either the parents or the child did not know the local language, Marathi, in which the RL content was delivered. 558 households had migrated elsewhere. 413 households were locked, could not be found, or parents were absent. In 73 households, the respondent gave another appointment day, but it could not be completed. 13 households dropped the survey in between, and for 6, the birth year of the child was outside the prespecified range. For 70 households for brevity, but it is available upon request. Out of the 4267 complete household surveys, we did not get consent for the child survey in 12 households and could not complete the child survey in 321 households. Of these 321 households, 217 respondents gave another appointment day, but it could not be completed. In 23 households, the child did not complete the assessment. For 61 households, the reason for survey incompletion is coded as "others", with several categories. We exclude the exact breakdown of survey incompletion is coded as "others", with several categories. We exclude the exact breakdown of survey in 231 households. The child did not complete the assessment. For 61 households, the reason for survey incompletion is coded as "others", with several categories. We exclude the exact breakdown of survey incompletion for these 61 households for brevity, but it is available upon request.

3 Data

For both the base and refined interventions, the data is derived from two primary sources: (1) surveys administered by J-PAL staff and (2) program engagement data obtained from the backend Rocket Learning servers. Below, we provide a detailed description of the data collected.

The primary outcome of interest is students' cognitive ability. In July 2022, eight months after the base intervention began, we conducted oral tests in mathematics, executive function, and the local language, Marathi. J-PAL staff administered these tests in respondents' homes to ensure the integrity of the assessments. Similar tests were administered between September and November 2023, five months after the launch of the intensive RL program.

The J-PAL research team independently designed the tests to capture a range of student achievements and competencies. Test scores were generated using the Item Response Theory (IRT) model, which places all students on a standardized scale and adjusts for the varying difficulty of test items, thereby avoiding the use of unweighted scores (Zhou et al., 2021). Differing from the base intervention, we also collected information on children's socio-emotional skills using the Strengths & Difficulties Questionnaire (SDQ) for ages 4-17 (Goodman et al., 1998) for the refined intervention. The SDQ consists of 25 items, which include 5 scales of 5 items, each completed by the child's parents. The five scales are emotional problems, conduct problems, hyperactivity, peer problems, and prosocial behavior. Details of all the test designs, the IRT procedure, and the SDQ are in the Appendix, Section A.3.

In addition to the child assessment survey, a household survey was conducted to gather information on various characteristics, such as socioeconomic status, parental education, access to clean water, and smartphone usage. We also included a series of questions regarding the delivery and usage of the Rocket program to evaluate its effectiveness in enhancing parent-child interaction. Furthermore, we collected data on subjective parental beliefs regarding the program's impact on child learning. The household survey for the refined intervention was largely similar to the survey conducted for the base intervention, with a few critical additions. First, we collected information on parents' monetary and time investments toward child learning, given the importance of these in the child skill formation production function (Agostinelli and Sorrenti, 2021). Second, we asked parents for their subjective opinion of their child's *anganwadi* attendance. This information was also collected from the March 2023 attendance register at the AWC. The reason

for this is twofold: one, the program could have potentially altered the likelihood of the child attending the AWC, and two, children with different attendance levels could be differently impacted by the program.

We also conducted an *anganwadi* worker survey to assess the effectiveness of program delivery and parental adherence to implementation protocols. Specifically, we verified whether the WhatsApp group had been created, when it was established, and the number of members in the group. For the refined intervention, the *anganwadi* worker survey included additional questions to gather information on the use of Rocket Learning (RL) materials for in-class instruction, enabling us to analyze whether the RL materials influenced the educational content delivered to students at the centers.

Finally, we also collected data from Rocket Learning's backend servers regarding platform activation and parental engagement on the WhatsApp groups. This data enables us to track the level of parental engagement over time, including the number of videos, pictures, and text messages sent by parents in the WhatsApp groups. It provides an independent measure of program delivery and engagement, separate from our survey data.

4 Results at midline

Eight months after the base intervention, we evaluated the effect of the regular Rocket Learning (RL) program on program delivery, program engagement, and children's learning outcomes. This section describes the empirical strategy and presents the midline results in detail.

We estimate the intent-to-treat (ITT) effects of the Rocket program (β_1) using the following equation:

$$Y_{ibp} = \beta_0 + \beta_1 \cdot \text{Regular Treatment}_b + \delta_p + \epsilon_{ibp}, \tag{1}$$

where Y_{ibp} is the program outcome for child *i* in beat *b* located in block *p*. Regular Treatment_{*b*} takes the value of one if child *i* attends an *anganwadi* center in the treatment beat *b*, and δ_p represents the block of residence fixed effects (the level at which the treatment was stratified). We cluster the standard errors (ϵ_{ibp}) at the beat level (the level at which the base intervention treatment was randomized).

We first evaluate whether the Rocket program changed the likelihood of households using WhatsApp for educational purposes. During the COVID-19 pandemic, some *an*-

ganwadi workers formed their own WhatsApp groups to interact with parents without in-person preschool. Additionally, initiatives from the state government of Maharashtra also existed that delivered educational instructions via WhatsApp. Therefore, households in the control group also had access to WhatsApp groups providing educational material. However, households in the treatment group were 13.7 percentage points (60%) more likely to be added to a WhatsApp group that delivered educational instructions and activities (*p*-value < 0.01), compared to a control mean of 22.8% (see Table 2, Column(1)). Households in the treatment group, on average, belonged to WhatsApp groups with 1.62 more participants compared to a control mean of 1.2 participants (*p*-value < 0.01), and were, on average, 14.1 percentage points (70%) more likely to receive WhatsApp messages compared to a control mean of 20.2% (*p*-value < 0.01) (see Table 2, Column(2)-Column(3)). These results are robust to the inclusion of covariates (see Table 2, Column(4)-Column(6)).¹³

The *anganwadi* worker survey corroborates this result: AWCs in the treatment beats were 19.6 percentage points (25.5%) more likely to have a WhatsApp group compared to the control group (*p*-value < 0.01). In 77% of the control *anganwadis*, a WhatsApp group existed, and the likelihood of the WhatsApp group being functional (conditional on being created) for more than one year was higher in the control group than in the treatment group (see Table 2, Column(8)).

Table A5 in the Appendix shows that households in the treatment group were 13.7 percentage points (548%) more likely to receive educational content on WhatsApp from Rocket Learning compared to a control mean of 2.5% (*p*-value < 0.01) (see Table A5, Panel A, Column (2)). However, regardless of who sends the messages, households also saw increased educational content delivered via WhatsApp. Households in the treatment group were 15.5 percentage points (316.3%) more likely to receive academic messages on the WhatsApp group daily or 4-5 times a week compared to a control mean of 4.9% (*p*-value < 0.01) and were 13.4 percentage points (75.7%) more likely to share the messages with their children compared to a control mean of 17.7% (*p*-value < 0.01) (see Table A5, Panel A, Column(3) and Column(4)). These results are robust to the inclusion of additional household-level covariates (see Table A5, Panel B).

Results from the *anganwadi* worker survey corroborate the household survey results and provide evidence that the program was executed as intended. As mentioned earlier, the role of the *anganwadi* worker was to answer parents' potential questions and encourage

¹³The included covariates are a home ownership indicator, mother's and father's education level fixed effects.

parents to engage with the content. This is precisely what the results show—there is no difference in the likelihood of the *anganwadi* worker sending educational content on her own between the treatment and control groups (see Table A5, Panel C, Column(1) in the Appendix). Further, the *anganwadi* survey indicates that *anganwadis* in the treatment group were 52.7 percentage points (285%) more likely to receive the Rocket program compared to a control mean of 18.5% (*p*-value < 0.01) (see Table A5, Panel C, Column(2) in the Appendix). Lastly, *Anganwadi* workers in the treatment group were 27.2 percentage points (55.4%) more likely to motivate parents to engage with the content compared to a control mean of 49.1% (*p*-value < 0.05) and 25.3 percentage points (37%) more likely to ask parents to share content back on the WhatsApp group compared to a control mean of 68.5% (*p*-value < 0.1).

Next, we evaluate the effect of the Rocket Learning program on the type of content received. Children in the treatment group were 15.2 percentage points (80%) more likely to receive any form of educational content compared to a control mean of 19.1% (*p*-value < 0.01) (see Table A6, Panel A in the Appendix). This difference is reflected across various modes of content delivery. Specifically, children in the treatment group were more likely to receive educational content through videos, audio, activities, and homework than those in the control group. These results are robust to the inclusion of covariates (see Table A6, Panel B)

A distinguishing component of the Rocket learning program was encouraging parents to share the educational activities done with their children on the WhatsApp group. Parents in the treatment group were 19.6 percentage points (148.5%) more likely to be asked to share back content compared to a control mean of 13% (*p*-value < 0.01) and were 14 percentage points (132%) more likely to send messages back on the WhatsApp group compared to a control mean of 10.6% (*p*-value < 0.01) (see Table A6, Panel A, Column(1) and Column(2)). Households in the treatment group are also 4.4 percentage points (293.3%) more likely to send messages back daily or 4-5 times a week on the WhatsApp group compared to a control mean of 1.5% (*p*-value < 0.01) and are 13.4 percentage points (128.8%) more likely to send content in the form of video, audio, photos or text compared to control mean on 10.4% (*p*-value < 0.01) (see Table A6, Panel A, Column(3) and Column (4)).

Finally, we investigate the child's engagement with the program. Table A8 in the Appendix shows that children in the treatment group were 3 percentage points (94%) more likely to engage with the educational material delivered through the WhatsApp group compared to a control mean of 2.7% (*p*-value < 0.1). Additionally, mothers in the treat-

ment group were 10.5 percentage points (60.7%) more likely to engage their children with the educational material compared to a control mean of 17.3% (*p*-value < 0.05).

The base RL program did not impact child learning outcomes (see Table 3). The point estimate of the treatment effect is negative, albeit statistically insignificant. This is true across all domains (math, language, and executive function) and holds even after controlling for covariates. Focusing on the overall IRT score, we can rule out a treatment effect above 0.09σ at the 95% level.

Taken together, these results indicate that the regular RL program was successfully delivered at scale and effectively engaged children with the educational activities delivered through the WhatsApp group. However, it had no impact on children's learning outcomes.

5 Results at endline

Following the base intervention, it remains unclear whether the null result on learning outcomes is attributable to insufficient duration of exposure or inadequate intensity of program delivery. First, note that the base intervention lasted nine months, which is shorter than the duration typically observed in global home-simulation interventions with an in-person facilitator (Andrew et al., 2020; Heckman et al., 2020). Second, the level of engagement generated by the base intervention may have been insufficient to improve children's learning outcomes. The refined intervention, which introduced the intensive RL program as an additional experimental arm, was designed to disentangle these two potential channels.

Specifically, to study the effects of a longer duration of exposure to the regular RL program, we compare outcomes for students in the treatment beats with those in the control beats approximately 2 years after the launch of the base intervention. To examine the effects of the intensive RL program, we compare the outcomes of students randomly allocated to intensive treatment and regular treatment *anganwadis* in the refined intervention. The relevant sample for studying the effect of the intensive RL program consists of children who were part of the *anganwadi* system during the 2022-2023 or 2023-2024 academic years, around the time the intensive RL program was launched.¹⁴ Of the 3,934 students in our endline sample, 1,869 belong to the regular or intensive treatment groups and

¹⁴Appendix Tables A13 and A18 show that the refined intervention did not affect the likelihood of the child attending the AWC.

are part of this subsample. Additionally, 645 students were enrolled in the *anganwadi* system during the 2023-2024 academic year, when the endline survey was conducted. We present our main results evaluating the intensive RL program using this relevant subsample and demonstrate the robustness of our findings for the full sample in the Appendix.

5.1 Comparing regular treatment to control

Using the empirical strategy outlined in equation 1, we estimate the intent-to-treat (ITT) effects of a longer duration of exposure to the regular RL program by comparing students in the regular treatment beats to those in the control beats, using the endline data. The results are detailed below.

5.1.1 Program delivery and engagement

Table 4 shows that the program continued to be delivered successfully approximately 2 years after the launch of the regular RL program. Compared to the control group, households in the regular treatment group were 12.6 percentage points (57.8%) more likely to receive educational content through a WhatsApp group, relative to a control mean of 21.8% (*p*-value < 0.01). Additionally, they were 10.8 percentage points (133.3%) more likely to report that the group was active, compared to a control mean of 8.1% (p-value < 0.01) (see Table 4, Panel B, Columns (1) and (3)). Notably, households in the regular treatment group were 8.8 percentage points (382.6%) more likely to receive educational messages from RL via WhatsApp groups, compared to a control mean of 2.3% (*p*-value < 0.01) (see Table 4, Panel B, Column (5)). This finding is corroborated by the anganwadi worker survey results (see Table 4, Panel A). Furthermore, Table A14 in the Appendix shows that this result holds across all message media formats. Specifically, Appendix Table A14, Column (3), indicates that households in the regular treatment group were 12.4 percentage points (95.4%) more likely to receive educational activities on WhatsApp, compared to a control mean of 9.8% (*p*-value < 0.01). All results are robust, with the inclusion of additional covariates.

RL continued to encourage parents to share educational content related to the activities they were doing with their children on WhatsApp. Households in the regular treatment group were 14.1 percentage points (139.6%) more likely to be asked to share content on the group, compared to a control mean of 10.1% (*p*-value < 0.01) (see Table 5, Column

(1)). This result is consistent across all message media formats—video, audio, photos, and text- and remains robust in including covariates. Results from Table 6 show that parents continued to engage actively on the WhatsApp groups more than a year after the regular RL program launch. Households in the regular treatment group were 10 percentage points (125%) more likely to share content on the WhatsApp group, compared to a control mean of 8% (*p*-value < 0.01) (see Table 6, Column (1)). Parents in the treatment group were significantly more likely to send educational messages through videos, audio, photos, or text than the control group. All results remain robust to the inclusion of additional covariates.

Appendix Table A15, Column (1), shows that parents in the regular treatment group were 12 percentage points (66%) more likely to share educational messages with their children, compared to a control mean of 18.1% (*p*-value < 0.01). Additionally, parents in the regular treatment group were 13.1 percentage points (70.4%) more likely to believe that the WhatsApp group is helping their child, compared to a control mean of 18.6%, and reported a higher likelihood of their child enjoying the educational content shared on the group (see Appendix Table A15, Columns (3) and (4)). Lastly, parents in the regular treatment group reported a 10.5 percentage point (50%) increase in the likelihood of purchasing educational materials for their children, compared to a control mean of 21% (*p*-value < 0.01) (see Appendix Table A16, Column (2)).

Taken together, these results indicate that more than a year after its launch, the regular version of the RL program continued to be successfully deployed at scale and was able to sustain parental engagement.

5.1.2 Learning outcomes

The regular RL program had no impact on children's learning outcomes. Results from Table 7 indicate that the program had no effect on overall cognitive ability, as measured by the IRT, nor specific skills in mathematics, language (Marathi), or executive function. Appendix Table A17 also shows that the program had an insignificant impact on children's socio-emotional skills.

This result addresses the first crucial question raised at the end of the base intervention: Was the lack of effect on children's learning outcomes due to insufficient duration of exposure? Results from the endline data, comparing students in the treated beats to those in the control beats, indicate this is not the case.

5.2 Comparing intensive treatment to regular

We now investigate the effects of the intensive version of the RL program launched in May 2023 on program engagement and children's learning outcomes.

We estimate the intent-to-treat (ITT) effects of the intensive RL program (γ_1) by comparing students who were part of the *anganwadi* system during the 2022-2023 or 2023-2024 academic years, randomly assigned to intensive treatment *anganwadis*, with those in regular treatment *anganwadis*, using the following equation:

$$Y_{iab} = \gamma_0 + \gamma_1 \cdot \text{Intensive Treatment}_a + \delta_b + \epsilon_{iab}, \tag{2}$$

where Y_{iab} is the program outcome for child *i* in *anganwadi a* located in beat *b*. Intensive Treatment_a takes the value of one if child *i* attends an intensive treatment *anganwadi* center, and zero if child *i* attends a regular treatment *anganwadi* center, δ_b represents the beat-level fixed effects (the level at which the intensive treatment was stratified). We cluster the standard errors (ϵ_{iab}) at the *anganwadi* level (the level at which the refined intervention treatment was randomized). Table 8 shows that we are balanced in terms of household and characteristics across the regular and intensive arm of the refined experiment.

The results on program engagement and child learning are detailed below.

5.2.1 Program delivery and engagement

Figure 2 illustrates the differences in activation levels on the WhatsApp platform and parental engagement, measured by the number of video and image messages sent to the group each month, using backend data from the RL server. First, as shown in Figure 2, Panel (A), we observe a divergence in activation levels beginning around May 2023, coinciding with the launch of the intensive RL intervention. Second, Figure 2, Panels (B) and (C) show that parents in the intensive group sent more video and audio messages on average per month compared to those in the regular treatment group, starting in May 2023. This provides initial evidence that the intensive RL program increased parental engagement on the platform beyond that of the regular treatment group.

Table A19 shows that the intensive RL program successfully increased the potency of program delivery compared to the regular program. Compared to the regular group, households in the intensive treatment group were 17.2 percentage points (74%) more

likely to receive educational content through a WhatsApp group, relative to the regular group mean of 23.3% (*p*-value < 0.01). Additionally, they were 16.5 percentage points (88.2%) more likely to report that the group was active, compared to the regular group mean of 18.7% (*p*-value < 0.01) (see Table A19, Panel B, Columns (1) and (3)). Further, households in the intensive treatment group were 12.1 percentage points (110%) more likely to receive educational messages from RL via WhatsApp groups, compared to the regular group mean of 11.1% (*p*-value < 0.01) (see Table A19, Panel B, Column (5)). This finding is corroborated by the *anganwadi* worker survey results (see Table A19, Panel A). Table A22 in the Appendix shows that educational content delivery increases across all media formats. All results are robust, with the inclusion of additional covariates. The results remain qualitatively unchanged for the entire sample, as well as when comparing both the regular and intensive arms of the experiment to the control group (see Appendix Tables A20 and A21).¹⁵

Rocket Learning, through its intensive program, also managed to increase content delivery substantially and the level of parental engagement on the WhatsApp groups. Households in the intensive treatment group were 16.8 percentage points (71.2%) more likely to be asked to share content on the group, compared to the regular group mean of 23.6% (p-value < 0.01) (see Table 10, Column (1)). This result is consistent across all message media formats—video, audio, photos, and text- and remains robust in including covariates. Results from Table 11 corroborate Figure 2 and show that the magnitude of parental engagement on the WhatsApp groups increased significantly in the intensive group. Households in the intensive treatment group were 14 percentage points (79%) more likely to share content on the WhatsApp group, compared to the regular group mean of 17.7% (*p*-value < 0.01) (see Table 11, Column (1)). Parents in the intensive group were significantly more likely to send educational messages through videos, audio, photos, or text than the regular group. All results remain robust to the inclusion of additional covariates. The results remain qualitatively unchanged for the entire sample, as well as when comparing both the regular and intensive arms of the experiment to the control group (see Appendix Tables A26, A27, A29, and A30).

Table 12, Column (1), shows that parents in the intensive treatment group were 17.5 percentage points (59%) more likely to share educational messages with their children, compared to the regular group mean of 29.6% (*p*-value < 0.01). Additionally, parents in the intensive treatment group were 16.6 percentage points (53%) more likely to believe

¹⁵The ITT parameter for the intensive RL program, using the regular and control groups, is estimated with a specification similar to equation 1, with project-level fixed effects and clustering standard errors at the beat level.

that the WhatsApp group is helping their child, compared to the regular group mean of 31.7%, and reported a higher likelihood of their child enjoying the educational content shared on the group. Parents in the intensive treatment group also reported a 12.3 percentage point (39.2%) increase in the likelihood of purchasing educational materials for their children, compared to the regular group mean of 31.4% (*p*-value < 0.01) (see Appendix Table A34, Column (2)).

Taken together, these results indicate that the intensive RL program was successful in increasing the potency of program delivery and parental engagement compared to the regular group.

5.2.2 Learning outcomes

We present our main findings on children's learning outcomes, which include overall learning, language (Marathi), mathematics, and executive function, all measured using item response theory (IRT).¹⁶ First, Table 13, Panel (A), Column (1) indicates that the intensive RL program improved students' overall cognitive ability, as measured by the IRT, by 0.104 σ (*p*-value < 0.1) compared to the regular group. In Table 13, Panel (A), Column (4), conditional on household-level covariates (mother's and father's education level fixed effects), the intensive arm of the refined intervention improved overall student ability by 0.122σ (*p*-value < 0.05) compared to the regular group. Second, Table 13, Panel (A), Columns (6) and (7), conditional on household-level covariates, shows that the intensive RL program improved students' mathematics and language (Marathi) ability by 0.11σ (*p*-value < 0.05) compared to the regular group. Third, no effect was found on students' executive function skills. Fourth, Table 13, Panel (B) presents the results for the subsample of students who were part of the anganwadi system for the academic year 2023-2024, and thus had a high likelihood of being treated by the intensive intervention. For this subsample, the intensive RL program improved students' overall learning ability by approximately 0.2σ (*p*-value < 0.01) compared to the regular group, and these results are robust to the inclusion of household-level covariates. Conditional on covariates, their mathematics ability improved by 0.217σ (*p*-value < 0.01), and their language ability improved by 0.154 σ (*p*-value < 0.05). As with the full sample, no effect was found on executive function skills for this subsample. Fifth, the results remain qualitatively unchanged when comparing the regular and intensive arms of the experiment to the

¹⁶All IRT learning outcomes are normalized such that the mean and standard deviation for the control group are 0 and 1, respectively. See Section A.3.1 in the Appendix for details regarding the administered test and Section A.3.2 for details regarding the IRT procedure.

control group (see Appendix Table A38) and when restricting the sample to the set of AWCs that were part of the midline sample but not in the endline sample (see Appendix Table A39). Lastly, we find that the intensive RL program did not impact children's socio-emotional skills as measured by the SDQ (see Appendix Tables A40 and A41)

This result addresses the second crucial question raised at the end of the base intervention: Was the lack of effect on children's learning outcomes due to insufficient intensity of exposure? The improvement in students' learning outcomes in the intensive treatment anganwadis compared to those in the regular treatment anganwadis suggests that this was indeed the case.

6 Discussion

The refined intervention's results indicate the following: First, the program was delivered as intended, with the intensive arm substantially increasing the RL program's reach. Second, the regular arm of the intervention was successfully implemented over an extended period, lasting more than a year, with continued parental engagement in the educational WhatsApp group. Third, results from the student learning outcomes show that the regular RL program did not impact children's learning outcomes. At the end of the base intervention, it was unclear whether the lack of improvement in learning outcomes was due to insufficient duration of exposure to the treatment; the null result from the regular arm of the refined intervention rules this out. Fourth, for the relevant sample of students who were part of the *anganwadi* system during the academic years 2022-2023 or 2023-2024, the intensive arm of the experiment improved learning outcomes by 0.104σ (significant at 10%, conditional on covariates) and by 0.122σ (significant at 5%, conditional on covariates). Fifth, for this relevant sample, mathematics and language learning abilities improved by 0.11σ (significant at 5%, conditional on covariates). Sixth, for the subsample of students who were part of the *anganwadi* system during the academic year 2023-2024 and were thus most likely to be treated by the intensive intervention, we find an improvement in overall child cognitive ability of 0.196σ (significant at 1%, conditional on covariates), an improvement in mathematics ability of 0.217σ (significant at 1%, conditional on covariates), and an improvement in language (Marathi) ability of 0.154σ (significant at 5%, conditional on covariates).

The intensive RL program provides a highly cost-effective way to improve children's foundational literacy and numeracy outcomes in the 3-5 age range. The intensive program served \approx 1,800 children across 90 AWCS and ran for five months. The total cost

of the program is \$2,103, which includes the following components: 1) Salaries of field team members and individuals responsible for calling parents and *anganwadi* teachers (\$1084), 2) Backend technological component costs (\$585), 3) Printed workbooks and certificates (\$434). Therefore, the per-child cost of the intensive RL program comes to \$1.17 (97 rupees). In comparison, the regular RL program, which had no effect on children's learning outcomes, cost \$0.55 (46 rupees) per child.

7 Conclusion

We study the impact of a large-scale intervention aimed at improving preschool services, including digital home simulation and support for preschool teachers in delivering early childhood education, on children's learning outcomes through a randomized controlled trial. Results indicate that while the base intervention was successfully implemented, it did not improve child learning outcomes. The refined RL intervention was designed to disentangle the effects of exposure duration and intensity as potential explanations for the lack of improvement. Results from the refined intervention reveal two key findings: First, the intensive version of the program improved student learning outcomes by 0.122σ (statistically significant at the 5% level, conditional on covariates) among children who were part of the anganwadi system during the 2022-2023 or 2023-2024 academic years, making them the most likely to have received the intensive RL treatment. Their mathematics and language abilities improved by 0.11σ (statistically significant at the 5% level, conditional on covariates). Second, the regular RL program did not improve learning outcomes at scale. Therefore, at a total cost of 21.3 cents (18 rupees) per child per year, the intensive RL program provides a highly cost-effective approach to improving learning outcomes at scale by offering educational support to parents and preschool teachers.

	Child in	AWC L	ast Year? (2022-2023 Academic Year)
Child Current Class			
(2023-2024 Academic Year)	No	Yes	Total
AWC	28	927	955
Nursery	4	17	21
LKG or KG1	87	251	338
UKG or KG2	429	435	864
Class 1	341	1,087	1,428
Above Class 1	242	71	313
Not Studying	10	5	15
Total	1,141	2,793	3,934

Table 1: AWC, Preschool, and School Transitions

Notes: AWC denotes *Anganwadi center*. Nursery refers to a private daycare facility. LKG and UKG are private preschool facilities, denoting lower and upper kindergarten. Child Current Class refers to the child's schooling status for the academic year 2023-2024, and the child in AWC last year refers to the child's AWC status for the 2022-2023 academic year. Blue indicates the subsample of children who attended AWC during the 2022-2023 academic year or the 2023-2024 academic year *and* have not transitioned to grade one and above and are potentially treated by the intensive intervention. Red indicates the subsample of children who attended AWC during the 2022-2023 academic year and have transitioned to class 1 and above for the 2023-2024 academic year, *or* were not part of the AWC system during the 2022-2023 and 2023-2024 academic year.

Figure 1: Program Timeline



		Household Survey						anwadi 1rvey
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Added to	Number Of	Receive	Added to	Number Of	Receive	WA group	WA group
	WA group	Participants	Messages	WA group	Participants	Messages	Formed	> 1 Year Old
Regular Treatment	0.137***	1.622***	0.141***	0.149***	1.714***	0.153***	0.196***	-0.182***
	(0.045)	(0.461)	(0.043)	(0.037)	(0.429)	(0.035)	(0.053)	(0.066)
Covariates	No	No	No	Yes	Yes	Yes	-	-
Observations	1,281	1,281	1,281	1,281	1,281	1,281	221	221
Control Mean	0.228	1.220	0.202	0.228	1.220	0.202	0.769	0.389

Table 2: Baseline Usage: Comparing regular treatment to control

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include an indicator for home ownership, and mother's and father's education level fixed effects. WA stands for WhatsApp. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *. In each tercile within each beat, the probability that a child is selected is proportional to the total enrollment across all *anganwadis* in the tercile. We create weights proportional to this probability, normalized so that the sum of weights within each beat equals one. These weights are used for the base intervention analysis.

Table 3: Baseline learning outcomes: Comparing regular treatment to control

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overall	Math	Language	EF	Overall	Math	Language	EF
	IRT	IRT	IRT	IRT	IRT	IRT	IRT	IRT
Regular Treatment	-0.022	-0.023	-0.016	-0.122	-0.022	-0.029	-0.008	-0.111
	(0.070)	(0.070)	(0.081)	(0.074)	(0.068)	(0.066)	(0.080)	(0.068)
Observations	1,281	1,281	1,281	1,281	1,281	1,281	1,281	1,281
Control Mean	-0.000	-0.000	0.000	0.000	-0.000	-0.000	0.000	0.000
Covariates	No	No	No	No	Yes	Yes	Yes	Yes

Notes: The sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include an indicator for home ownership, and mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *. EF stands for executive function. Learning outcomes are estimated using item response theory (IRT). See Appendix Section A.3.2 for details. In each tercile within each beat, the probability that a child is selected is proportional to the total enrollment in the selected centers divided by the total enrollment across all *anganwadis* in the tercile. We create weights proportional to this probability, normalized so that the sum of weights within each beat equals one. These weights are used for the base intervention analysis.

Table 4: Endline Usage: Comparing regular treatment to control

		Objective Measures			Subjective Measures			
	(1) Group Active	(2) Number of WA Participants	(3) Group >= 1 Year Old	(4) Rocket sends messages	(5) Rocket follows-up	(6) AWW sends messages	(7) AWW motivates parents	
Regular Treatment	0.290***	4.570***	0.268***	0.272***	0.184***	-0.088	0.040	
	(0.058)	(1.179)	(0.064)	(0.057)	(0.063)	(0.058)	(0.061)	
Observations	255	254	255	255	255	255	255	
Control Mean	0.350	3.504	0.267	0.442	0.308	0.367	0.558	

(a) Anganwadi Survey

(b) Household Survey

		Objective Measures		Subje Meas	ective sures
	(1) Added to group	(2) Group Size	(3) Group Active	(4) Receive messages	(5) RL sends messages
Regular Treatment	0.126*** (0.027)	0.724*** (0.223)	0.108*** (0.018)	0.126*** (0.023)	0.088*** (0.012)
Observations Control Mean Additional Covariates	2,946 0.218 No	2,652 0.575 No	2,946 0.081 No	2,946 0.107 No	2,946 0.023 No
		Objective Measures		Subje Meas	ective sures
	(1) Added to group	Objective Measures (2) Group Size	(3) Group Active	Subje Meas (4) Receive messages	ective sures (5) RL sends messages
Regular Treatment	(1) Added to group 0.121*** (0.027)	Objective Measures (2) Group Size 0.694*** (0.224)	(3) Group Active 0.105*** (0.018)	Subje Meas (4) Receive messages 0.120*** (0.023)	ective sures (5) RL sends messages 0.087*** (0.011)

Notes: The sample for Panel A consists of AWCs assigned to the regular treatment or control group. For Panel B, the sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Regular Treatment	0.141***	0.136***	0.033***	0.125***	0.052***
	(0.023)	(0.022)	(0.010)	(0.021)	(0.012)
Observations	2,946	2,946	2,946	2,946	2,946
Control Mean	0.101	0.088	0.028	0.091	0.027
Additional Covariates	No	No	No	No	No
	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Regular Treatment	0.135***	0.131***	0.032***	0.120***	0.049***
	(0.023)	(0.022)	(0.010)	(0.021)	(0.012)
Observations	2,946	2,946	2,946	2,946	2,946
Control Mean	0.101	0.088	0.028	0.091	0.027
Additional Covariates	Yes	Yes	Yes	Yes	Yes

Table 5: Endline Asked to share back content: Comparing regular treatment to control

Notes: The sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

Table 6: E	Endline Househc	ld shares bacl	k content:	Comparing 1	regular trea	tment to control
				1 0	0	

	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
Regular Treatment	0.100***	0.091***	0.022***	0.087***	0.033***
	(0.019)	(0.017)	(0.007)	(0.016)	(0.010)
Observations	2,946	2,946	2,946	2,946	2,946
Control Mean	0.080	0.068	0.018	0.066	0.016
Additional Covariates	No	No	No	No	No
	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
Regular Treatment	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
	0.096***	0.088***	0.022***	0.082***	0.031***
	(0.018)	(0.017)	(0.007)	(0.015)	(0.009)

Notes: The sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

Table 7: Endline Learning Outcomes: Comparing regular treatment to control

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overall	Math	Language	EF	Overall	Math	Language	EF
	IRT	IRT	IRT	IRT	IRT	IRT	IRT	IRT
Regular Treatment	0.000	0.002	0.005	0.002	-0.030	-0.028	-0.023	-0.022
	(0.054)	(0.056)	(0.051)	(0.046)	(0.042)	(0.044)	(0.040)	(0.041)
Observations	2,946	2,946	2,946	2,946	2,946	2,946	2,946	2,946
Control Mean	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000
Additional Covariates	No	No	No	No	Yes	Yes	Yes	Yes

Notes: The sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level).Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

Table 8: Endline: Balance table comparing intensive to regular treatment (In AWC 2022-2023 or 2023-2024)

Variable	(1) Regular Mean/(SE)	(2) Intensive Treatment Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
SC/ST/OBC	0.779 (0.022)	0.750 (0.033)	0.029
Mother Passed 10th Grade	0.521 (0.021)	0.484 (0.025)	0.037
Father Passed 10th Grade	0.423 (0.020)	0.413 (0.024)	0.010
Mother Passed 12th Grade	0.432 (0.021)	0.404 (0.024)	0.028
Father Passed 12th Grade	0.369 (0.019)	0.355 (0.023)	0.014
Smartphone with Internet	0.675 (0.018)	0.707 (0.022)	-0.033
Wealth Index	0.752 (0.008)	0.766 (0.009)	-0.015
Girl Child	0.503 (0.015)	0.493 (0.020)	0.010
Child Age (March 31st, 2023)	4.694 (0.024)	4.716 (0.028)	-0.022
Age Started attending AWC	3.157 (0.033)	3.157 (0.039)	0.000
Attendance Data Present	0.938 (0.024)	0.938 (0.026)	0.000
F-test of joint significance (F-stat)			1.110
Number of observations Number of clusters	1128 126	741 86	1869 212

Notes: The sample consists of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2022-2023 or 2023-2024 academic year, as observed in the endline survey. This table presents the mean and standard error (in parenthesis) of several characteristics for households in the control group (Column 1) and the treatment group (Column 2), as well as the difference in means in Column 3. Column 4 shows the number of observations. SC stands for Schedule Caste, ST stands for Schedule Tribe, and OBC stands for Other Backward Class.All regressions include beat-level (refined intervention randomization cluster) fixed effect, with standard errors clustered at the anganwadi-level (refined intervention, treatment assignment level). Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

Figure 2: Endline RL Activity: Comparing intensive to regular treatment (In AWC 2022-2023 or 2023-2024)



(a) Activation on RL Platform

Note: Data source: RL backend data. The sample consists of students who were part of the anganwadi system for the 2022-2023 or 2023-2024 academic year. Figure (a) shows the average user activation monthly on the RL platform for the experiment's regular and intensive RL arm. Figures (b) and (c) show the average video and image messages per month that parents send on the WA group for the experiment's regular and intensive RL arm, respectively.

Table 9: Endline usage: Comparing intensive to regular treatment (In AWC 2022-2023 or 2023-2024)

	Objective Measures			Subjective Measures			
	(1) Group Active	(2) Number of WA Participants	(3) Group >= 1 Year Old	(4) Rocket sends messages	(5) Rocket follows-up	(6) AWW sends messages	(7) AWW motivates parents
Intensive Treatment	0.267***	5.274***	0.089	0.181***	0.304***	0.030	0.137**
	(0.053)	(1.984)	(0.067)	(0.052)	(0.062)	(0.061)	(0.062)
Observations	225	225	225	225	225	225	225
Regular Treatment Mean	0.350	3.504	0.267	0.442	0.308	0.367	0.558

(a) Anganwadi Survey

(b) Household Survey

		Objective Measures		Subjective Measures		
	(1) Added to group	(2) Group Size	(3) Group Active	(4) Receive messages	(5) RL sends messages	
Intensive Treatment	0.163*** (0.033)	1.918*** (0.286)	0.165*** (0.025)	0.172*** (0.029)	0.121*** (0.020)	
Observations Regular Treatment Mean Additional Covariates	1,868 0.342 No	1,587 1.303 No	1,868 0.187 No	1,868 0.233 No	1,868 0.111 No	
		Objective Measures		Subje Meas	ective sures	
	(1) Added to group	Objective Measures (2) Group Size	(3) Group Active	Subje Meas (4) Receive messages	ective sures (5) RL sends messages	
Intensive Treatment	(1) Added to group 0.168*** (0.030)	Objective Measures (2) Group Size 1.917*** (0.276)	(3) Group Active 0.170*** (0.023)	Subje Meas (4) Receive messages 0.175*** (0.027)	(5) RL sends messages 0.122*** (0.020)	

Notes: The sample for Panel A consists of AWCs assigned to the intensive or regular treatment group. The sample for Panel B consists of households in the intensive or regular treatment group with children in the anganwadi system for the 2022-2023 or 2023-2024 academic year, as observed in the endline survey. All regressions include beatlevel (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadilevel (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

Table 10: Endline asked to share back content: Comparing intensive to regular treatment (In AWC 2022-2023 or 2023-2024)

	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Intensive Treatment	0.168***	0.140***	0.036***	0.148***	0.021
	(0.030)	(0.028)	(0.013)	(0.029)	(0.018)
Observations	1,868	1,868	1,868	1,868	1,868
Regular Treatment Mean	0.236	0.219	0.059	0.210	0.075
Additional Covariates	No	No	No	No	No
	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Intensive Treatment	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
	0.174***	0.145***	0.038***	0.153***	0.022
	(0.027)	(0.026)	(0.012)	(0.026)	(0.017)

Notes: The sample consists of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2022-2023 or 2023-2024 academic year, as observed in the endline survey. All regressions include beat-level (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadi-level (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

Table 11: Endline household shares back content: Comparing intensive to regular treatment (In AWC 2022-2023 or 2023-2024)

	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
Intensive Treatment	0.139***	0.127***	0.031***	0.134***	0.025*
	(0.028)	(0.026)	(0.011)	(0.026)	(0.014)
Observations	1,868	1,868	1,868	1,868	1,868
Regular Treatment Mean	0.177	0.155	0.040	0.149	0.047
Additional Covariates	No	No	No	No	No
	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
Intensive Treatment	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
	0.143***	0.130***	0.032***	0.137***	0.026*
	(0.025)	(0.025)	(0.010)	(0.024)	(0.014)

Notes: The sample consists of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2022-2023 or 2023-2024 academic year, as observed in the endline survey. All regressions include beat-level (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadi-level (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

Table 12: Endline subjective beliefs: Comparing intensive to regular treatment (In AWC 2022-2023 or 2023-2024)

	(1) Share Messages with child	(2) Mother Engages	(3) WA group helping child	(4) Enjoys WA group
Intensive Treatment	0.175*** (0.032)	0.126*** (0.029)	0.166*** (0.032)	0.166*** (0.033)
Observations Regular Treatment Mean Additional Covariates	1,868 0.296 No	1,868 0.272 No	1,868 0.314 No	1,868 0.317 No
	(1) Share Messages with child	(2) Mother Engages	(3) WA group helping child	(4) Enjoys WA group
Intensive Treatment	(1) Share Messages with child 0.182*** (0.029)	(2) Mother Engages 0.134*** (0.026)	(3) WA group helping child 0.171*** (0.030)	(4) Enjoys WA group 0.170*** (0.030)

Notes: The sample consists of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2022-2023 or 2023-2024 academic year, as observed in the endline survey. All regressions include beat-level (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadi-level (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.
Table 13: Endline Learning Outcomes: Comparing intensive to regular treatment (In AWC 2022-2023 or 2023-2024)

		Panel A: In AWC 2022-2023 or 2023-2024							
	(1) Overall IRT	(2) Math IRT	(3) Language IRT	(4) EF IRT	(5) Overall IRT	(6) Math IRT	(7) Language IRT	(8) EF IRT	
Intensive Treatment	0.104* (0.060)	0.093 (0.059)	0.092 (0.061)	0.013 (0.053)	0.122** (0.048)	0.110** (0.047)	0.110** (0.052)	0.024 (0.048)	
Observations Regular Treatment Mean Additional Covariates	1,868 -0.026 No	1,868 -0.021 No	1,868 -0.023 No	1,868 -0.009 No	1,868 -0.026 Yes	1,868 -0.021 Yes	1,868 -0.023 Yes	1,868 -0.009 Yes	
			Pa	nel B: In A	AWC 2023-2	2024			
	(1) Overall IRT	(2) Math IRT	Pa (3) Language IRT	nel B: In A (4) EF IRT	AWC 2023-2 (5) Overall IRT	2024 (6) Math IRT	(7) Language IRT	(8) E EF IRT	
Intensive Treatment	(1) Overall IRT 0.202** (0.080)	(2) Math IRT 0.232*** (0.082)	Pa (3) Language IRT 0.159* (0.085)	nel B: In A (4) EF IRT 0.077 (0.082)	AWC 2023-2 (5) Overall IRT 0.196*** (0.074)	2024 (6) Math IRT 0.217*** (0.076)	(7) Language IRT 0.154** (0.077)	(8) EF IRT 0.110 (0.086)	

Notes: The sample consists of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2022-2023 or 2023-2024 academic year, as observed in the endline survey. All regressions include beat-level (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadi-level (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

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A Appendix

A.1 Additional tables and figures

Table A1: Midline: Comparing regular to control household assessment compliance

Variable	(1) Control Mean/(SE)	(2) Regular Treatment Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
Survey Completed	0.507 (0.020)	0.544 (0.017)	-0.037
Parent/Legal Guardian Home	0.786 (0.014)	0.793 (0.013)	-0.006
Consent Given	0.775 (0.013)	0.783 (0.013)	-0.008
F-test of joint significance (F-stat)			0.958
Number of observations Number of clusters	1731 40	1838 45	3569 85

NOTES: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). * p < 0.1, ** p < .05, *** p < 0.01.

Table A2: Midline: Comparing regular to control child assessment compliance

Variable	(1) Control Mean/(SE)	(2) Regular Treatment Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
Child Not Available	0.154 (0.015)	0.140 (0.015)	0.014
No Marathi	0.153 (0.038)	0.207 (0.039)	-0.055
Survey Completed	0.679 (0.037)	0.638 (0.035)	0.041
F-test of joint significance (F-stat)			0.488
Number of observations Number of clusters	946 40	1003 45	1949 85

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). * p < 0.1, ** p < .05, *** p < 0.01.

Table A3: Midline: Comparing regular to control anganwadi assessment compliance

Variable	(1) Control Mean/(SE)	(2) Regular Treatment Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
Survey Completed	1.000 (0.000)	0.948 (0.021)	0.052***
Anganwadi Center Open	1.000 (0.000)	0.980 (0.012)	0.020*
Anganwadi Teacher Present	1.000 (0.000)	0.972 (0.014)	0.028**
Anganwad Teacher Respondent	0.850 (0.046)	0.838 (0.036)	0.012
Worked > 5 Years	0.956 (0.019)	0.923 (0.028)	0.033
Total Children	24.177 (1.345)	23.076 (1.426)	1.102
F-test of joint significance (F-stat)			4.705***
Number of observations Number of clusters	109 40	119 45	228 85

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). * p < 0.1, ** p < .05, *** p < 0.01.

Variable	(1) Control Mean/(SE)	(2) Regular Treatment Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
SC/ST/OBC	0.829 (0.025)	0.848 (0.036)	-0.019
Household Size	5.111 (0.091)	5.279 (0.097)	-0.168
Own Home	0.929 (0.026)	0.975 (0.009)	-0.045*
Mother Passed 10th Grade	0.505 (0.033)	0.539 (0.033)	-0.033
Father Passed 10th Grade	0.461 (0.031)	0.515 (0.034)	-0.054
Mother Passed 12th Grade	0.183 (0.027)	0.182 (0.021)	0.001
Father Passed 12th Grade	0.167 (0.018)	0.146 (0.018)	0.021
Smartphone with Internet	0.670 (0.025)	0.659 (0.040)	0.011
Wealth Index	0.658 (0.011)	0.670 (0.014)	-0.012
Girl Child	0.542 (0.029)	0.520 (0.031)	0.021
Child Age	4.153 (0.041)	4.140 (0.031)	0.013
F-test of joint significance (F-stat)			1.776*
Number of observations Number of clusters	625 40	656 45	1281 85

Table A4: Midline: Balance table

Notes: This table presents the mean and standard deviation (in parenthesis) of several characteristics for households in the control group (Column 1) and the treatment group (Column 2), as well as the difference in means (and the standard error of the difference, in parenthesis) in Column 3. Column 4 shows the number of observations. SC stands for Schedule Caste, ST stands for Schedule Tribe, and OBC stands for Other Backward Class. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *. In each tercile within each beat, the probability that a child is selected is proportional to the total enrollment in the selected centers divided by the total enrollment across all anganwadis in the tercile. We create weights proportional to this probability, normalized so that the sum of weights within each beat equals one. These weights are used for the base intervention analysis.

			Pan	el A: House	hold Surve	у		
	(1) Anganwadi Worker Sends Messages	(2) Rocket Lea Sends Mes	rning sages	(3 Academic Received) Messages 1 Often	(4) Share Message With Child	es Share With C	(5) Messages hild Often
Regular Treatment	0.070* (0.041)	0.137** (0.022	**)	0.155 (0.02	5*** 25)	0.134*** (0.041)	0.1 (0	00*** .032)
Observations Control Mean	1,281 0.166	1,281 0.025		1,2 0.0	81 49	1,281 0.177	1 0	,281 .074
		Pane	l B: Hou	isehold Surv	vey (with C	ovariates)		
	(1) Anganwadi Worker Sends Messages	(1) (2) nganwadi Worker Rocket Learr Sends Messages Sends Messa		(3 Academic Received) Messages d Often	(4) Share Message With Child	es Share With C	(5) Messages hild Often
Regular Treatment	0.080** (0.036)	0.139** (0.021	0.139*** 0.164*** (0.021) (0.023)		0.146*** (0.033)	0.1 (0	18*** .025)	
Observations Control Mean	1,281 0.195	1,281 0.029		1,2 0.0	81 58	1,281 0.208	1 0	,281 .086
			F	anel C: Ang	<i>anwadi</i> Sur	vey		
	(1) AWW Sends Information Sen	(2) Rocket ds messages	AWW Pa	(3) Motivates arents	Video, A or Hom	(4) udio, Acitivity ework Shared	(5) Messages Often	(6) Asks Parents to Share Back
Regular Treatment	0.074 (0.080)	0.527*** (0.063)	0.: ((272*** 0.061)	0	.202*** 0.058)	0.546*** (0.059)	0.253*** (0.058)
Observations Control Mean	221 0.639	221 0.185	(221 0.491		221 0.713	213 0.318	221 0.685

Table A5: Midline Comparing regular to control: Medium of message delivery

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include an indicator for home ownership, and mother's and father's education level fixed effects. Panel A shows the ITT estimates related to message delivery using *anganwadi* level data. "Often" is defined as a receiving messages daily or 4-5 times a week. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *. In each tercile within each beat, the probability that a child is selected is proportional to the total enrollment in the selected centers divided by the total enrollment across all *anganwadi* is in the tercile. We create weights proportional to this probability, normalized so that the sum of weights within each beat equals one. These weights are used for the base intervention analysis.

		Pa	nel A: Wi	thout Covar	riates	
	(1) Receive content	(2) Receive video	(3) Receive audio	(4) Receive activities	(5) Receive homework	(6) Receive praise
Regular Treatment	0.152*** (0.043)	0.165*** (0.041)	0.160*** (0.031)	0.110*** (0.039)	0.123*** (0.030)	0.055*** (0.015)
Observations Control Mean	1 <i>,</i> 281 0.191	1,281 0.184	1,281 0.108	1,281 0.115	1,281 0.076	1,281 0.023
		-	Panel B: W	/ith Covaria	ites	
	(1) Receive content	(2) Receive video	Panel B: W (3) Receive audio	/ith Covaria (4) Receive activities	ttes (5) Receive homework	(6) Receive praise
Regular Treatment	(1) Receive content 0.165*** (0.036)	(2) Receive video 0.176*** (0.034)	Panel B: W (3) Receive audio 0.170*** (0.026)	/ith Covaria (4) Receive activities 0.126*** (0.033)	(5) Receive homework 0.134*** (0.029)	(6) Receive praise 0.054*** (0.016)

Table A6: Midline Comparing regular to control: Material received

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include an indicator for home ownership, and mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *. In each tercile within each beat, the probability that a child is selected is proportional to the total enrollment in the selected centers divided by the total enrollment across all *anganwadis* in the tercile. We create weights proportional to this probability, normalized so that the sum of weights within each beat equals one. These weights are used for the base intervention analysis.

Table A7: Midline Comparing regular to control: Material sent back

			Panel A: Wi	thout Covariates			
	(1) Asked to Share Back	(2) HH Sends Messages Back	(3) HH Sends Messages Back Often	(4) HH Sends Back Content	(5) HH Sends Back video	(6) HH Sends Back audio	(7) HH Sends Back photos
Regular Treatment	0.196*** (0.036)	0.140*** (0.030)	0.044*** (0.014)	0.134*** (0.030)	0.124*** (0.029)	0.039** (0.018)	0.102*** (0.028)
Observations Control Mean	1,281 0.130	1,281 0.106	1,281 0.015	1,281 0.104	1,281 0.095	1,281 0.053	1,281 0.072
			Panel B: W	/ith Covariates			
	(1) Asked to Share Back	(2) HH Sends Messages Back	Panel B: W (3) HH Sends Messages Back Often	/ith Covariates (4) HH Sends Back Content	(5) HH Sends Back video	(6) HH Sends Back audio	(7) HH Sends Back photos
Regular Treatment	(1) Asked to Share Back 0.207*** (0.031)	(2) HH Sends Messages Back 0.141*** (0.027)	(3) HH Sends Messages Back Often 0.044*** (0.015)	/ith Covariates (4) HH Sends Back Content 0.138*** (0.027)	(5) HH Sends Back video 0.129*** (0.027)	(6) HH Sends Back audio 0.043** (0.018)	(7) HH Sends Back photos 0.104*** (0.026)

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include an indicator for home ownership, and mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *. In each tercile within each beat, the probability that a child is selected is proportional to the total enrollment in the selected centers divided by the total enrollment across all *anganwadis* in the tercile. We create weights proportional to this probability, normalized so that the sum of weights within each beat equals one. These weights are used for the base intervention analysis.

Table A8: Midline comparing regular to control: Child engagement

	(1)	(2)	(3)	(4)
	Child Engages	Mother Engages	Child Engages	Mother Engages
Regular Treatment	0.030*	0.105**	0.027*	0.112***
	(0.016)	(0.041)	(0.016)	(0.034)
Observations	1,281	1,281	1,281	1,281
Control Mean	0.027	0.173	0.027	0.173
Covariates	No	No	Yes	Yes

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include an indicator for home ownership, and mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *. In each tercile within each beat, the probability that a child is selected is proportional to the total enrollment in the selected centers divided by the total enrollment across all *anganuadis* in the tercile. We create weights proportional to this probability, normalized so that the sum of weights within each beat equals one. These weights are used for the base intervention analysis.

Table A9: Endline balance table household survey: Comparing intensive and regular treatment to control

Variable	(1) Control Mean/(SE)	(2) Regular Mean/(SE)	(3) Intensive Mean/(SE)	(1)-(2) Mean difference	(1)-(3) Pairwise t-test Mean difference	(2)-(3) Mean difference
Survey Completed	0.646 (0.030)	0.625 (0.037)	0.609 (0.041)	0.021	0.037	0.016
Mother or Father Present	0.820 (0.011)	0.832 (0.011)	0.816 (0.016)	-0.012	0.004	0.016
Consent Given	0.648 (0.030)	0.627 (0.037)	0.611 (0.041)	0.021	0.038	0.017
F-test of joint significance (F-stat)				0.221	0.527	0.489
Number of observations Number of clusters	2290 40	2727 45	1794 45	5017 85	4084 85	4521 45

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). * p < 0.1, ** p < 0.5, *** p < 0.01.

Table A10: Endline balance table child assessment survey: Comparing intensive and regular treatment to control

Variable	(1) Control Mean/(SE)	(2) Regular Mean/(SE)	(3) Intensive Mean/(SE)	(1)-(2) Mean difference	(1)-(3) Pairwise t-test Mean difference	(2)-(3) Mean difference
Understands Marathi	0.905 (0.014)	0.922 (0.013)	0.888 (0.018)	-0.017	0.017	0.034*
Survey Completed	0.904 (0.014)	0.920 (0.013)	0.885 (0.018)	-0.016	0.019	0.035*
F-test of joint significance (F-stat)				1.893	1.857	1.570
Number of observations Number of clusters	1516 40	1738 45	1126 44	3254 85	2642 84	2864 45

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). * p < 0.1, ** p < 0.5, *** p < 0.01.

Table A11: Endline balance table AWW assessment survey: Comparing intensive and regular treatment to control

Variable	(1) Control Mean/(SE)	(2) Regular Mean/(SE)	(3) Intensive Mean/(SE)	(1)-(2) Mean difference	(1)-(3) Pairwise t-test Mean difference	(2)-(3) Mean difference
Anganwadi Center Open	0.983 (0.012)	0.993 (0.007)	0.989 (0.011)	-0.009	-0.006	0.004
Anganwad Teacher Respondent	0.942 (0.024)	0.896 (0.028)	0.911 (0.037)	0.045	0.031	-0.015
Worked ¿ 5 Years	0.867 (0.033)	0.874 (0.029)	0.811 (0.046)	-0.007	0.056	0.063
Total Children (3-6) Registered	24.233 (1.268)	23.541 (1.384)	23.400 (1.240)	0.693	0.833	0.141
F-test of joint significance (F-stat)				0.712	0.585	0.499
Number of observations Number of clusters	120 40	135 45	90 45	255 85	210 85	225 45

Notes: The sample consists of AWCs assigned to the regular treatment or control group. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). * p < 0.1, ** p < 0.05, *** p < 0.01.

Variable	(1) Control Mean/(Var)	(2) Regular Mean /(Var)	(3) Intensive Mean/(Var)	F-test for balance across all groups E-stat/P-yalue	(1)-(2) F	(1)-(3) Pairwise t-tes P-yalue	(2)-(3) st
SC/ST/OBC	0.782 (6.074)	0.784 (6.114)	0.768 (4.091)	0.149 0.862	0.944	0.747	0.507
Mother Passed 10th Grade	0.540 (8.864)	0.579 (8.811)	0.531 (5.722)	1.803 0.171	0.146	0.791	0.092*
Father Passed 10th Grade	0.454 (8.844)	0.494 (9.033)	0.443 (5.670)	2.021 0.139	0.116	0.738	0.055*
Mother Passed 12th Grade	0.465 (8.876)	0.493 (9.032)	0.439 (5.659)	1.725 0.184	0.300	0.391	0.076*
Father Passed 12th Grade	0.405 (8.598)	0.445 (8.923)	0.385 (5.438)	2.809* 0.066	0.111	0.431	0.019**
Smartphone with Internet	0.733 (6.983)	0.718 (7.323)	0.729 (4.542)	0.361 0.698	0.438	0.861	0.440
Wealth Index	0.776 (0.744)	0.774 (0.811)	0.776 (0.464)	0.156 0.856	0.633	0.773	0.544
Girl Child	0.500 (8.921)	0.508 (9.032)	0.487 (5.740)	0.610 0.546	0.809	0.347	0.265
Child Age (March 31st, 2023)	4.867 (20.740)	4.776 (18.051)	4.809 (12.763)	3.362** 0.039	0.009***	0.169	0.346
Age Started attending AWC	3.165 (22.289)	3.157 (22.288)	3.159 (12.187)	0.025 0.976	0.869	0.751	0.994
Attendance Data Present	0.923 (2.527)	0.932 (2.288)	0.924 (1.612)	0.062 0.940	0.673	0.970	0.957
F-test of joint significance (P-value)					0.105	0.837	0.113
Number of observations Number of clusters	1356 39	1590 45	988 44	3934 84	2946 84	2344 83	2578 45

Table A12: Endline comparing intensive and regular treatment to control: Balance table

Notes: This table presents the differences in means of household and child characteristics across the control group (Column 1), the regular treatment group (Column 2), and the intensive treatment group (Column 3). SC refers to Scheduled Caste, ST refers to Scheduled Tribe, and OBC refers to Other Backward Classes. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

	(1)	(2)	(3)	(4)	(5)	(6)
	Child Missed					
	<= 10 Days	<= 10 Days	< 1 month	<= 10 Days	<= 10 Days	< 1 month
	Last Month	Last Year	Last Year	Last Month	Last Year	Last Year
Regular Treatment	0.017	0.004	-0.003	0.015	0.003	-0.007
	(0.014)	(0.024)	(0.023)	(0.013)	(0.024)	(0.022)
Observations	2,946	2,946	2,946	2,946	2,946	2,946
Control Mean	0.859	0.304	0.767	0.859	0.304	0.767
Covariates	No	No	No	Yes	Yes	Yes

Table A13: Endline attendance: Comparing regular to control

NOTES: The sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A14: Endline messages received: Comparing regular to control

	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
Regular Treatment	0.132***	0.061***	0.124***	0.114***	0.065***	0.056***
	(0.025)	(0.015)	(0.024)	(0.021)	(0.018)	(0.012)
Observations	2,946	2,946	2,946	2,946	2,946	2,946
Control Mean	0.148	0.056	0.130	0.098	0.071	0.027
	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
Regular Treatment	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
	0.126***	0.058***	0.119***	0.110***	0.062***	0.054***
	(0.024)	(0.014)	(0.023)	(0.021)	(0.017)	(0.011)

Notes: The sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

	(1) Share Messages with child	(2) Mother Engages	(3) WA group helping child	(4) Enjoys WA group
Regular Treatment	0.119*** (0.026)	0.111*** (0.024)	0.131*** (0.027)	0.127*** (0.028)
Observations Control Mean Additional Covariates	2,946 0.181 No	2,946 0.162 No	2,946 0.186 No	2,946 0.192 No
	(1) Share Messages with child	(2) Mother Engages	(3) WA group helping child	(4) Enjoys WA group
Regular Treatment	(1) Share Messages with child 0.112*** (0.026)	(2) Mother Engages 0.104*** (0.024)	(3) WA group helping child 0.125*** (0.027)	(4) Enjoys WA group 0.122*** (0.028)

Table A15: Endline subjective beliefs: Comparing regular to control

Notes: The sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level).Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < 0.05, *** p < 0.01.

	(1) Time Spent By Parents	(2) Parents Bought Education Material
Regular Treatment	0.023 (0.145)	0.105*** (0.024)
Observations Control Mean Additional Covariates	880 2.160 No	2,946 0.210 No
	(1) Time Spent By Parents	(2) Parents Bought Education Material
Regular Treatment	(1) Time Spent By Parents -0.011 (0.142)	(2) Parents Bought Education Material 0.100*** (0.024)

Table A16: Endline parental inputs: Comparing regular to control

NOTES: The sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beatlevel (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A17: Endline socioemotional skills: Comparing regular to control

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SDQ	SDQ	Externa-	Interna-	SDQ	SDQ	Externa-	Interna-
	Difficulty	Pro-Social	lizing	lizing	Difficulty	Pro-Social	lizing	lizing
	Score	Score	Score	Score	Score	Score	Score	Score
Regular Treatment	-0.090	-0.017	-0.077	-0.047	-0.115	-0.015	-0.093	-0.060
	(0.205)	(0.087)	(0.124)	(0.122)	(0.201)	(0.085)	(0.122)	(0.121)
Observations	2,835	2,822	2,889	2,876	2,835	2,822	2,889	2,876
Control Mean	13.684	7.835	7.289	6.442	13.684	7.835	7.289	6.442
Additional Covariates	No	No	No	No	Yes	Yes	Yes	Yes

Notes: The sample consists of households in the regular treatment or control group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

	(1)	(2)	(3)	(4)	(5)	(6)
	Child Missed					
	<= 10 Days	<= 10 Days	< 1 month	<= 10 Days	<= 10 Days	< 1 month
	Last Month	Last Year	Last Year	Last Month	Last Year	Last Year
Intensive Treatment	-0.008	0.022	0.017	-0.005	0.025	0.021
	(0.015)	(0.023)	(0.019)	(0.015)	(0.022)	(0.018)
Observations	2,577	2,577	2,577	2,577	2,577	2,577
Control Mean	0.859	0.304	0.767	0.859	0.304	0.767
Covariates	No	No	No	Yes	Yes	Yes

Table A18: Endline attendance: Comparing intensive to regular treatment

NOTES: All regressions include beat-level (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadi-level (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A19: Endline usage: Comparing intensive to regular treatment (In AWC 2023-2024)

		Objective Measures	Subje Mea	ective sures	
	(1) Added to group	(2) Group Size	(3) Group Active	(4) Receive messages	(5) RL sends messages
Intensive Treatment	0.153*** (0.047)	2.178*** (0.515)	0.158*** (0.043)	0.157*** (0.041)	0.144*** (0.031)
Observations Regular Treatment Mean Additional Covariates	645 0.342 Yes	540 1.303 Yes	645 0.187 Yes	645 0.233 Yes	645 0.111 Yes
		Objective Measures		Subje Mea	ective sures
	(1) Added to group	Objective Measures (2) Group Size	(3) Group Active	Subje Mea (4) Receive messages	ective sures (5) RL sends messages
Intensive Treatment	(1) Added to group 0.140*** (0.043)	Objective Measures (2) Group Size 2.136*** (0.500)	(3) Group Active 0.150*** (0.038)	Subje Mea: (4) Receive messages 0.149*** (0.038)	(5) RL sends messages 0.139*** (0.029)

NOTES: The sample consists of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2023-2024 academic year, as observed in the endline survey. All regressions include beat-level (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadi-level (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

	Objective			Subje	ective
	Measures			Meas	sures
	(1)	(2)	(3)	(4)	(5)
	Added to	Group	Group	Receive	RL sends
	group	Size	Active	messages	messages
Intensive Treatment	0.159***	1.784***	0.155***	0.154***	0.117***
	(0.030)	(0.256)	(0.022)	(0.025)	(0.018)
Observations	2,577	2,205	2,577	2,577	2,577
Regular Treatment Mean	0.342	1.303	0.187	0.233	0.111
Additional Covariates	No	No	No	No	No
		Objective Measures		Subje Meas	ective sures
	(1) Added to group	Objective Measures (2) Group Size	(3) Group Active	Subje Meas (4) Receive messages	ective sures (5) RL sends messages
Intensive Treatment	(1) Added to group 0.172*** (0.028)	Objective Measures (2) Group Size 1.857*** (0.252)	(3) Group Active 0.163*** (0.021)	Subje Meas (4) Receive messages 0.164*** (0.023)	(5) RL sends messages 0.123*** (0.018)

Table A20: Endline usage: Comparing intensive to regular treatment (Overall Sample)

Notes: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include beat-level (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadi-level (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A21: Endline usage: Comparing intensive and regular treatment to control (Overall Sample)

		Objective Measures	Subje Mea	ective sures	
	(1) Added to group	(2) Group Size	(3) Group Active	(4) Receive messages	(5) RL sends messages
Regular Treatment	0.124*** (0.027)	0.704*** (0.225)	0.107*** (0.018)	0.123*** (0.023)	0.087*** (0.012)
Intensive Treatment	0.299*** (0.030)	2.447*** (0.258)	0.262*** (0.022)	0.285*** (0.022)	0.201*** (0.016)
Observations Control Mean Additional Covariates	3,934 0.218 No	3,446 0.575 No	3,934 0.081 No	3,934 0.107 No	3,934 0.023 No
		Objective Measures		Subje Mea	ective sures
	(1) Added to group	Objective Measures (2) Group Size	(3) Group Active	Subje Meas (4) Receive messages	ective sures (5) RL sends messages
Regular Treatment	(1) Added to group 0.118*** (0.027)	Objective Measures (2) Group Size 0.675*** (0.225)	(3) Group Active 0.104*** (0.018)	Subje Meas (4) Receive messages 0.118*** (0.023)	(5) RL sends messages 0.085*** (0.012)
Regular Treatment Intensive Treatment	(1) Added to group 0.118*** (0.027) 0.304*** (0.030)	Objective Measures (2) Group Size 0.675*** (0.225) 2.509*** (0.255)	(3) Group Active 0.104*** (0.018) 0.265*** (0.021)	Subje Mea: (4) Receive messages 0.118*** (0.023) 0.289*** (0.022)	ective sures (5) RL sends messages 0.085*** (0.012) 0.203*** (0.016)

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A22: Endline messages received: Comparing intensive to regular treatment

	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
Intensive Treatment	0.160***	0.115***	0.151***	0.125***	0.083***	0.053***
	(0.032)	(0.023)	(0.031)	(0.026)	(0.022)	(0.018)
Observations	1,868	1,868	1,868	1,868	1,868	1,868
Regular Treatment Mean	0.278	0.116	0.250	0.208	0.134	0.081
Additional Covariates	No	No	No	No	No	No

(a) Panel A: In AWC 2022-2023 or 2023-2024

(b) Panel B: In AWC 2022-2023 or 2023-2024

	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
Intensive Treatment	0.164***	0.116***	0.154***	0.128***	0.086***	0.056***
	(0.030)	(0.022)	(0.029)	(0.024)	(0.021)	(0.018)
Observations	1,868	1,868	1,868	1,868	1,868	1,868
Regular Treatment Mean	0.278	0.116	0.250	0.208	0.134	0.081
Additional Covariates	Yes	Yes	Yes	Yes	Yes	Yes

(c) Panel C: In AWC 2023-2024

	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
Intensive Treatment	0.148***	0.116***	0.143***	0.124***	0.102***	0.105***
	(0.044)	(0.033)	(0.044)	(0.033)	(0.033)	(0.027)
Observations	645	645	645	645	645	645
Regular Treatment Mean	0.278	0.116	0.250	0.208	0.134	0.081
Additional Covariates	Yes	Yes	Yes	Yes	Yes	Yes

(d) Panel D: In AWC 2023-2024

	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
Intensive Treatment	0.137***	0.111***	0.138***	0.114***	0.098***	0.108***
	(0.041)	(0.033)	(0.040)	(0.031)	(0.034)	(0.027)
Observations	645	645	645	645	645	645
Regular Treatment Mean	0.278	0.116	0.250	0.208	0.134	0.081
Additional Covariates	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Panel A and B sample consist of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2022-2023 or 2023-2024 academic year. Panel C and D sample consist of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2023-2024 academic year. All regressions include beat-level (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadi-level (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. Statistical significance at the 1, 5, 10% levels is indicated by ***, **, and *.

Table A23: Endline messages received: Comparing intensive to regular treatment (Overall sample)

		Objective		Subje	ective
		Measures		Mea	sures
	(1)	(2)	(3)	(4)	(5)
	Added to group	Group Size	Group Active	Receive messages	RL sends messages
Intensive Treatment	0.159*** (0.030)	1.784*** (0.256)	0.155*** (0.022)	0.154*** (0.025)	0.117*** (0.018)
Observations Regular Treatment Mean Additional Covariates	2,577 0.342 No	2,205 1.303 No	2,577 0.187 No	2,577 0.233 No	2,577 0.111 No
		Objective Measures		Subje Mea	ective sures
	(1) Added to group	Objective Measures (2) Group Size	(3) Group Active	Subje Mea (4) Receive messages	ective sures (5) RL sends messages
Intensive Treatment	(1) Added to group 0.172*** (0.028)	Objective Measures (2) Group Size 1.857*** (0.252)	(3) Group Active 0.163*** (0.021)	Subje Mean (4) Receive messages 0.164*** (0.023)	ective sures (5) RL sends messages 0.123*** (0.018)

Notes: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include beat-level (refined intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the anganwadi-level (refined intervention treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A24: Endline messages received: Comparing intensive and regular treatment to control (Overall sample)

	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
Regular Treatment	0.129***	0.059***	0.122***	0.113***	0.065***	0.058***
	(0.024)	(0.015)	(0.024)	(0.021)	(0.018)	(0.012)
Intensive Treatment	0.293***	0.159***	0.279***	0.238***	0.152***	0.119***
	(0.025)	(0.019)	(0.023)	(0.023)	(0.017)	(0.015)
Observations	3,934	3,934	3,934	3,934	3,934	3,934
Control Mean	0.148	0.056	0.130	0.098	0.071	0.027
Additional Covariates	No	No	No	No	No	No
	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
Regular Treatment	(1)	(2)	(3)	(4)	(5)	(6)
	Receive	Receive	Receive	Receive	Receive	Receive
	Video	Audio	Activities	Homework	Not Study	Praise
	0.124***	0.055***	0.116***	0.109***	0.060***	0.055***
	(0.024)	(0.014)	(0.023)	(0.021)	(0.017)	(0.012)
Regular Treatment Intensive Treatment	(1) Receive Video 0.124*** (0.024) 0.297*** (0.024)	(2) Receive Audio 0.055*** (0.014) 0.162*** (0.018)	(3) Receive Activities 0.116*** (0.023) 0.282*** (0.022)	(4) Receive Homework 0.109*** (0.021) 0.241*** (0.022)	(5) Receive Not Study 0.060*** (0.017) 0.154*** (0.017)	(6) Receive Praise 0.055*** (0.012) 0.121*** (0.015)

Notes: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A25: Endline asked to share back content: Comparing intensive to regular treatment (In AWC 2023-2024)

	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Intensive Treatment	0.170***	0.148***	0.051**	0.140***	0.014
	(0.041)	(0.038)	(0.020)	(0.041)	(0.027)
Observations	645	645	645	645	645
Regular Treatment Mean	0.236	0.219	0.059	0.210	0.075
Additional Covariates	Yes	Yes	Yes	Yes	Yes
	(4)				
	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Intensive Treatment	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
	0.158***	0.132***	0.038*	0.128***	0.005
	(0.039)	(0.036)	(0.021)	(0.037)	(0.026)

Notes: The sample consists of households in the intensive or regular treatment group with children in the anganwadi system for the 2023-2024 academic year. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A26: Endline asked to share back content: Comparing intensive to regular treatment (Overall sample)

		Objective Measures	Subjective Measures		
	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Intensive Treatment	0.154***	0.134***	0.042***	0.140***	0.023
	(0.026)	(0.025)	(0.013)	(0.026)	(0.016)
Observations	2,577	2,577	2,577	2,577	2,577
Regular Treatment Mean	0.236	0.219	0.059	0.210	0.075
Additional Covariates	No	No	No	No	No
		Objective Measures		Subjec Measu	tive tres
	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Intensive Treatment	0.166***	0.145***	0.046***	0.152***	0.027*
	(0.024)	(0.023)	(0.012)	(0.024)	(0.015)

Notes: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A27: Endline household shares back content: Comparing intensive and regular treatment to control (Overall sample)

	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Regular Treatment	0.138***	0.134***	0.032***	0.121***	0.052***
	(0.023)	(0.021)	(0.010)	(0.022)	(0.012)
Intensive Treatment	0.303***	0.280***	0.076***	0.273***	0.081***
	(0.026)	(0.023)	(0.012)	(0.024)	(0.014)
Observations	3,934	3,934	3,934	3,934	3,934
Control Mean	0.101	0.088	0.028	0.091	0.027
Additional Covariates	No	No	No	No	No
	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
Regular Treatment	(1)	(2)	(3)	(4)	(5)
	Asked to	Asked to	Asked to	Asked to	Asked to
	Share Back	Share Back Videos	Share Back Audio	Share Back Photos	Share Back Text
	0.132***	0.128***	0.031***	0.116***	0.049***
	(0.023)	(0.021)	(0.010)	(0.022)	(0.012)
Regular Treatment Intensive Treatment	(1) Asked to Share Back 0.132*** (0.023) 0.308*** (0.025)	(2) Asked to Share Back Videos 0.128*** (0.021) 0.284*** (0.022)	(3) Asked to Share Back Audio 0.031*** (0.010) 0.078*** (0.012)	(4) Asked to Share Back Photos 0.116*** (0.022) 0.277*** (0.023)	(5) Asked to Share Back Text 0.049*** (0.012) 0.082*** (0.013)

NOTES: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A28: Endline household shares back content: Comparing intensive to regular treatment (In AWC 2023-2024)

	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
Intensive Treatment	0.161***	0.155***	0.054***	0.151***	0.013
	(0.037)	(0.036)	(0.018)	(0.036)	(0.020)
Observations	645	645	645	645	645
Regular Treatment Mean	0.177	0.155	0.040	0.149	0.047
Additional Covariates	Yes	Yes	Yes	Yes	Yes
	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
Intensive Treatment	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
	0.148***	0.146***	0.047***	0.140***	0.012
	(0.037)	(0.037)	(0.018)	(0.036)	(0.021)

NOTES: The sample consists of households in the intensive or regular treatment group with children in the anganwadi system for the 2023-2024 academic year. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A29: Endline asked to share back content: Comparing intensive to regular treatment (Overall sample)

	(]	Objective Measures				
	(1) HH Shares Back on WA Group	(2) HH Sends Back Videos	(3) HH Sends Back Audio	(4) HH Sends Back photos	(5) HH Sends Back Text	
Intensive Treatment	0.134*** (0.022)	0.122*** (0.021)	0.024** (0.009)	0.133*** (0.021)	0.031** (0.013)	
Observations Regular Treatment Mean Additional Covariates	2,577 0.177 No	2,577 0.155 No	2,577 0.040 No	2,577 0.149 No	2,577 0.047 No	
	(N	Objective Measures		Subjee Meas	ctive ures	
	(1) HH Shares Back on WA Group	Dbjective Measures (2) HH Sends Back Videos	(3) HH Sends Back Audio	Subjee Meas (4) HH Sends Back photos	ctive ures (5) HH Sends Back Text	
Intensive Treatment	(1) HH Shares Back on WA Group 0.144*** (0.021)	Dbjective Measures (2) HH Sends Back Videos 0.131*** (0.020)	(3) HH Sends Back Audio 0.026*** (0.009)	Subjec Meas (4) HH Sends Back photos 0.143*** (0.019)	(5) HH Sends Back Text 0.034*** (0.012)	

Notes: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A30: Endline household shares back content: Comparing intensive and regular treatment to control (Overall sample)

	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
Regular Treatment	0.097***	0.088***	0.022***	0.083***	0.033***
	(0.019)	(0.017)	(0.007)	(0.016)	(0.010)
Intensive Treatment	0.239***	0.216***	0.044***	0.219***	0.066***
	(0.025)	(0.023)	(0.010)	(0.024)	(0.011)
Observations	3,934	3,934	3,934	3,934	3,934
Control Mean	0.080	0.068	0.018	0.066	0.016
Additional Covariates	No	No	No	No	No
	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
Regular Treatment	(1)	(2)	(3)	(4)	(5)
	HH Shares	HH Sends	HH Sends	HH Sends	HH Sends
	Back on WA Group	Back Videos	Back Audio	Back photos	Back Text
	0.093***	0.085***	0.021***	0.079***	0.031***
	(0.019)	(0.017)	(0.007)	(0.016)	(0.009)
Regular Treatment Intensive Treatment	(1) HH Shares Back on WA Group 0.093*** (0.019) 0.244*** (0.024)	(2) HH Sends Back Videos 0.085*** (0.017) 0.221*** (0.022)	(3) HH Sends Back Audio 0.021*** (0.007) 0.045*** (0.010)	(4) HH Sends Back photos 0.079*** (0.016) 0.224*** (0.023)	(5) HH Sends Back Text 0.031*** (0.009) 0.067*** (0.011)

Notes: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). * p < 0.1, ** p < .05, *** p < 0.01.

Table A31: Endline subjective beliefs: Comparing intensive to regular treatment (In AWC 2023-2024)

	(1) Share Messages with child	(2) Mother Engages	(3) WA group helping child	(4) Enjoys WA group
Intensive Treatment	0.141*** (0.045)	0.099** (0.038)	0.146*** (0.045)	0.150*** (0.045)
Observations Regular Treatment Mean Additional Covariates	645 0.296 Yes	645 0.272 Yes	645 0.314 Yes	645 0.317 Yes
	(1) Share Messages with child	(2) Mother Engages	(3) WA group helping child	(4) Enjoys WA group
Intensive Treatment	(1) Share Messages with child 0.130*** (0.041)	(2) Mother Engages 0.091** (0.037)	(3) WA group helping child 0.133*** (0.041)	(4) Enjoys WA group 0.133*** (0.042)

Notes: The sample consists of households in the intensive or regular treatment group with children in the anganwadi system for the 2023-2024 academic year. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A32: Endline subjective beliefs: Comparing intensive to regular treatment (Overall sample)

		Objective Measures		Subjective Measures
	(1) Share Messages with child	(2) Mother Engages	(3) WA group helping child	(4) Enjoys WA group
Intensive Treatment	0.169*** (0.029)	0.120*** (0.026)	0.160*** (0.029)	0.158*** (0.029)
Observations Regular Treatment Mean Additional Covariates	2,577 0.296 No	2,577 0.272 No	2,577 0.314 No	2,577 0.317 No
		Objective Measures		Subjective Measures
	(1) Share Messages with child	Objective Measures (2) Mother Engages	(3) WA group helping child	Subjective Measures (4) Enjoys WA group
Intensive Treatment	(1) Share Messages with child 0.183*** (0.027)	Objective Measures (2) Mother Engages 0.137*** (0.024)	(3) WA group helping child 0.174*** (0.026)	Subjective Measures (4) Enjoys WA group 0.171*** (0.027)

Notes: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A33: Endline subjective beliefs: Comparing intensive and regular treatment to control (Overall sample)

	(1) Share Messages with child	(2) Mother Engages	(3) WA group helping child	(4) Enjoys WA group
Regular Treatment	0.116*** (0.026)	0.110*** (0.024)	0.129*** (0.027)	0.125*** (0.027)
Intensive Treatment	0.302*** (0.028)	0.243*** (0.025)	0.305*** (0.028)	0.298*** (0.029)
Observations Control Mean Additional Covariates	3,934 0.181 No	3,934 0.162 No	3,934 0.186 No	3,934 0.192 No
	(1) Share Messages with child	(2) Mother Engages	(3) WA group helping child	(4) Enjoys WA group
Regular Treatment	(1) Share Messages with child 0.110*** (0.025)	(2) Mother Engages 0.102*** (0.024)	(3) WA group helping child 0.123*** (0.027)	(4) Enjoys WA group 0.119*** (0.027)
Regular Treatment Intensive Treatment	(1) Share Messages with child 0.110*** (0.025) 0.307*** (0.028)	(2) Mother Engages 0.102*** (0.024) 0.250*** (0.024)	(3) WA group helping child 0.123*** (0.027) 0.310*** (0.027)	(4) Enjoys WA group 0.119*** (0.027) 0.303*** (0.028)

NOTES: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A34: Endline parental inputs: Comparing intensive to regular treatment (In AWC 2022-2023 or 2023-2024)

	(1)	(2)	(3)	(4)
	Time Spent	Parents Bought	Time Spent	Parents Bought
	By Parents	Education Material	By Parents	Education Material
Intensive Treatment	-0.061	0.130***	-0.064	0.134***
	(0.089)	(0.029)	(0.091)	(0.027)
Observations	790	1,868	790	1,868
Regular Treatment Mean	2.178	0.314	2.178	0.314
Additional Covariates	No	No	Yes	Yes

NOTES: The sample consists of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2022-2023 or 2023-2024 academic year, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A35: Endline parental inputs: Comparing intensive to regular treatment (In AWC 2023-2024)

	(1)	(2)	(3)	(4)
	Time Spent	Parents Bought	Time Spent	Parents Bought
	By Parents	Education Material	By Parents	Education Material
Intensive Treatment	-0.036	0.123***	-0.036	0.115***
	(0.141)	(0.045)	(0.156)	(0.040)
Observations	250	645	250	645
Regular Treatment Mean	2.178	0.314	2.178	0.314
Additional Covariates	No	No	Yes	Yes

Notes: The sample consists of households in the intensive or regular treatment group with children in the anganwadi system for the 2023-2024 academic year. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A36: Endline parental inputs: Comparing intensive to regular treatment (Overall Sample)

		Objective Measures		Subjective Measures
	(1)	(2)	(3)	(4)
	Time Spent	Parents Bought	Time Spent	Parents Bought
	By Parents	Education Material	By Parents	Education Material
Intensive Treatment	-0.130	0.132***	-0.117	0.145***
	(0.086)	(0.027)	(0.086)	(0.025)
Observations	1,084	2,577	1,084	2,577
Regular Treatment Mean	2.178	0.314	2.178	0.314
Additional Covariates	No	No	Yes	Yes

NOTES: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A37: Endline parental inputs: Comparing intensive and regular treatment to control (Overall sample)

	(1)	(2)	(3)	(4)
	Time Spent	Parents Bought	Time Spent	Parents Bought
	By Parents	Education Material	By Parents	Education Material
Regular Treatment	-0.021	0.104***	-0.047	0.098***
	(0.156)	(0.024)	(0.153)	(0.024)
Intensive Treatment	-0.156	0.249***	-0.157	0.254***
	(0.158)	(0.028)	(0.154)	(0.028)
Observations	1,403	3,934	1,403	3,934
Control Mean	2.160	0.210	2.160	0.210
Additional Covariates	No	No	Yes	Yes

NOTES: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A38: Endline Learning Outcomes: Comparing intensive and regular treatment to control (Overall sample)

	Panel A: Overall							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overall	Math	Language	EF	Overall	Math	Language	EF
	IRT	IRT	IRT	IRT	IRT	IRT	IRT	IRT
Regular Treatment	0.003	0.006	0.006	0.005	-0.026	-0.024	-0.021	-0.017
	(0.056)	(0.058)	(0.053)	(0.048)	(0.043)	(0.045)	(0.041)	(0.042)
Intensive Treatment	0.069	0.067	0.063	0.016	0.094*	0.094*	0.085	0.030
	(0.065)	(0.062)	(0.066)	(0.061)	(0.050)	(0.048)	(0.052)	(0.051)
Observations	3,934	3,934	3,934	3,934	3,934	3,934	3,934	3,934
Control Mean	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000
Additional Covariates	No	No	No	No	Yes	Yes	Yes	Yes
Intensive - Regular (Estimate)	0.065	0.062	0.057	0.010	0.120	0.118	0.106	0.046
Intensive - Regular (p-value)	0.332	0.361	0.384	0.867	0.022	0.026	0.051	0.356
			Panel B: Ir	AWC 202	22-2023 or 2	2023-2024		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overall	Math	Language	EF	Overall	Math	Language	EF
	IRT	IRT	IRT	IRT	IRT	IRT	IRT	IRT
Regular Treatment	-0.017	-0.017	-0.007	0.009	-0.038	-0.036	-0.025	-0.006
	(0.054)	(0.056)	(0.053)	(0.052)	(0.045)	(0.047)	(0.044)	(0.047)
Intensive Treatment	0.098	0.090	0.092	0.035	0.097*	0.089*	0.093	0.033
	(0.067)	(0.065)	(0.068)	(0.069)	(0.054)	(0.053)	(0.057)	(0.061)
Observations	2,821	2,821	2,821	2,821	2,821	2,821	2,821	2,821
Control Mean	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000
Additional Covariates	No	No	No	No	Yes	Yes	Yes	Yes
Intensive - Regular (Estimate)	0.116	0.106	0.099	0.026	0.135	0.125	0.118	0.039
Intensive - Regular (p-value)	0.101	0.123	0.170	0.688	0.015	0.023	0.052	0.464
			Pan	el C: In A	WC 2023-2	.024		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Overall	Math	Language	EF	Overall	Math	Language	EF
	IRT	IRT	IRT	IRT	IRT	IRT	IRT	IRT
Regular Treatment	-0.008	-0.049	0.044	0.001	-0.036	-0.070	0.012	-0.032
	(0.073)	(0.069)	(0.076)	(0.089)	(0.062)	(0.058)	(0.065)	(0.083)
Intensive Treatment	0.202**	0.199**	0.197**	0.064	0.150**	0.151**	0.140*	0.040
	(0.085)	(0.078)	(0.089)	(0.096)	(0.072)	(0.067)	(0.074)	(0.095)
Observations	955	955	955	955	955	955	955	955
Control Mean	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000
Additional Covariates	No	No	No	No	Yes	Yes	Yes	Yes
Intensive - Regular (Estimate)	0.210	0.247	0.153	0.063	0.186	0.221	0.128	0.072
Intensive - Regular (p-value)	0.009	0.001	0.084	0.481	0.007	0.001	0.092	0.425

Notes: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table A39: Endline Learning Outcomes: Comparing intensive to regular treatment using midline AWCs

	Panel A: In AWC 2022-2023 or 2023-2024							
	(1) Overall IRT	(2) Math IRT	(3) Language IRT	(4) EF IRT	(5) Overall IRT	(6) Math IRT	(7) Language IRT	(8) EF IRT
Intensive Treatment	0.106 (0.066)	0.067 (0.064)	0.109 (0.072)	0.023 (0.067)	0.124** (0.057)	0.087 (0.057)	0.126** (0.062)	0.035 (0.060)
Observations Regular Treatment Mean Additional Covariates	1,119 -0.026 No	1,119 -0.021 No	1,119 -0.023 No	1,119 -0.009 No	1,119 -0.026 Yes	1,119 -0.021 Yes	1,119 -0.023 Yes	1,119 -0.009 Yes
			Par	el B: In A	WC 2023-2	024		
	(1) Overall IRT	(2) Math IRT	Par (3) Language IRT	el B: In A (4) EF IRT	WC 2023-2 (5) Overall IRT	024 (6) Math IRT	(7) Language IRT	(8) EF IRT
Intensive Treatment	(1) Overall IRT 0.122 (0.080)	(2) Math IRT 0.150* (0.084)	(3) Language IRT 0.095 (0.089)	el B: In A (4) EF IRT 0.015 (0.105)	WC 2023-2 (5) Overall IRT 0.164* (0.084)	024 (6) Math IRT 0.184** (0.088)	(7) Language IRT 0.139* (0.083)	(8) EF IRT 0.065 (0.119)

Notes: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey *and* the midline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

Table A40: Endline Socioemotional Outcomes: Comparing intensive to regular treatment (In AWC 2022-2023 or 2023-2024)

		Panel A: In AWC 2022-2023 or 2023-2024							
	(1) SDQ Difficulty Score	(2) SDQ Pro-Social Score	(3) Externa- lizing Score	(4) Interna- lizing Score	(5) SDQ Difficulty Score	(6) SDQ Pro-Social Score	(7) Externa- lizing Score	(8) Interna- lizing Score	
Intensive Treatment	-0.163 (0.214)	0.113 (0.097)	-0.078 (0.140)	-0.094 (0.133)	-0.163 (0.214)	0.113 (0.097)	-0.078 (0.140)	-0.094 (0.133)	
Observations Regular Treatment Mean Additional Covariates	1,795 13.655 No	1,791 7.815 No	1,825 7.233 No	1,827 6.430 No	1,795 13.655 No	1,791 7.815 No	1,825 7.233 No	1,827 6.430 No	
			Pa	nel B: In A	WC 2023-2024	4			
	(1) SDQ Difficulty	(2) SDQ Pro-Social	(3) Externa- lizing	(4) Interna- lizing	(5) SDQ Difficulty	(6) SDQ	(7) Externa-	(8) Interna-	
	Score	Score	Score	Score	Score	Pro-Social Score	Score	Score	
Intensive Treatment	Score 0.104 (0.351)	0.069 (0.146)	0.120 (0.225)	-0.064 (0.225)	-0.001 (0.373)	0.036 (0.156)	0.068 (0.239)	-0.102 (0.244)	

NOTES: The sample consists of households in the intensive or regular treatment group with children in the *anganwadi* system for the 2022-2023 or 2023-2024 academic year, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

		Panel A: In AWC 2022-2023 or 2023-2024						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SDQ	SDQ	Externa-	Interna-	SDQ	SDQ	Externa-	Interna-
	Difficulty	Pro-Social	lizing	lizing	Difficulty	Pro-Social	lizing	lizing
	Score	Score	Score	Score	Score	Score	Score	Score
Intensive Treatment	-0.076	0.062	-0.016	-0.048	-0.103	0.080	-0.019	-0.065
	(0.198)	(0.091)	(0.130)	(0.117)	(0.199)	(0.088)	(0.130)	(0.117)
Observations	2,480	2,468	2,523	2,521	2,480	2,468	2,523	2,521
Regular Treatment Mean	13.655	7.815	7.233	6.430	13.655	7.815	7.233	6.430
Additional Covariates	No	No	No	No	Yes	Yes	Yes	Yes

Table A41: Endline Socioemotional Outcomes: Comparing intensive to regular treatment (Overall)

Notes: The sample consists of households in the intensive or regular treatment group, as observed in the endline survey. All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < 0.05, *** p < 0.01.
Table A42: Endline Socioemotional Outcomes: Comparing intensive and regular treatment to control (Overall sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SDQ	SDQ	Externa-	Interna-	SDQ	SDQ	Externa-	Interna-
	Difficulty	Pro-Social	lizing	lizing	Difficulty	Pro-Social	lizing	lizing
	Score	Score	Score	Score	Score	Score	Score	Score
Regular Treatment	-0.080	-0.007	-0.075	-0.040	-0.105	-0.010	-0.093	-0.051
	(0.203)	(0.089)	(0.124)	(0.123)	(0.200)	(0.087)	(0.122)	(0.121)
Intensive Treatment	-0.078	0.056	-0.061	-0.038	-0.114	0.077	-0.077	-0.056
	(0.205)	(0.102)	(0.127)	(0.125)	(0.193)	(0.098)	(0.123)	(0.121)
Observations	3,779	3,773	3,854	3,839	3,779	3,773	3,854	3,839
Control Mean	13.684	7.835	7.289	6.442	13.684	7.835	7.289	6.442
Intensive - Regular (Estimate)	0.002	0.063	0.015	0.001	-0.009	0.086	0.015	-0.005
Intensive - Regular (p-value)	0.990	0.456	0.913	0.991	0.966	0.306	0.910	0.969
Additional Covariates	No	No	No	No	Yes	Yes	Yes	Yes

NOTES: All regressions include project-level (base intervention randomization cluster) and child's year of birth fixed effect, with standard errors clustered at the beat-level (base intervention, treatment assignment level). Covariates include mother's and father's education level fixed effects. * p < 0.1, ** p < .05, *** p < 0.01.

A.2 Rocket Learning Program Content

The educational content sent by Rocket Learning (RL) through WhatsApp groups encompassed various developmental areas essential for early childhood education; in the domain of pre-literacy, the program aimed to enhance children's listening and comprehension skills by engaging them in activities such as following simple oral instructions, enjoying age-appropriate short stories, and retelling stories in sequence. Additionally, children were encouraged to identify the beginning sounds of common words, recognize letters and their corresponding sounds, and decode words. The program also focused on recognizing sight words and the correct formation of letters, thus laying a foundation for future literacy skills.

In pre-numeracy, the RL program targeted basic numerical skills, teaching children to count and give up to ten objects when asked and to identify numerals with their corresponding quantities. Motor skills development was also a significant component, with activities designed to improve fine motor skills, such as cutting along a line and buttoning, and gross motor skills, including running, jumping, and catching. Cognitive skills were addressed through exercises in executive function, pattern recognition, and the ability to understand relationships and properties of objects. Furthermore, the program emphasized socio-emotional skills, helping children describe themselves and others, follow game rules, express appropriate emotions, and maintain health and hygiene practices. Through these comprehensive educational activities, the RL program aimed

to support holistic child development in preparation for primary school.

A.3 Child Assessment and SDQ

A.3.1 Test Questions

Our child assessment consisted of 46 questions, with 21 questions testing local language (Marathi) skills, 16 testing math skills, and 11 testing the child's executive function. The language portion of the test was conducted in the local language, Marathi, and tested children's listening comprehension, letter recognition, and letter-writing skills. In the first part of the language test (4 questions), children were told a short story and asked a series of questions about the story. In the second part (9 questions), children were asked to identify letters and words from the Marathi language. Children were asked to write letters in the last part (4 questions). The mathematics portion of the test assessed children's number recognition and basic arithmetic skills. The first part of the math test tested children on counting (4 questions), the second part tested on number recognition (8 questions), and the last part tested on arithmetic operations- addition and subtraction (4 questions). The executive function test (11 questions) assessed children's working memory and cognition. The first part tested children's working memory by asking them to recall the pictures in order. The second part tested children's ability to recognize image shapes and patterns.

A.3.2 Item Response Theory (IRT)

All items administered were multiple-choice questions, and responses were marked as correct or incorrect. Tests were scored using Item Response Theory (IRT) models, which specify a function linking the probability of answering a particular question correctly with the underlying latent ability (Baker, 2001; Lord, 2012). Several recent papers in the economics of education literature in developing countries have utilized IRT models (Singh, 2015; Muralidharan et al., 2019; Zhou et al., 2021). The use of IRT models offers two main advantages over raw item scores. First, it allows different questions to contribute variably to the underlying ability measure. Second, it provides a framework to assess each test question's performance. Through IRT, we can quantify the information each question contributes to the underlying ability measure and how well a question discriminates between students of different abilities.

We use a 2-parameter logistic model to score the tests. The function linking the probability of answering a question correctly to the underlying ability measure is given by:

$$Pr(Y_{ij} = 1|\theta_j) = \frac{\exp(a_i(\theta_j - b_i))}{1 + \exp(a_i(\theta_j - b_i))},$$
(A1)

where Y_{ij} is the response of individual *i* to item *j*. $Pr(Y_{ij} = 1|\theta_j)$ is the probability of individual *i* getting item *j* correct. a_i is the discrimination parameter, with larger values indicating a greater ability of an item to discriminate between students of different abilities. b_i is the difficulty parameter, with larger values indicating more difficult questions. θ_j is the latent trait of person *j* and is assumed to be distributed as $\theta_j \sim \mathcal{N}(0, 1)$.

Figures A1 (a), A2 (a), and A3 (a) show the item characteristic curves for the language, mathematics, and executive (EF) test, respectively. The item characteristic curve (ICC) typically has an S-shape, where the curve's shape, slope, and position provide key insights into a particular question's properties. The left side of the curve tends to be flatter for more difficult items, and the curve becomes steeper as the item's discrimination ability increases. The steepness at the inflection point, generally near the item's difficulty parameter, reflects how well the item differentiates between individuals whose abilities are just below and just above this difficulty level. The curve's position along the θ -axis indicates the item's difficulty, with a curve shifted to the right signifying a more difficult item.

Figures A1 (b), A2 (b), and A3 (b) show the item information curves for the language, mathematics, and executive (EF) test, respectively. The item information curve (IIC) graphically illustrates the amount of information an item provides about the latent trait, θ , across different levels of that trait. The curve shows how well an item discriminates between individuals at various points along the ability continuum. A question in the assessment provides the most information at the point where the curve peaks, typically near the item's difficulty parameter, indicating that the item is most effective at measuring individuals with abilities close to that level. The height of the peak reflects the item's discrimination power; items with higher discrimination provide more information.

Figures A1 (c), A2 (c), and A3 (c) show the Wright Map (Wilson and Draney, 2002), also known as a person-item map for language, mathematics, and executive (EF) test, respectively displays the distribution of individuals' latent ability, θ , and the difficulty of test questions on the same scale. The map shows the latent trait, θ , on a vertical axis, with individuals represented on one side and items on the other. Individuals are placed according to their estimated ability levels, while items are positioned based on

their difficulty parameters. This comparison allows for an understanding of how well the test items align with the ability levels of the assessed individuals. The location of the question number represents the threshold ability at which the probability of getting the question correct is 50%. The higher the threshold value, the more difficult a question. We use this map to classify questions into easy, medium, and hard difficulty levels. Questions with a threshold value less than -1 are classified as easy-difficulty, questions between -1 and 0 are classified as medium-difficulty, and questions above the 0 threshold are classified as hard-difficulty.

We use Cronbach's alpha (Cronbach, 1951) to assess the reliability of test items. Cronbach's alpha for the overall test is 0.95, indicating high test reliability. Cronbach's alpha for the individual Marathi, mathematics, and executive function tests is 0.91, 0.92, and 0.71, respectively.



Figure A1: Languge Test Analysis

(a) Item Characteristic Curve

(b) Item Information Curve

Note: Figure (A) shows the item characteristic curves. Figure (B) shows the item information curves, and Figure (C) shows the Wright map for Marathi questions.



Figure A2: Mathematics Test Analysis

Note: Figure (A) shows the item characteristic curves. Figure (B) shows the item information curves, and Figure (C) shows the Wright map for math questions.



Figure A3: EF Test Analysis

Note: EF stands for Executive function. Figure (*A*) *shows the item characteristic curves. Figure* (*B*) *shows the item information curves, and Figure* (*C*) *shows the Wright map for EF questions.*

A.3.3 Strengths and Difficulties Questionnaire (SDQ)

The Strengths and Difficulties Questionnaire (SDQ) is a behavioral screening questionnaire that includes 25 items for completion by a child's parents or teachers (Goodman, 2001). The test encompasses both positive and negative characteristics. These attributes are categorized into five distinct scales: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. Each scale consists of five items. The first four scales—emotional symptoms, conduct problems, hyperactivity/inattention, and peer relationship problems—are combined to generate a total difficulties score based on 20 items. The fifth scale, prosocial behavior, evaluates positive social behaviors separately. For each item, the child's parent responds to the question as not true, somewhat true, or certainly true. See the following link: https://www.sdqinfo.org/py/sdqinfo/b3.py?language=Englishqz(USA) for the SDQ for parents or teachers of 4-10-year-olds.





Note: AWC denoted Anganwadi center and H denoted households.