Play to Learn: Improving Foundational Learning with Technology-Aided Formative Teaching*

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Abstract

We evaluate the impact of a teacher-directed education technology intervention on the foundational learning outcomes of first- and second-grade students. The intervention employs a game-based software that tracks student progress and enables teachers to assign personalized supplemental activities for students to complete at home. Through a stratified randomized trial, we identify a significant treatment effect of 0.25 standard deviations (SD) in math, primarily driven by a 0.37 SD improvement among first-grade students. We find suggestive evidence that the formative assessment facilitated by the app benefited first-grade students. Furthermore, the intervention is cost-effective, delivering a 1 SD improvement in math learning for every $100 spent. While second-grade students exhibited a 0.30 SD improvement in English scores, we only see significant effects in second-grade math in classrooms where teachers assign more Chimple activities. Our findings underscore the potential of educational technology to enhance learning outcomes, contingent upon teachers' effective integration and utilization of these tools.

Keywords: Computer-aided learning, foundational learning, formative assessment, productivity in education, teaching at the right level
JEL Classification: C93, I21, I24, J24, O15

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1 Introduction

The role of educational technology (ed-tech) or computer-aided learning (CAL) in bridging educational gaps has garnered substantial interest from researchers and policymakers (see Escueta et al. 2020 for a review). CAL has the potential to improve learning outcomes by expanding access to education, augmenting traditional classroom training, delivering personalized materials, and encouraging engagement through compelling content. Some studies have shown that ed-tech improves students' educational achievements significantly by providing adapting learning opportunities (Banerjee et al. 2007; Muralidharan, Singh, and Ganimian 2019). However, the efficacy of ed-tech in improving foundational learning for younger primary school students remains under-researched despite significant learning gaps for this age group in developing countries.

Furthermore, ed-tech can facilitate formative assessment: unlike summative assessment models where teachers assess learning at the end of a unit, formative models provide on-going assessment enabling teachers to target instruction to specific students. Ed-tech products can reduce the cost of frequent assessment and facilitate individual assignments, empowering teachers to meet each child where he or she is and achieve learning gains at all parts of the baseline distribution. For example, such tools can be used to help teachers identify struggling students and provide remedial education, but they can also be used to identify advanced students and provide additional challenges.

This study examines the effect of an ed-tech program deployed in a teacher-directed model on foundational learning outcomes. We conducted a stratified randomized control trial during the April 2022-March 2023 academic year using the app Chimple. Chimple uses a game-based approach to boost engagement and focuses on early literacy and numeracy. Treatment group teachers integrated Chimple into their course plans as a supplemental tool. Each week, teachers assigned homework via Chimple, and students engaged with these activities on their parents' smartphones, thus keeping hardware requirements to a minimum. Notably, the Chimple dashboard tracks student progress in real time to aid formative assessment, and teachers can customize assignments based on this input. Students also have access to the rest of Chimple's library of educational games.

Our sample consists of students in grades 1 and 2 in 34 private affordable schools managed by the Bharti Foundation across five districts in Haryana, India. A school grade is the unit of randomization. We used average test scores from previous years to group schools into eight strata. In each stratum, 50% of schools were randomly chosen to offer the Chimple program in grade 1; the other schools offered the Chimple program in grade 2. The school grades that did not receive Chimple serve as the control group.

We use multiple sources of data. Our primary data source is English literacy and numeracy tests that we designed and administered independently following Early Grade Reading Assessment (EGRA) and Early Grade Mathematics Assessment (EGMA) guidelines. We administered a baseline test in August 2022[1] and an endline test in March 2023. The second data source is the Chimple dashboard, from which we examine how teachers and students use the app. For example, we have data on how many minutes per day teachers spend on the Chimple dashboard and on each time a teacher assigns an activity. Third, we conducted an online survey of all teachers during the intervention in November 2022. Finally, we obtained school administrative records with information on student demographic characteristics, internal math and English assessments, and teacher characteristics. We find balance in observable characteristics across treatment arms. Attrition was low and unrelated to treatment; reassuringly, the attributes of attriters did not vary by treatment status.

We find that the intervention significantly improved learning outcomes. Math test scores improved by 0.25 standard deviations (SD), driven by large gains of 0.37 SD in grade 1. Weaker students in grade 1 benefit the most: first graders in the bottom half of the baseline distribution experience a 0.44-0.49 SD gain in math. Overall, the intervention was highly cost-effective, yielding a gain of 1 SD in math per 100 USD spent. In English, the point estimates indicate a gain of 0.14 SD, although this effect is imprecisely measured. We observe a statistically significant gain of 0.30 SD in English literacy for grade 2 students. These effects vary across the baseline distribution as well, with larger effects for the top three quartiles (0.20-0.49 SD) than the bottom quartile.

Incorporating data from the Chimple dashboard and teacher survey, we examine why the effects differ by grade, with significant effects in math for first grade but English for second grade. CAL effects in literacy are generally harder to find than effects in math (Bulman and Fairlie 2016), which could explain the lack of an effect in first grade English. We hypothesize that differences in how second grade teachers used Chimple explain the lack of a significant effect in second grade math. Second grade teachers assign fewer activities than first grade teachers on average. We find that second grade teachers who assign more activities than the median teacher achieve large, positive and significant (and significantly different) effects in math.

Finally, we provide suggestive evidence of ed-tech's ability to facilitate formative assessment. Our main results are driven by teachers who spend more time on the app, which is a necessary (although not sufficient) indicator of using the student feedback provided by the

1. Schools had just returned to regular in-person instruction after the COVID-19 pandemic and Bharti foundation used the first few months of the academic year as a bridge program to reinforce the previous year's material.

app. We also find larger effects for teachers who report assigning different Chimple homework to different students. The effects are larger for first grade math and for both second grade math and English, although the only significant difference is in first grade math. We acknowledge that these indicators of teacher app usage are endogenous, but they suggest that the app generated improvements in learning via its facilitation of formative assessment.

Our intervention also increased the possibility of information-sharing between parents and teachers, given the use of parents' smartphones and WhatsApp groups used to remind parents of newly assigned Chimple homework. Previous research has documented that sharing information regarding children's school activities with parents at a high frequency can alter educational outcomes (Barrera-Osorio et al. 2020; Bergman and Chan 2021; Ajzenman et al. 2022). We embedded an additional experiment in our study to test the efficacy of providing salient information on engagement. Students in all treated classes were encouraged to use the software: teachers assigned content regularly and sent reminders/nudges to the parents' mobile phones that activities had been assigned. To study how engagement responds to reminders, we randomly assigned children to two groups, with one group's parents receiving nudges twice per month and the other group's parents receiving nudges twice per week. We did not find any impact of more frequent nudges on engagement, plausibly because teachers were already sending many messages through the group chats, reducing the marginal impact of our nudges.

Our paper contributes to the literature on computer-aided learning (CAL). Bulman and Fairlie (2016), Escueta et al. (2020), and Rodriguez-Segura (2021) provide comprehensive reviews of this literature. Most of the existing literature is targeted toward older children, with few studies focusing on foundational learning. The only study focused on first graders to our knowledge is Campuzano et al. (2019), which tested several products used in school and found no effects on reading scores in the US. Hardware-focused studies have generally found little improvement in test scores, likely because instruction remains unchanged (Angrist and Lavy 2002; Barrera-Osorio and Linden 2009; Malamud and Pop-Eleches 2011; Cristia et al. 2017; and Beuermann et al. 2015). Product-based studies have mixed results, with some moderate positive effects as the students review grade-appropriate content (Carrillo, Onofa, and Ponce 2011; Lai et al. 2012; Lai et al. 2013; Lai et al. 2015; Linden 2008; Mo et al. 2014; Barrow, Markman, and Rouse 2009, and Rouse and Krueger 2004). Muralidharan, Singh, and Ganimian (2019) and Banerjee et al. (2007) find large effects, perhaps because their products utilize adaptive instructional models teaching at the right level.

Our paper contributes to this literature by demonstrating the potential of a game-based ed-tech product for foundational learning, designed to engage younger children. Our model is built around formative assessment, where the teachers have continuous access to data

on how well students grasp the material, allowing them to target those who need help in specific domains more easily. An important innovation of our study is that the product is embedded in the classroom curriculum to ensure higher and more consistent take-up: the delivery is teacher-directed at-home reinforcement of concepts learned. Our results highlight that the impact of such products depends on how teachers use it, as also noted in two recent papers. Beg et al. (2022) evaluate a technology-enhanced pedagogical intervention in Pakistan but find that it only improves learning when integrated into the classroom and not when bypassing teachers. Oreopoulos et al. (2024) evaluate interventions integrating Khan Academy modules into the classroom in Nashville, TN, and Arlington, TX, and find that the effect depends on how much class time teachers devote to the intervention.

Finally, using parents' mobile phones also reduces costs and provides an opportunity to continue learning even when schools are disrupted. In a closely related paper, Angrist, Bergman, and Matsheng (2022) delivered SMS-based instruction to parents to address learning gaps during school disruptions. From a policy perspective, leveraging mobile phones that parents already have can alleviate the cost concerns of CAL instruction for poor populations in the developing world.

The remainder of the paper is organized as follows: Section 2 provides background, while Section 3 presents the research design. The data is described in Section 4. Section 5 lays out the empirical strategy and Section 6 presents the results. Section 7 discusses possible mechanisms and formative assessment. Section 8 addresses effect sizes and cost-effectiveness while Section 9 concludes.

2 Background

2.1 Chimple app

Chimple is a free educational app geared towards foundational learning (literacy and numeracy). Chimple was first conceived in 2015 and after becoming a finalist for the Global Learning X-PRIZE, Chimple won $1 million to build and test their idea. A pilot evaluation in Tanzania conducted by UNESCO from December 2017 to March 2019 with 500 children aged 7-11 across 30 villages documented large improvements of around 0.5 standard deviations in literacy and numeracy. Continued development of the app included adding languages spoken in India, including Hindi, Urdu, Marathi, and Kannada, and pilot interventions in Mumbai, India. One pilot intervention in computer labs in 15 schools in Mumbai, in partnership with the 'Brihan Mumbai Municipal Corporation,' was disrupted due to COVID. A second pilot intervention targeted 500 children from low-income households who accessed Chimple

via Door Step School Mumbai community centers. Our intervention is the first to test the efficacy of Chimple in a teacher-driven at-home environment.

Chimple has a number of features that make it a promising tool to address learning gaps in school. First, especially important for a low-income rural population, the app can be installed on low-end internet-enabled smartphones and content can be downloaded for offline use. Second, Chimple's interactive game-based approach to learning is designed to engage young children with short attention spans. Third, the app's learning journey is aligned with the national curriculum for grades K-2, making it easier for teachers to find the right activities to assign. The literacy ladder starts with letter recognition and progresses to sentence formation and reading comprehension. The numeracy ladder starts with number sense and progresses through to basic multiplication. Finally, Chimple's interface for teachers includes a dashboard that tracks each child's participation and progress, facilitating formative assessment.

In Appendix Figures B.1-B.3, we present three screenshots from the teacher dashboard. The top panel of Figure B.1 (in purple) has 4 buttons that enable teachers to assign new activities, track activity on assignments, generate reports by subject and class, and send reminders about the activities. In the remaining panels, the teacher can gauge each student's progress at a glance. The dashboard indicates which students need help, which students are still learning, which students have mastered the concepts, and which students have not engaged with Chimple recently.[2] Chimple's dashboard also provides additional details on learning allowing teachers to identify the specific concepts each child finds challenging. Clicking on one of the panels displays the list of students in that category and their scores on all activities. Figure B.2 provides an example of the students listed as doing well. Clicking on a student's name displays a timeline of the student's progress, including when the student engaged with Chimple, how many activities he or she completed each time, and the student's scores on each activity. Figure B.3 provides an example. The dashboard is updated continuously, in real time, significantly reducing the effort required for teachers to measure individual student progress.

Chimple also makes it easier for teachers to customize assignments based on each student's progress. Teachers have access to engaging activities from Chimple's library of literacy and numeracy games. These games have been aligned with the K-2 curriculum, making it easier

2. Chimple's algorithms classify students into these categories automatically, based on their average score from their last five activities completed (whether the activities were assigned by the teacher or not). Students whose average score is below 50% are classified as needing help and listed in the red panel of Figure B.1. Students whose average score is between 50 and 70% are classified as still learning and listed in the yellow panel. Students whose average score is greater than or equal to 70% are listed as doing well in the green panel. Finally, students who have been inactive for more than seven days are listed in the gray panel with an icon displaying the number of days the student has been inactive.

for teachers to find the right homework assignments. From the teacher dashboard, teachers can assign activities to the entire class or to a subset of students in the class based on their mastery of previous concepts, for example. Children can complete activities assigned by their teachers, but Chimple also offers suggestions for engaging further with the app, for example, through attempting the next activity in the learning journey. To motivate children, the app also includes a monkey avatar (named Chimple) who nudges children to complete more activities and offers rewards for their engagement with stickers and badges.

2.2 Satya Bharti schools

Bharti Foundation, the philanthropic arm of Bharti Enterprises, is a non-governmental organization established in 2000 with a mission of improving access to quality education across rural India. In 2006, Bharti launched its Satya Bharti School Program that provides free, quality education to impoverished children. The foundation uses the same grade-specific curriculum across all its schools in India. Weekly teaching plans, learning objectives, and examples of exercises are shared with teachers at the start of the academic year. In math, the focus is to master number recognition, and gain competency in arithmetic computation such as addition, subtraction, multiplication, and division. The curriculum also includes grade-appropriate word problems and analytical problems. In English, students learn letter recognition, word formation and sounds, and comprehension, with more complex words and basic grammar introduced in grade 2. Teachers generally have a Bachelors in Education or an Elementary Teacher Training (ETT) diploma.[3]

3 Intervention and research design

3.1 Sample

Currently, Bharti Foundation operates 38 Satya Bharti schools in the state of Haryana, India. Satya Bharti schools are clustered in two districts in the north of the state (Kaithal and Kurukshetra) and three districts in the south (Jhajjar, Mahendragarh, and Rewari). The intervention and surveys were piloted in four of these schools in the 2021-2022 academic year; these four schools were then excluded from the main study.[4] The study sample consists of the remaining 34 schools. Total enrollment across the sample was around 800 students per grade. More than 80 percent of children enrolled are from disadvantaged castes, and

3. An ETT is a 2 year diploma course available to high school graduates. The content is similar to a Bachelors in Education, but does not include on-the-job practical training.

4. These four schools were selected based on their proximity to Delhi for monitoring ease.

50 percent of households earn less than USD 1,300 per year. Approximately 90 percent of households have access to at least one smartphone that can run Chimple.

3.2 Intervention

Teachers in treated grades integrated Chimple into their course plans as a supplemental tool. Each week teachers were supposed to assign homework via Chimple and track students' progress via the dashboard. Teachers had discretion over how many activities to assign per week, which activities to assign, and to which students. However, Chimple provided an easy correspondence between the library of available activities and the teachers' (Bharti-provided) weekly lesson plans. Bharti administrator conducted periodic check-ins with the teachers and a Chimple district cluster coordinator monitored how teachers used the app.

At the beginning of the intervention, schools held parent-teacher meetings to create awareness about Chimple, encourage activation, and highlight the potential value of Chimple. Classes also competed to achieve the highest Chimple activation rates, with various recognition-based rewards. Teachers were awarded monthly certificates for having the highest number of active student users, the longest average duration of Chimple use, and the most completed assignments. Ninety percent of students had access to Chimple via a parent's phone, but teachers were also expected to help students who had limited access to Chimple at home access Chimple on a device in the classroom during the school day.

In addition, the intervention leveraged WhatsApp, a messaging tool, as a platform for teachers to communicate with parents. Teachers used a group chat on WhatsApp to instruct parents on installing Chimple on their phones and to alert parents when activities were assigned. The cluster coordinator also created WhatsApp groups with teachers in treated grades to facilitate communicating important announcements and providing on-demand technological support.

3.3 Timeline

The timeline is depicted in Figure 1. We determined which classes would receive treatment in March 2022, before the start of the 2022-2023 school year, followed immediately by teacher training. Chimple and Bharti held a one-day training workshop for teachers, with hands-on exercises from both the children's and teachers' perspectives. The training covered modules on the programmatic elements, including lesson planning, monitoring student progress, and other support functions such as generating reports. Refresher training was provided every quarter to teachers and Bharti staff.

Program roll-out began in April 2022 with parent-teacher meetings and activation campaigns. Since pandemic-era measures were ending and schools were meeting in-person for the first time since 2020, Bharti Foundation offered a bridge program in the summer to help students get ready for the new school year. This ended in July 2022, at which point teachers began assigning more activities on Chimple. In August 2022, we conducted a short 'baseline' test of math and English in school. Baseline testing before the intervention began was not possible logistically, given constraints on in-person testing and the bridge program; reassuringly, our empirical results are robust to including or omitting these controls and also to including or omitting test scores from Bharti's internal assessments from the beginning of the year.

During the intervention, we periodically visited some schools to better understand implementation and in November 2022, we conducted a teacher survey via Zoom to learn more about usage and teacher attitudes towards Chimple. Finally, we conducted an endline test in math and English in March 2023. Both baseline and endline tests were conducted by an independent research firm in school, but tests were not shared with Bharti. A second day of in-school testing enabled us to test students who were absent on the designated testing day. We also began a household survey after the completion of in-school testing but this was halted midway due to concerns from Bharti about our enumerators contacting their students outside of school.

3.4 Randomization

We used a stratified design to determine the treatment and control groups, where a grade within a school was the unit of randomization. The sample includes 34 schools with 1 section each of grades 1 and 2, Chimple's targeted age group. Strata were based on school administrative records from the previous academic year. Specifically, we used average test scores from the end of the academic year 2021-2022 to group schools in 8 strata (7 groups of 4 schools and one group of six schools). In each stratum, 50% of schools were randomly chosen to offer the Chimple program in grade 1, while grade 2 was in the control group; the remaining schools offered the Chimple program in grade 2, with grade 1 left in the control group. Table 1 shows that treated grades are not statistically different from control grades on observable characteristics and baseline test scores.

Our final sample consists of the 1675 students enrolled in the sample schools as of May 2022. Even though randomization occurred in March 2022, prior to this roster, it is common for new students to enroll during the first few months of the academic year. Since activation did not begin until May 2022, this roster is very unlikely to be selected.

We nested a second experiment within the treatment group to test the impact of higher frequency nudges to parents' mobile phones. Students were randomly assigned to a low or high-intensity WhatsApp group, stratified by class and access to smartphones (measured by whether either parent has a smartphone). We find no impact of these nudges, likely because teachers and Chimple coordinators were already sending many WhatsApp messages to parents - the marginal impact of biweekly messages was likely negligible. More details about this embedded experiment (including the results) are in Appendix C.

4 Data

4.1 Math and English tests

The primary outcome of interest is students' scores on math and English tests designed by the research team and administered independently by a survey firm. The tests were designed based on EGRA and EGMA guidelines from RTI International as well as Pratham-ASER tests and previous grade-level tests shared by Bharti. We conducted the tests in school, during the school day, to ensure we reached as many students as possible. To minimize the disruption to the school day and given the short attention spans of such young children, we kept each test to about 30 minutes. The endline tests can be found in Appendix D.

We conducted a first round of tests in August 2022, three months into the intervention, for logistical reasons: schools had recently returned to in-person teaching and Bharti was operating a bridge instruction program. Even though Chimple activation and on-boarding began a few months earlier, in June, we use this test as a baseline since grade-level instruction did not begin until August. Table 1 confirms that test scores were still balanced between the treatment and control groups at this time.

We conducted endline tests in early March 2023. To minimize attrition, we offered the endline tests in school, during the school day, and on two different days so that those absent on the first day could take the make-up.

Out of the 1675 students in our sample, we have endline test scores for 1528 students (91%). This attrition rate is similar across treatment and control (8.92% vs 8.63%) but slightly higher in grade 2 than grade 1 (10.5% vs. 7.21%). The vast majority of students who attrited are also missing from our baseline data, suggesting that this attrition occurred prior to August 2022. In Section 6.5, we confirm that attrition does not affect our results, by estimating inverse probability weighted specifications and by using Lee bounds (Lee 2009).

4.2 Other data sources

Data from Bharti Foundation We have access to administrative data from Bharti for the 2021-2022 and 2022-2023 school years. These data include school characteristics, student and teacher demographic characteristics, and information on at-home device access. We used the data from 2021-2022 to conduct the randomization and we checked balance in the 2022-2023 data as shown above in Table 1.

Bharti also conducts annual assessments in all classes at the beginning of the academic year. Thus, we can use pre-intervention test scores, collected by Bharti from the 2022-2023 school year, as baseline controls as well.

Chimple dashboard data The Chimple app logs all student and teacher activity, providing a rich, high-frequency source of data on take-up from both students (engaging with the app) and teachers (assigning activities). For each student, the dashboard includes data on each session on the app, recording the time spent, number of activities completed in each subject (English, Hindi, and math), and the students' score. We also have data on when teachers assign activities, which activities they assign, and to which students each activity is assigned as well as how much time teachers spend on the dashboard each day.

Teacher survey In November-December 2022, in the middle of the intervention, we conducted Zoom interviews with all teachers from both grades (68 teachers). We asked teachers about their teaching practices including, among other things, how frequently they assign homework (both on and off Chimple), how they determine what homework to assign, how often they use the Chimple dashboard and for what purposes, how often they interact with parents, and their perceptions of using Chimple as part of their pedagogy. The survey instruments can be found in Appendix E.

Household Endline Survey After the endline tests, in May 2023, we conducted a household survey to better understand take-up, the likelihood of spillovers, and parental perceptions of Chimple as a learning tool. Due to Bharti's requirements, we surveyed a subset of treatment and control households from 62 villages with 10 or more Bharti students.[5] The survey instrument can be found in Appendix E.

5. Bharti requested that we not approach their students' families directly. Thus we conducted a census of schoolchildren in these villages and surveyed those households that had students enrolled in Bharti schools.

5 Empirical specifications

To estimate the impact of the Chimple app on students' performance, we estimate intention-to-treat (ITT) effects using the following regression specification:

$$Y_{igst_1} = \beta_0 + \beta_1 Treat_{gs} + \mu_k + \lambda_r + \beta_2 Y_{igst_0} + X'_{gst_0}\Phi + \epsilon_{igst_1} \quad (1)$$

where Y_{igst_1} is the test score of student i in grade g in school s at the time of endline t_1. Test scores are normalized using the control group's distribution. $Treat_{gs}$ indicates that grade g of school s was selected to offer the Chimple program, and β_1 is the ITT estimate. Our regressions control for students' normalized baseline scores (Y_{igst_0}) on our tests as well as Bharti's internal assessments, with indicators for missing observations. As specified in our pre-analysis plan, we also control for strata and district fixed effects (μ_k, λ_r) and other predetermined characteristics (X_{gst_0}). The predetermined characteristics include gender, caste, migrant family status, father's occupation (day labor, agriculture, or private job), mother's occupation (day labor or housewife), special needs child, family income, poverty status (below poverty line, BPL), access to android phones, connectivity categories (4g, 3g, or 2g). In pooled regressions we include grade fixed effects. Since strata and district fixed effects identify more than half the treatment schools when we estimate grade-specific regressions, we drop district fixed effects in those regressions to avoid our results being driven by a very small set of schools. ϵ_{igst_1} is the error term clustered at the school-grade level. We report estimates on students' performance on mathematics and English tests separately.

Using data on take-up and engagement from Chimple, we can also estimate the dose-response relationship. Since dosage, measured in average hours of engagement per week, is endogenous, we instrument with treatment status in a two stage least squares model. The control variables are as listed in the ITT model. Specifically, we estimate

$$Y_{igst_1} = \beta_0 + \beta_1 \widehat{Engagement}_{igs} + \mu_k + \lambda_r + \beta_2 Y_{igst_0} + X'_{gst_0}\Phi + \epsilon_{igst_1} \quad (2)$$

where $\widehat{Engagement}_{igs}$ is predicted from the first stage regression:

$$Engagement_{igs} = \alpha_0 + \alpha_1 Treat_{gs} + \mu_k + \lambda_r + \alpha_2 Y_{igst_0} + X'_{gst_0}\Phi + \epsilon_{igs} \quad (3)$$

6 Results

6.1 Take-up and spillovers

We begin by examining the take-up of the intervention, as measured by the fraction of children who engage with Chimple and the average time spent on Chimple each week. As seen in Figure 2, Panel a, take-up was relatively high and consistent. Between 60 and 80% of students engaged with the app each week, with some dips corresponding to holidays or festivals leading to school closures. Conditional on logging in each week, students spend more than 60 minutes on the app per week (Panel b) on average.

Spillovers are a possible threat to internal validity. While we see some evidence of technology usage by control students, we still see substantial differences in take-up of technology-aided learning in the treatment classes. In November 2022, we asked teachers whether they gave app-based homework: 100% of those in treatment classes responded that they used apps for homework and subsequently confirmed that it was Chimple. In the control group, no second-grade teachers and only two first-grade teachers (11%) responded that they used an app, but it was not Chimple.

Even if control teachers were not assigning Chimple-based work, their students could have downloaded it independently and used it. Using data from the household survey at the end of the intervention, Figure 3 confirms relatively high take-up in the treatment group, where 64-70% of parents report that their children use Chimple for homework or academic purposes. We also observe that 23-26% of parents in the control grades report that their children use Chimple. The difference in take-up is economically and statistically significant. Recall that the household survey was conducted to a subset of households due to Bharti's concerns, thus we view this difference as merely suggestive. If representative, the ITT effect would be interpreted as the effect of this 40-45 percentage point difference in students' Chimple use. In addition, Chimple use among treatment children was more likely to be teacher-directed. Given our within-school randomization (chosen to increase statistical power with a small number of schools), one might be concerned that Chimple use in the control sample is driven by siblings. To allay this, we confirm that the difference in take-up across treatment and control students does not vary significantly by whether the sample child has siblings currently in school (Appendix Figure B.4).

6.2 Treatment effects

We begin with descriptive plots of math and English test scores at baseline and endline. Test scores are normalized by the baseline distribution separately by subject and grade.

Figure 4 presents means from the pooled sample by subject (math and English), and Figures 5 and 6 present the results by grade and subject. As can be seen in Figure 4, differences at baseline are small, and differences at endline are substantially larger, although the confidence intervals do overlap. Splitting the sample by grade suggests some heterogeneity in these results: the difference in math test scores at endline are large for grade 1 and small for grade 2 (Figure 5) while the opposite is true for English test scores (Figure 6). We proceed by estimating the lagged dependent variable model to test the significance of these results.

Our ITT estimates by subject are reported in Table 2. Columns (1) - (4) report the results for math and (5) - (8) for English. Endline test scores are normalized by the control population distribution, separately by subject and grade. Within each set of columns, we begin with specifications that include grade and strata fixed effects and sequentially add: our baseline test scores, test scores from Bharti-administered baseline tests, and demographic characteristics, such as gender, caste, socioeconomic status, and district fixed effects. We also include indicators for missing baseline or Bharti test scores. Standard errors clustered by school-grade are in parentheses and randomized inference p-values are provided below the main estimates. We observe positive and sizeable effects for math and English (0.25 SD and 0.14 SD, respectively), although only the impact on math is statistically significant.

As foreshadowed by the raw differences, the pooled results mask some heterogeneity by grade. Table 3 provides estimates of specification 1 separately by grade.[6] The top panel presents results for grade 1 and the bottom panel for grade 2. We find large, positive, and statistically significant effects on math scores in grade 1, on the order of 0.37 SD, but insignificant effects in grade 2. Surprisingly, we see the opposite pattern for English: large, positive, and significant effects on English test scores in grade 2, but insignificant effects in grade 1. We discuss possible explanations for the grade-specific effects in Section 7 below.[7]

Estimating separate treatment effects by gender reveals similar effects for both female and male students, with slightly larger but not significantly different effects for girls (Appendix Table A.3). This is meaningful due to concerns about intra-household allocation of resources in India which might affect access to shared household devices. Similarly, we find larger effects for children from disadvantaged castes (Appendix Table A.4), but the estimates are not significantly different.

6. As noted in Section 5, we omit district fixed effects in grade-specific regressions because the combination of strata and district fixed effects identify too many treatment schools.

7. We also assessed the impact of Chimple on specific competencies tested in our math and English tests (Appendix Table A.1). In math, we find significant improvement in arithmetic computation, word problems, and analytical skills but not in recognizing numbers. In English, we find significant improvements in spelling but not vocabulary, comprehension, or grammar (only tested in second grade). Splitting the sample by grade (Appendix Table A.2) confirms that the math improvements are only in grade 1 and the English improvements only in grade 2 as seen in our overall results.

6.3 Heterogeneous effects by baseline score

Next, we consider heterogeneity by baseline performance. We estimate the results by quartile of the baseline distribution by subject and grade; we lose some observations since not all students in our sample took the baseline test. Table 4 presents the regression results, and Figures 7 and 8 display the results graphically with 95% confidence intervals. In Table 4, Columns 1-3 report results for math, pooled and then by grade, while Columns 4-6 report similar results for English. In math, Chimple has the largest effect for the bottom half of the distribution, driven by below-median first graders. The effects, on the order of 0.5 SD, are large. The effects in math for above-median first graders are not statistically significant, but the point estimates are positive and economically meaningful. For second-grade students, the effects in math are statistically insignificant across the distribution, but the point estimates for students in the middle of the distribution are positive and nontrivial in magnitude. Tests of equality reveal that the effects are indistinguishable across the distribution for first graders, but significantly different from each other for the pooled sample.

In English, the intervention had large and economically meaningful effects for second graders above the bottom quartile of the baseline distribution, although only those for the second and fourth quartiles are precisely estimated. A test of equality marginally rejects that these estimates are the same across the distribution. In grade 1, on the other hand, the point estimates are statistically insignificant throughout the distribution.

6.4 Dose-response relationship

Next, we estimate a two-stage least squares specification, 2, by subject and grade to provide treatment on the treated estimates (Table 5). The endogenous variable is the average number of hours spent on Chimple per week from May 2022 through February 2023. We use time spent across all activities since time spent on English could theoretically improve test scores in math and vice versa. As seen in the bottom two rows, the first stage indicates a strong correlation between treatment and time spent on the app; children in the treatment group spend approximately 1 hour per week on Chimple. Given this first stage, the dose-response effects are very similar to our main results, as expected. An additional hour per week on the app increases math test scores by a statistically significant 0.24 SD (0.38 SD for first graders) and English test scores by a statistically insignificant 0.13 SD overall and a marginally significant 0.26 SD for second graders.

6.5 Attrition

Out of the 1675 students in Bharti's roster as of May 2022, we could not conduct endline tests for 147 (8.8%). Several robustness tests show that attrition is not systematic and does not confound our estimates. First, we show that treatment is not correlated with attrition. Appendix Table A.5 presents results from regressions of an indicator for attrition on treatment, various controls, and interactions of those controls with treatment. We run these regressions including only baseline test scores and an indicator for missing baseline test scores as the controls, as well as including all the demographic controls from our main regressions, such as demographic characteristics and mobile phone access. In the latter case, we do not show all coefficients in the interest of space; however, we do present p-values from F-tests of treatment and all the interactions. Neither treatment nor the interactions are significant: Treatment does not predict attrition itself and it does not predict attrition differentially with respect to baseline test scores or the full set of controls. Whether a student is missing baseline test scores strongly predicts attrition, suggesting that most attrition occurred between May 2022, when the roster was collected, and the baseline test in August 2022, very early on in the intervention.

Next, we estimate inverse probability weighted specifications where the weights are the inverse of the predicted probability of having scores both in math and English.[8] Results shown in Appendix Table A.6 are consistent with our main results; in fact, accounting for attrition, we see a larger effect for grade 1 in math (0.44 SD) and grade 2 in English (0.38 SD). Finally, we use Lee Bounds to test the robustness of our inference to attrition (Lee 2009). As seen in Appendix Table A.7, we find fairly tight bounds for overall math scores, math in grade 1, and English in grade 2. The upper Lee bound for second grade math is also statistically significant.

7 Potential mechanisms: the role of formative assessment

In this section, we incorporate data from the Chimple dashboard and teacher survey to examine two questions related to mechanisms. First, we seek to understand the different effects by grade and subject. Second, we look into how teachers used the app and whether

8. The probability is predicted using a probit model with baseline scores, demographic characteristics, grade fixed effects, and school fixed effects.

the learning gains were due to the formative assessment facilitated by the Chimple.[9]

7.1 Intensity of usage

Data from the Chimple dashboard reveal that first- and second-grade teachers both used the app intensively, spending on average 12 minutes on the app per week, ranging from 6 to 30 minutes. Teachers assigned 23 activities on the app per week on average, ranging from 8 to 89. Second grade teachers spent more time on the app than first grade teachers, but assigned fewer activities. First- and second-grade students attempted a similar fraction of the assigned activities and received similar scores on them, while second graders spend more time on the app on both assigned and unassigned activities. Differences in usage between first- and second-grade students are not generally statistically significant.

To better understand the different effects by grade and subject, we consider heterogeneous effects by intensity of app usage by teachers. We estimate separate treatment effects for teachers who assign fewer and more than the median number of Chimple activities (Table 6). The main effects we find in first grade math and second grade English are driven by teachers who assign more activities, although the effects are not statistically different from each other. In second-grade math, however, where we did not see an overall effect in Table 2, the treatment effect for teachers who assign more activities is large, positive, and marginally significant in Table 6. This effect is also significantly different (p-value 0.075) than for teachers who assign fewer activities. The point estimate in second-grade math for teachers who do not assign many Chimple activities is, in fact, large and negative, explaining the overall null effects. We acknowledge that intensity of app usage is endogenous - teachers who assign more activities differ from teachers who assign fewer activities - but we conclude that variation in how second-grade teachers used Chimple explain the different math effects by grade.

Considering first-grade English, we see no significant effect or meaningful difference in the point estimates between teachers who assigned few or many activities. Reviewing the literature on CAL, Bulman and Fairlie (2016) notes that previous studies have also found more positive effects in math than in language and we leave further investigation of this to future work.

9. We also consider differences in effects by teacher characteristics including education, gender, and caste even though these characteristics do not differ much by grade. Effects are similar for teachers with and without a Masters degree (Appendix Table A.8 and for teachers of general and disadvantaged castes (Appendix Table A.9). We see different effects for male and female teachers but with such few male teachers (3 in grade 1, none of whom are in the treatment group, and 6 in grade 2, 4 of whom are in the treatment group), we hesitate to infer much from these differences.

7.2 Formative assessment

Next, we investigate the role of formative assessment in our intervention and results. In order to use the feedback from the app to target instruction, teachers would need to physically spend time on the app. Thus, while necessary but not sufficient (or exogenous), we use spending more time on the Chimple dashboard as a suggestive proxy for whether a teacher is using the app for formative assessment. Table 7 estimates separate effects for teachers who spend more than the median amount of time on the Chimple dashboard. Our main results in first-grade math and second-grade English are larger for teachers who spend more time on the app (the difference for first-grade math is large, 0.55 SD, and significant, p-value 0.013).

Next we turn to the teacher survey from November 2022 in the middle of the intervention. We asked teachers whether they assign different Chimple homework to each student or the same homework to all students. While all teachers in treated classrooms reported using Chimple to assign homework and also often in the classroom, the same number of teachers in each grade (3 out of 17) reported assigning different homework to each student. These teachers also reported using student performance on past homework when deciding on Chimple assignments. Table 8 estimates separate effects for teachers who reported assigning the same homework to all students and those who reported assigning different homework to each student. The results mirror those of Table 7 - the effects in first-grade math and second-grade English are larger for teachers who report using this formative assessment strategy. The difference in first-grade math is marginally different (p-value 0.078). We also see a large, economically meaningful, but not significant effect (0.37 SD) for second-grade teachers who assign different homework. We note that these results should be taken with a grain of salt since the behavior is self-reported (and endogeneous) and we have a very small sample of teachers. However, combined with the different impacts by intensity of dashboard use, these results suggest that teachers who employed the formative assessment facilitated by Chimple achieved greater learning gains.

8 Effect size and cost effectiveness

In this section, we discuss the magnitude of our effects and the cost-effectiveness of our intervention. Compared to the literature, our ITT effect sizes are large and economically meaningful. Kraft (2020) provides a review of 1942 effect sizes from 747 randomized control trials focusing on learning outcomes and documents a median effect size of 0.10 SD. Evans and Yuan (2022) confirms this 0.10 SD median effect size after reviewing 234 studies in low-

and middle-income countries. Our intervention had more than twice as large an effect in math at approximately 0.25 SD, and even larger for below-median first graders (0.5 SD).

The intervention cost around USD 25 per treated student for 1 year in 2022 dollars. Using the estimate from Table 2 of 0.25 SD, we calculate an increase of 1 SD in math test scores per 100 dollars spent, which we can compare to other education initiatives, as described in Kremer, Brannen, and Glennerster (2013). This number is smaller, but comparable to two similar studies in India: an in-school CAL-based remedial program (1.54 SD gains per 100 USD, Banerjee et al. 2007) and an in-person CAL-based adaptive program (1.05-1.68 SD per 100 USD). Similarly, it is slightly larger, but comparable to SMS and phone-based tutoring provided to parents (0.63 SD gains per 100 USD, Angrist, Bergman, and Matsheng 2022).

9 Conclusion

This paper provides evidence on leveraging low-cost technology to improve foundational learning outcomes. Teachers regularly assigned homework on a game-based app that children completed on their parents' internet-enabled, but not necessarily high-end, smartphones. We find a 0.25 SD gain in math scores and 0.14 SD gain in English, although this English result is imprecise. In math, the intervention is quite cost-effective at 1 SD gain per USD 100. These results suggest that low-cost technology can help reduce learning poverty in developing countries.

One potential benefit of the app was to lower the cost of formative assessment, offering teachers more real time information on their students' mastery of the material and making it easier to assign customized homework. We find suggestive evidence that these features of the app were helpful in driving the overall results. We also find larger effects for children at the bottom of the baseline distribution in grade 1, highlighting the value of formative assessment for foundational learning. Considering magnitudes, 2SLS estimates indicate that 1 hour per week spent on the app can generate a 0.24 SD improvement in math test scores.

Our results provide proof of concept and are policy relevant across the developing world. Take-up of such educational apps is generally low and uneven, but our study demonstrates that a teacher-directed model can ensure consistent take-up for the entire academic year. While schools in our sample serve underprivileged communities, they are still private schools run by an NGO with a selected sample of teachers and households. Future trials should assess the effect of app-based mobile interventions in even less privileged communities, government schools, and at scale. App-based mobile interventions may also be valuable during school disruptions, for example due to extreme weather events in low resources settings. The automation of content delivery, adaptive learning ladder, and simple vernacular approach

to instruction can offer a low-cost alternative to in-person instruction over mobile phones during such times.

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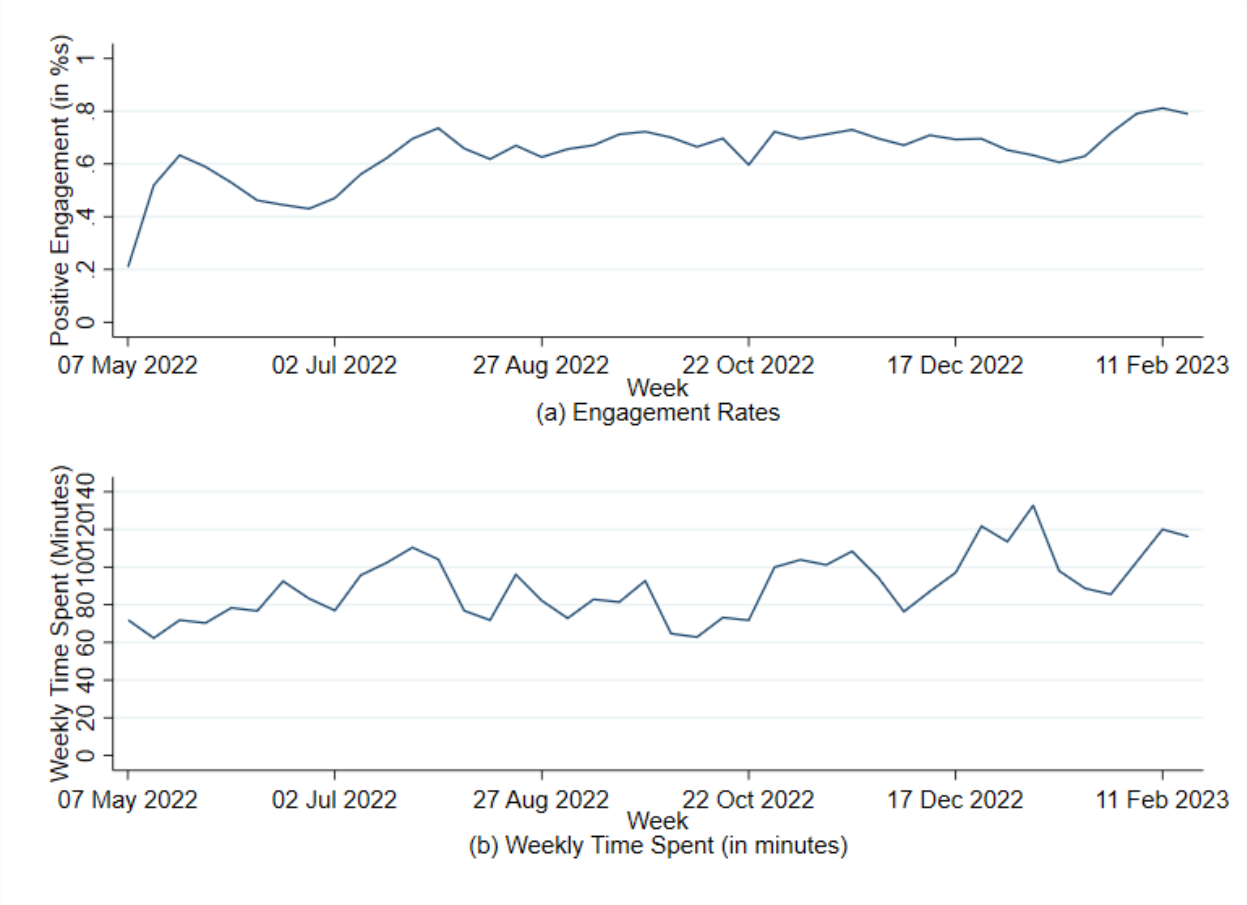
Figures

Figure 1. Timeline



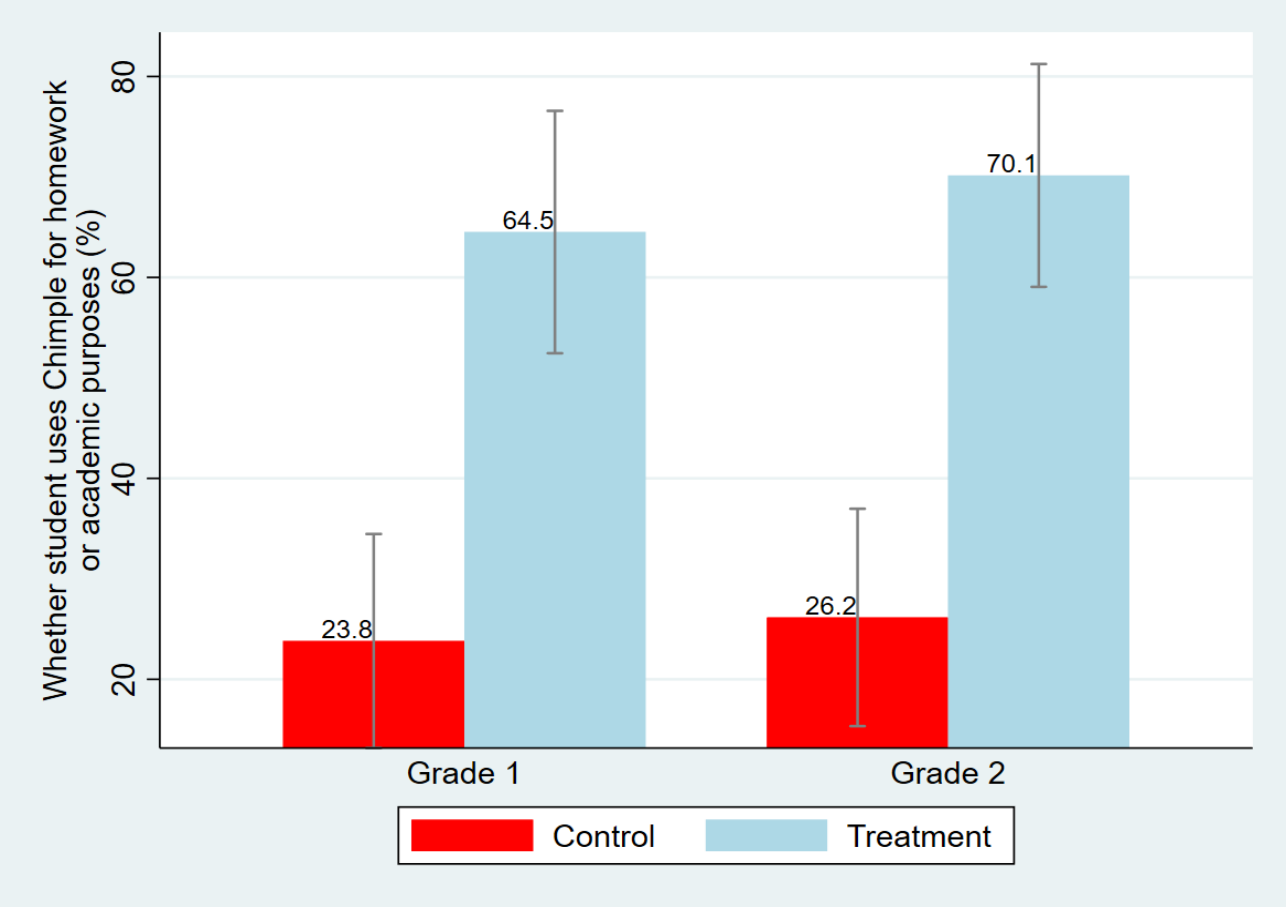
Note: This figure presents the timeline of the intervention. In addition to the activities presented, a member of the research team visited a few schools in September 2022 and February 2023 to conduct focus groups with teachers.

Figure 2. Weekly time-trends in engagement



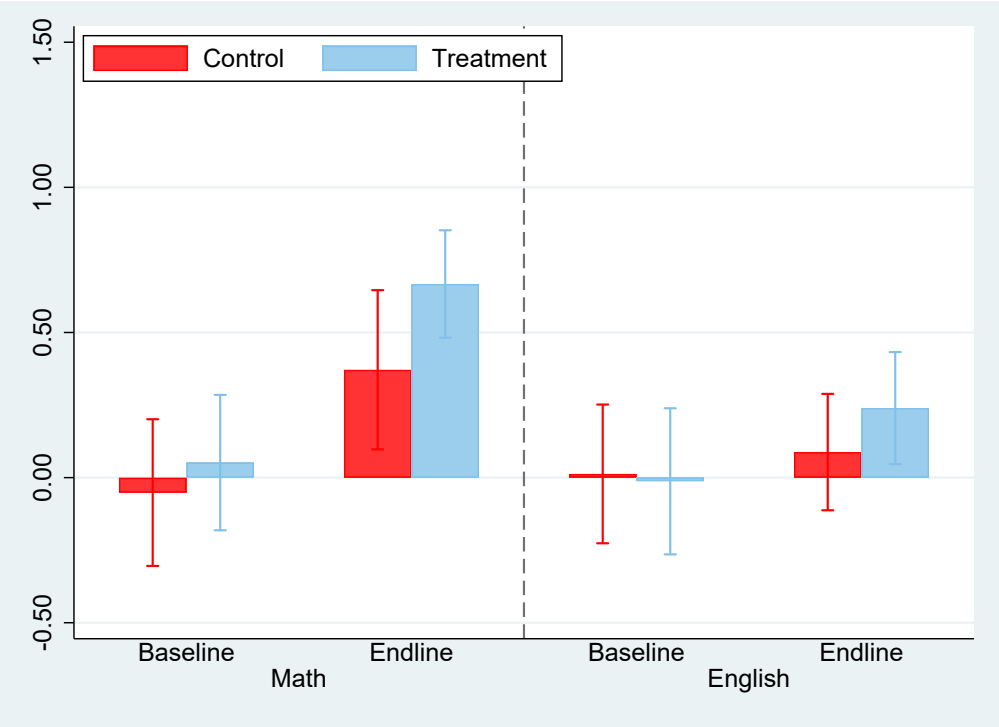
Note: This figure plots the fraction of students in treatment classes who engage with Chimple each week for a non-zero number of minutes (Panel a) and the average number of minutes spent on Chimple each week conditional on logging in (Panel b).

Figure 3. Parent-reported take-up



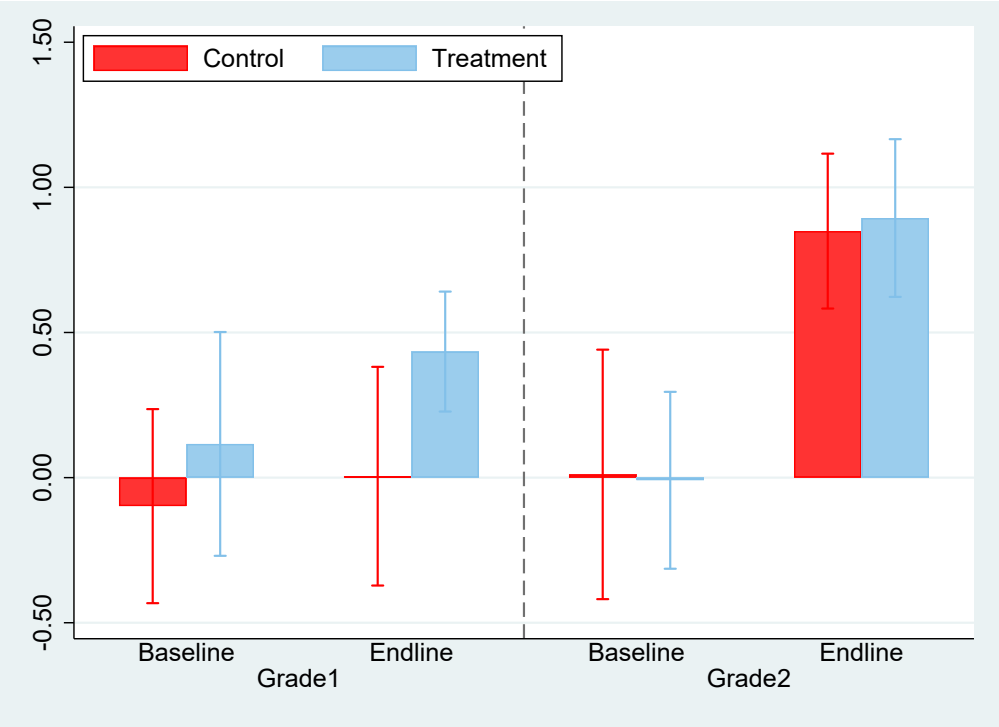
Note: This figure presents the fraction of parents who report that their children use Chimple for homework or academic purposes by grade and treatment status from the May 2023 household survey with 95% confidence intervals.

Figure 4. Mean difference in math and English scores



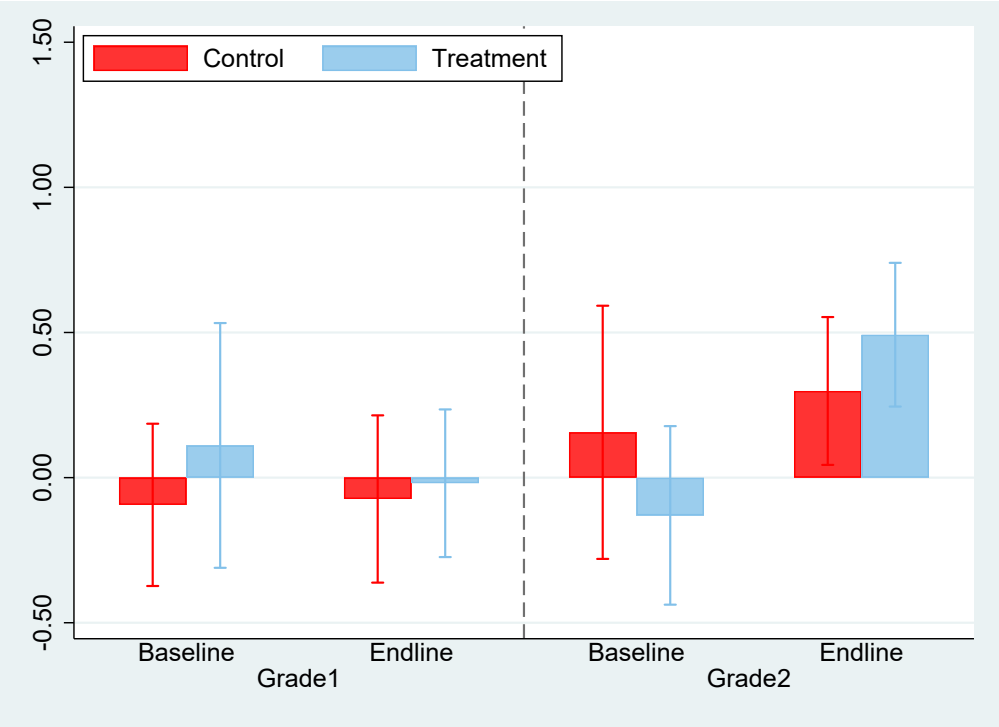
Note: This figure presents raw differences between the treatment group and control group on each math and English test (baseline and endline), with 95% confidence intervals. Scores are normalized relative to the baseline distribution.

Figure 5. Mean difference in math scores by grade



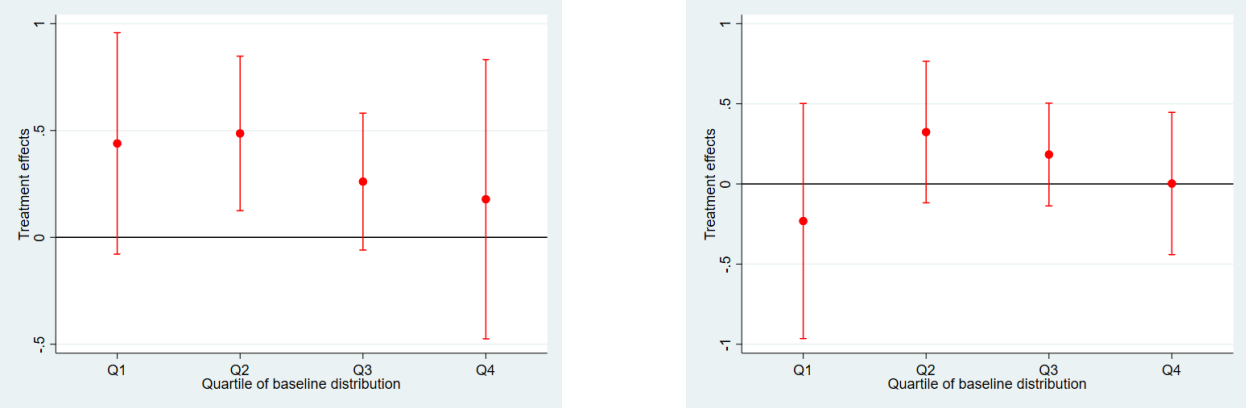
Note: This figure presents raw differences between the treatment group and control group on each math test (baseline and endline), with 95% confidence intervals. Scores are normalized relative to the baseline distribution.

Figure 6. Mean difference in English scores by grade



Note: This figure presents raw differences between the treatment group and control group on each English test (baseline and endline), with 95% confidence intervals. Scores are normalized relative to the baseline distribution.

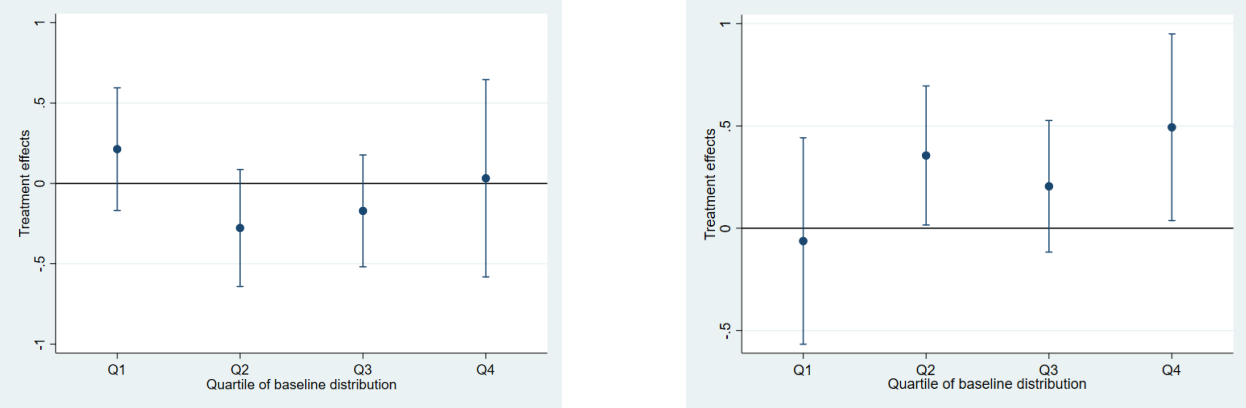
Figure 7. Heterogeneous treatment effects in math by baseline quartile



(a) Grade 1 (b) Grade 2

Note: This figure presents heterogeneous treatment effects in math by quartile in the baseline test distribution for grade 1 (Panel a) and grade 2 (Panel b), along with 95% confidence intervals. Test scores are normalized relative to the control group distribution.

Figure 8. Heterogeneous treatment effects in English by baseline quartile



(a) Grade 1 (b) Grade 2

Note: This figure presents heterogeneous treatment effects in English by quartile in the baseline test distribution for grade 1 (Panel a) and grade 2 (Panel b), along with 95% confidence intervals. Test scores are normalized relative to the control group distribution.

Tables

Table 1. Balance on observable characteristics

	Treatment (1)	Control (2)	Standard P-value (3)	RI P-value (4)
Panel A: Teacher Characteristics				
% male teacher	0.091	0.176	0.288	0.474
% general teacher	0.515	0.529	0.945	1.000
% OBC teacher	0.424	0.324	0.432	0.449
% SCST teacher	0.061	0.147	0.283	0.438
% MA teacher	0.364	0.471	0.384	0.483
% BA teacher	0.212	0.294	0.448	0.595
Average teacher age	38.576	36.882	0.289	0.278
Panel B: Student Characteristics				
% male students	0.529	0.508	0.419	0.404
% general caste students	0.172	0.177	0.910	0.918
% OBC caste students	0.350	0.363	0.769	0.794
% SC caste students	0.478	0.460	0.700	0.707
% migrant students	0.026	0.021	0.588	0.609
% below PL students	0.158	0.185	0.485	0.537
Panel C: Baseline Test Scores				
Average English score (SDs)	-0.011	0.009	0.888	0.887
Average Math score (SDs)	0.114	0.016	0.452	0.465
Average Bharti English score (SDs)	-0.071	-0.016	0.566	0.570
Average Bharti Math score (SDs)	0.007	-0.002	0.940	0.938
Number of grades	34	34		

Note: This table provides means of teacher characteristics and student characteristics for the treated and control grades, including conventional and randomized inference p-values of tests of difference. OBC, SC, and ST indicate caste categories (other backward caste, scheduled caste, and scheduled tribe, respectively). MA and BA indicate educational qualificiations (masters and bachelors). PL stands for poverty line.

Table 2. Intent-to-treat effects by subject

	Math				English			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	0.24*	0.22*	0.23*	0.25**	0.13	0.11	0.13	0.14
	(0.14)	(0.13)	(0.13)	(0.11)	(0.12)	(0.12)	(0.12)	(0.11)
RI p-value	0.12	0.15	0.13	0.09	0.33	0.40	0.34	0.34
Observations	1528	1528	1528	1527	1528	1528	1528	1527
R-squared	0.09	0.13	0.17	0.24	0.09	0.14	0.19	0.22
Grade FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Strata FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline scores	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Bharti scores	No	No	Yes	Yes	No	No	Yes	Yes
Other controls	No	No	No	Yes	No	No	No	Yes

Note: This table reports estimates of specification 1 for the pooled sample, separately for math (Columns 1-4) and English (Columns 5-8). Columns 1 and 5 include grade and strata fixed effects, Columns 2 and 6 further include test scores from our baseline test, Columns 3 and 7 add test scores in math and English from Bharti administrative data, and Columns 4 and 8 include district fixed effects and demographic controls (gender, caste, migrant family, parents occupation, special needs status, smartphone and internet access, and family income). Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Table 3. Intent-to-treat effects by subject and grade

	Math				English			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Grade 1							
Treatment	0.41**	0.35**	0.39**	0.37**	-0.00	-0.05	-0.02	-0.01
	(0.18)	(0.16)	(0.14)	(0.14)	(0.17)	(0.16)	(0.16)	(0.15)
RI p-value	0.07	0.07	0.04	0.06	0.99	0.80	0.93	0.95
Observations	811	811	811	811	811	811	811	811
R-squared	0.12	0.21	0.28	0.31	0.10	0.15	0.23	0.25
	Grade 2							
Treatment	0.07	0.06	0.06	0.07	0.24	0.27*	0.30*	0.30**
	(0.19)	(0.19)	(0.19)	(0.17)	(0.16)	(0.15)	(0.16)	(0.15)
RI p-value	0.76	0.82	0.80	0.78	0.20	0.13	0.12	0.12
Observations	717	717	717	716	717	717	717	716
R-squared	0.13	0.14	0.17	0.23	0.14	0.21	0.24	0.27
Grade FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Strata FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline scores	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Bharti scores	No	No	Yes	Yes	No	No	Yes	Yes
Other controls	No	No	No	Yes	No	No	No	Yes

Note: This table reports estimates of specification 1 by grade, separately for math (Columns 1-4) and English (Columns 5-8). Columns 1 and 5 include grade and strata fixed effects, Columns 2 and 6 further include test scores from our baseline test, Columns 3 and 7 add test scores in math and English from Bharti administrative data, and Columns 4 and 8 include demographic controls (gender, caste, migrant family, parents occupation, special needs status, smartphone and internet access, family income). Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Table 4. Heterogeneous effects by baseline quartile

	Math			English		
	(1) All	(2) Grade 1	(3) Grade 2	(4) All	(5) Grade 1	(6) Grade 2
Treatment x Q1	0.24	0.44*	-0.23	0.12	0.22	-0.06
	(0.24)	(0.25)	(0.36)	(0.18)	(0.19)	(0.25)
Treatment x Q2	0.47***	0.49***	0.32	0.07	-0.23	0.36**
	(0.14)	(0.18)	(0.22)	(0.15)	(0.19)	(0.17)
Treatment x Q3	0.11	0.26	0.18	0.13	-0.07	0.20
	(0.14)	(0.16)	(0.16)	(0.13)	(0.18)	(0.16)
Treatment x Q4	0.10	0.18	0.00	0.14	0.09	0.49**
	(0.19)	(0.32)	(0.22)	(0.23)	(0.31)	(0.22)
Observations	1280	679	601	1280	679	601
R-squared	0.249	0.346	0.241	0.230	0.277	0.278
Test of equality	0.0588	0.489	0.395	0.961	0.195	0.0898

Note: This table reports heterogeneous effects using specification 1 and adding interaction terms between treatment and indicators for the child's position in the distribution of baseline test scores in the relevant subject (by quartile). The regression includes interaction terms for all four quartiles, but no main treatment effect. Columns 1 and 4 include all children and Columns 2-3, 5-6 estimate these results by grade. Controls in pooled regressions are as in Columns 4 and 8 of Table 2 while controls in grade-specific regressions are as in Columns 4 and 8 of Table 3. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%; *** Significant at 1%.

Table 5. Dose-response relationship

	Math			English		
	(1) All	(2) Grade 1	(3) Grade 2	(4) All	(5) Grade 1	(6) Grade 2
Weekly time spent (in hours)	0.24**	0.38**	0.06	0.13	-0.01	0.26*
	(0.11)	(0.15)	(0.15)	(0.11)	(0.15)	(0.14)
Observations	1527	811	716	1527	811	716
R-squared	0.148	0.199	0.109	0.140	0.173	0.0931
First stage coef.	1.030	0.970	1.150	1.030	0.970	1.150
F-statistic	216.5	134.3	138.6	216.5	134.3	138.6

Note: This table reports 2sls estimates of specification 2. The endogenous variable is the average time spent per week on the app across all types of activities. Columns 1 and 4 include all children and Columns 2-3, 5-6 estimate these results by grade. Controls in pooled regressions are as in Columns 4 and 8 of Table 2 while controls in grade-specific regressions are as in Columns 4 and 8 of Table 3. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Table 6. Heterogeneous effects by above median activities assigned

	Math		English	
	(1) Grade 1	(2) Grade 2	(3) Grade 1	(4) Grade 2
Treatment × Below median activities assigned	0.23	-0.22	-0.06	0.14
	(0.19)	(0.25)	(0.22)	(0.19)
Treatment × Above median activities assigned	0.54**	0.37*	0.05	0.48**
	(0.21)	(0.21)	(0.21)	(0.23)
Observations	811	716	811	716
R-squared	0.323	0.246	0.255	0.277
P-value of difference	0.281	0.0746	0.742	0.257
Treatment behavior mean	0.408	0.511	0.408	0.511

Note: This table reports heterogeneous effects using specification 1 and adding interaction terms between treatment and indicators for whether the teacher assigned more or fewer Chimple activities than the median teacher. The regression includes interaction terms for both options, but no main treatment effect. Controls in all regressions are as in Columns 4 and 8 of Table 3. The last row of the table provides the fraction of treated students in classrooms with above median teachers. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Table 7. Heterogeneous effects by above median dashboard use by teachers

	Math		English	
	(1) Grade 1	(2) Grade 2	(3) Grade 1	(4) Grade 2
Treatment × Below median dashboard use	0.20	-0.10	0.04	0.18
	(0.17)	(0.34)	(0.19)	(0.16)
Treatment × Above median dashboard use	0.75***	0.11	-0.12	0.34**
	(0.15)	(0.18)	(0.16)	(0.16)
Observations	811	716	811	716
R-squared	0.340	0.228	0.257	0.271
P-value of difference	0.0132	0.565	0.459	0.403
Treatment behavior mean	0.274	0.766	0.274	0.766

Note: This table reports heterogeneous effects using specification 1 and adding interaction terms between treatment and indicators for whether the teacher spent more or less time on the Chimple dashboard than the median teacher. The regression includes interaction terms for both options, but no main treatment effect. Controls in all regressions are as in Columns 4 and 8 of Table 3. The last row of the table provides the fraction of treated students in classrooms with above median teachers. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Table 8. Heterogeneous effects by customized homework

	Math		English	
	(1) Grade 1	(2) Grade 2	(3) Grade 1	(4) Grade 2
Treatment × Same homework to all	0.31*	0.00	0.03	0.25
	(0.16)	(0.19)	(0.16)	(0.15)
Treatment × Different homework	0.68***	0.37	-0.23	0.52**
	(0.16)	(0.27)	(0.19)	(0.25)
Observations	811	716	811	716
R-squared	0.322	0.231	0.258	0.273
P-value of difference	0.0777	0.260	0.261	0.312
Treatment behavior mean	0.149	0.189	0.149	0.189

Note: This table reports heterogeneous effects using specification 1 and adding interaction terms between treatment and indicators for whether teachers report assigning the same or different homework to each student. The regression includes interaction terms for both options, but no main treatment effect. Controls in all regressions are as in Columns 4 and 8 of Table 3. The last row of the table provides the fraction of treated students whose teacher reports the formative behavior. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Appendixes [Not for publication]

A Appendix tables

Table A.1. Intent-to-treat effects by competency

	Math				English			
	(1) Number recognition	(2) Arithmetic computation	(3) Word problems	(4) Analytical	(5) Spelling	(6) Vocabulary	(7) Comprehension	(8) Grammar
Treatment	0.028	0.069***	0.056*	0.062*	0.062*	0.007	0.050	0.026
	(0.034)	(0.024)	(0.033)	(0.035)	(0.033)	(0.019)	(0.042)	(0.046)
RI p-value	0.53	0.03	0.19	0.20	0.12	0.76	0.32	0.71
Observations	1527	1527	1527	1527	1527	1527	1527	716
R-squared	0.20	0.19	0.14	0.23	0.27	0.23	0.16	0.31
Dep var mean	0.74	0.78	0.76	0.73	0.59	0.77	0.62	0.69

Note: This table reports estimates of specification 1 for the pooled sample, separately for math competencies (Columns 1-4) and English competencies (Columns 5-8). The outcome variable in each regression is the share of correct answers in each competency category. All regressions include grade and strata fixed effects, test scores from our baseline test, test scores in math and English from Bharti administrative data, district fixed effects, and demographic controls (gender, caste, migrant family, parents occupation, special needs status, smartphone and internet access, family income). Standard errors are clustered by school-grade, conventional p-values are in parentheses, and randomized inference p-values are in brackets. * Significant at 10%; ** Significant at 5%.

Table A.2. Intent-to-treat effects by competency and grade

	Math				English			
	(1) Number recognition	(2) Arithmetic computation	(3) Word problems	(4) Analytical	(5) Spelling	(6) Vocabulary	(7) Comprehension	(8) Grammar
	Grade 1							
Treatment	-0.016	0.096***	0.093*	0.142***	-0.014	-0.000	0.029	
	(0.044)	(0.025)	(0.048)	(0.046)	(0.041)	(0.022)	(0.058)	
RI p-value	0.82	0.01	0.14	0.02	0.80	0.99	0.68	
Observations	811	811	811	811	811	811	811	
R-squared	0.26	0.22	0.18	0.27	0.21	0.20	0.17	
Dep var mean	0.72	0.80	0.74	0.63	0.67	0.81	0.65	
	Grade 2							
Treatment	0.067	0.032	-0.001	-0.031	0.128***	0.017	0.093*	0.044
	(0.040)	(0.036)	(0.047)	(0.047)	(0.043)	(0.031)	(0.048)	(0.054)
RI p-value	0.27	0.51	0.98	0.62	0.02	0.68	0.16	0.57
Observations	716	716	716	716	716	716	716	716
R-squared	0.20	0.22	0.13	0.21	0.38	0.21	0.22	0.25
Dep var mean	0.76	0.77	0.78	0.86	0.48	0.72	0.59	0.69

Note: This table reports estimates of specification 1 by grade, separately for math competencies (Columns 1-4) and English competencies (Columns 5-8). The outcome variable in each regression is the share of correct answers in each competency category. All regressions include grade and strata fixed effects, test scores from our baseline test, test scores in math and English from Bharti administrative data, and demographic controls (gender, caste, migrant family, parents occupation, special needs status, smartphone and internet access, family income). Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Table A.3. Heterogeneous effects by student gender

	Math			English		
	(1) All	(2) Grade 1	(3) Grade 2	(4) All	(5) Grade 1	(6) Grade 2
Treatment × Female student	0.26**	0.42***	0.04	0.12	-0.06	0.30*
	(0.12)	(0.15)	(0.19)	(0.12)	(0.15)	(0.16)
Treatment × Male student	0.22*	0.37**	0.05	0.09	-0.10	0.28*
	(0.12)	(0.16)	(0.17)	(0.12)	(0.16)	(0.15)
Observations	1527	811	716	1527	811	716
R-squared	0.239	0.315	0.225	0.223	0.255	0.269
P-value of diff	0.580	0.581	0.948	0.689	0.702	0.881
Characteristic mean	0.516	0.514	0.519	0.516	0.514	0.519

Note: This table reports heterogeneous effects using specification 1 and adding interaction terms between treatment and student gender. The regression includes interaction terms for both male and female students, but no main treatment effect. Controls in all regressions are as in Columns 4 and 8 of Table 3. The last row of the table provides the fraction of students who are male. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Table A.4. Heterogeneous effects by student caste

	Math			English		
	(1) All	(2) Grade 1	(3) Grade 2	(4) All	(5) Grade 1	(6) Grade 2
Treatment × General caste student	0.03	0.31	-0.09	0.11	-0.04	0.18
	(0.14)	(0.23)	(0.21)	(0.15)	(0.22)	(0.19)
Treatment × OBC student	0.27**	0.39**	0.07	0.08	-0.04	0.15
	(0.13)	(0.16)	(0.17)	(0.14)	(0.17)	(0.17)
Treatment × SC student	0.30**	0.38**	0.13	0.20	0.02	0.47***
	(0.13)	(0.16)	(0.24)	(0.13)	(0.17)	(0.17)
Observations	1527	811	716	1527	811	716
R-squared	0.241	0.315	0.227	0.223	0.255	0.275
P-value of diff	0.159	0.943	0.606	0.612	0.895	0.108
Characteristic mean	2.308	2.361	2.255	2.308	2.361	2.255

Note: This table reports heterogeneous effects using specification 1 and adding interaction terms between treatment and student caste. The regression includes interaction terms for both caste groups, but no main treatment effect. Controls in all regressions are as in Columns 4 and 8 of Table 3. The last row of the table provides the fraction of students from disadvantaged castes. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Table A.5. Determinants of attrition

	Attrition			
	(1)	(2)	(3)	(4)
Treatment	0.01	-0.00	0.16	0.46
	(0.38)	(0.85)	(0.43)	(0.24)
Baseline math	0.01	0.01	0.01	0.01
	(0.18)	(0.17)	(0.05)*	(0.05)*
Baseline English	-0.00	-0.01	-0.00	-0.01
	(0.33)	(0.12)	(0.54)	(0.13)
Missing baseline score	0.34	0.31	0.29	0.27
	(0.00)***	(0.00)***	(0.00)***	(0.00)***
Treatment X Baseline math		-0.00		-0.01
		(0.57)		(0.33)
Treatment X Baseline English		0.01		0.01
		(0.16)		(0.12)
Treatment X Missing baseline score		0.06		0.04
		(0.33)		(0.49)
Observations	1675	1675	1674	1674
R-squared	0.276	0.278	0.364	0.365
P-value from F-test of treament and interactions		0.539		0.310

Note: This table presents results from regressions of attrition on treatment, controls, and interactions between treatment and those controls. In addition to the variables shown, Columns (3) and (4) include all controls from Columns (4) and (8) of Table 3 and interactions of those controls with treatment. All regressions also include grade and strata fixed effects. Standard errors are clustered by school-grade and conventional p-values are in parentheses. * Significant at 10%; ** Significant at 5%.

Table A.6. Inverse probability weighted regressions

	Math			English		
	(1) All	(2) Grade 1	(3) Grade 2	(4) All	(5) Grade 1	(6) Grade 2
Treatment	0.23**	0.44***	0.03	0.17	0.05	0.38***
	(0.11)	(0.11)	(0.14)	(0.12)	(0.15)	(0.12)
Observations	1320	708	612	1320	708	612
R-squared	0.254	0.381	0.380	0.330	0.312	0.523

Note: This table reports regression results similar to Table 2, but weighted by the inverse of the predicted probability of having endline test scores. The probability is predicted using a probit model with baseline test scores, Bharti-administered baseline test scores, demographic characteristics, and fixed effects for grade and school. Standard errors are clustered by school-grade and conventional p-values are shown in parentheses. * Significant at 10%; ** Significant at 5%.

Table A.7. Estimates using Lee Bounds

	Math			English		
	(1) All Treat	(2) Grade 1 Treat	(3) Grade 2 Treat	(4) All Treat	(5) Grade 1 Treat	(6) Grade 2 Treat
Lower	0.16*	0.30***	0.04	0.06	-0.09	0.23**
	(0.06)	(0.06)	(0.09)	(0.05)	(0.07)	(0.07)
Upper	0.25***	0.47***	0.25**	0.13**	0.09	0.45***
	(0.04)	(0.07)	(0.08)	(0.05)	(0.06)	(0.08)
Observations	1675	874	801	1675	874	801

Note: This table presents Lee (2009) bounds for treatment effects. Bootstrapped standard errors are in parentheses. We use residuals from a regression of endline test scores on baseline test scores and Bharti baseline test scores as the dependent variable. The bounds are tightened using dummy variables for strata and grade. * Significant at 10%; ** Significant at 5%.

Table A.8. Heterogeneous effects by teacher education

	Math			English		
	(1) All	(2) Grade 1	(3) Grade 2	(4) All	(5) Grade 1	(6) Grade 2
Treatment × Teacher without MA	0.32**	0.47***	0.20	0.24	0.28	0.23
	(0.13)	(0.12)	(0.20)	(0.16)	(0.22)	(0.19)
Treatment × Teacher with MA	0.27	0.38	-0.12	0.21	-0.23	0.30
	(0.19)	(0.24)	(0.26)	(0.15)	(0.19)	(0.18)
Observations	1527	811	716	1527	811	716
R-squared	0.241	0.317	0.238	0.227	0.281	0.270
P-value of diff	0.795	0.711	0.291	0.876	0.0176	0.753
Characteristic mean	0.442	0.332	0.551	0.442	0.332	0.551

Note: This table reports heterogeneous effects using specification 1 and adding interaction terms between treatment and teacher education. The regression includes interaction terms for teachers with and without a Masters degree, but no main treatment effect. Controls in all regressions are as in Columns 4 and 8 of Table 3. The last row of the table provides the fraction of students in classes with a teachers with a Masters degree. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

Table A.9. Heterogeneous effects by teacher caste

	Math			English		
	(1) All	(2) Grade 1	(3) Grade 2	(4) All	(5) Grade 1	(6) Grade 2
Treatment × General caste teacher	0.25	0.41*	-0.08	0.15	0.05	0.17
	(0.18)	(0.22)	(0.23)	(0.17)	(0.23)	(0.22)
Treatment × OBC/SC/ST teacher	0.23	0.39*	-0.05	0.06	0.08	0.23
	(0.15)	(0.20)	(0.28)	(0.17)	(0.21)	(0.23)
Observations	1527	811	716	1527	811	716
R-squared	0.239	0.316	0.231	0.223	0.260	0.273
P-value of diff	0.898	0.920	0.924	0.639	0.909	0.818
Characteristic mean	0.446	0.522	0.372	0.446	0.522	0.372

Note: This table reports heterogeneous effects using specification 1 and adding interaction terms between treatment and teacher caste. The regression includes interaction terms for teachers from different caste groups, but no main treatment effect. Controls in all regressions are as in Columns 4 and 8 of Table 3. The last row of the table provides the fraction of students who have a teacher from the OBC/SC/ST caste groups. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

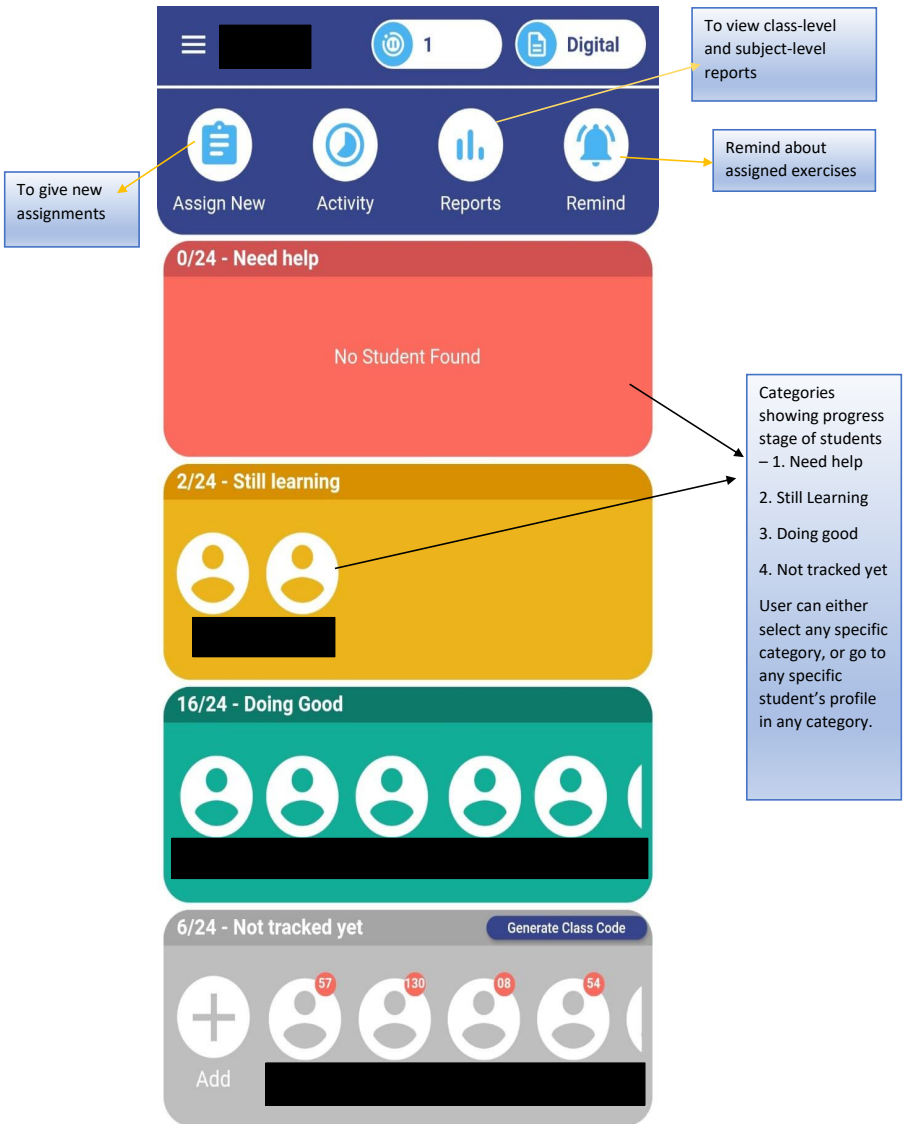
Table A.10. Heterogeneous effects by teacher gender

	Math			English		
	(1) All	(2) Grade 1	(3) Grade 2	(4) All	(5) Grade 1	(6) Grade 2
Treatment × Female teacher	0.26**	0.38**	0.09	0.13	-0.09	0.33**
	(0.12)	(0.15)	(0.18)	(0.11)	(0.14)	(0.15)
Treatment × Male teacher	-0.21	0.00	-0.47	0.06	0.00	0.18
	(0.18)	(.)	(0.35)	(0.24)	(.)	(0.25)
Observations	1527	811	716	1527	811	716
R-squared	0.249	0.315	0.266	0.223	0.262	0.271
P-value of diff	0.0367	0.0153	0.107	0.793	0.550	0.604
Characteristic mean	0.103	0	0.205	0.103	0	0.205

Note: This table reports heterogeneous effects using specification 1 and adding interaction terms between treatment and teacher gender. The regression includes interaction terms for both male and female teachers, but no main treatment effect. Controls in all regressions are as in Columns 4 and 8 of Table 3. The last row of the table provides the fraction of students with a male teacher; there are no male first grade teachers. Standard errors, in parentheses, are clustered by school-grade. * Significant at 10%; ** Significant at 5%.

B Appendix figures

Figure B.1. Chimple dashboard landing page



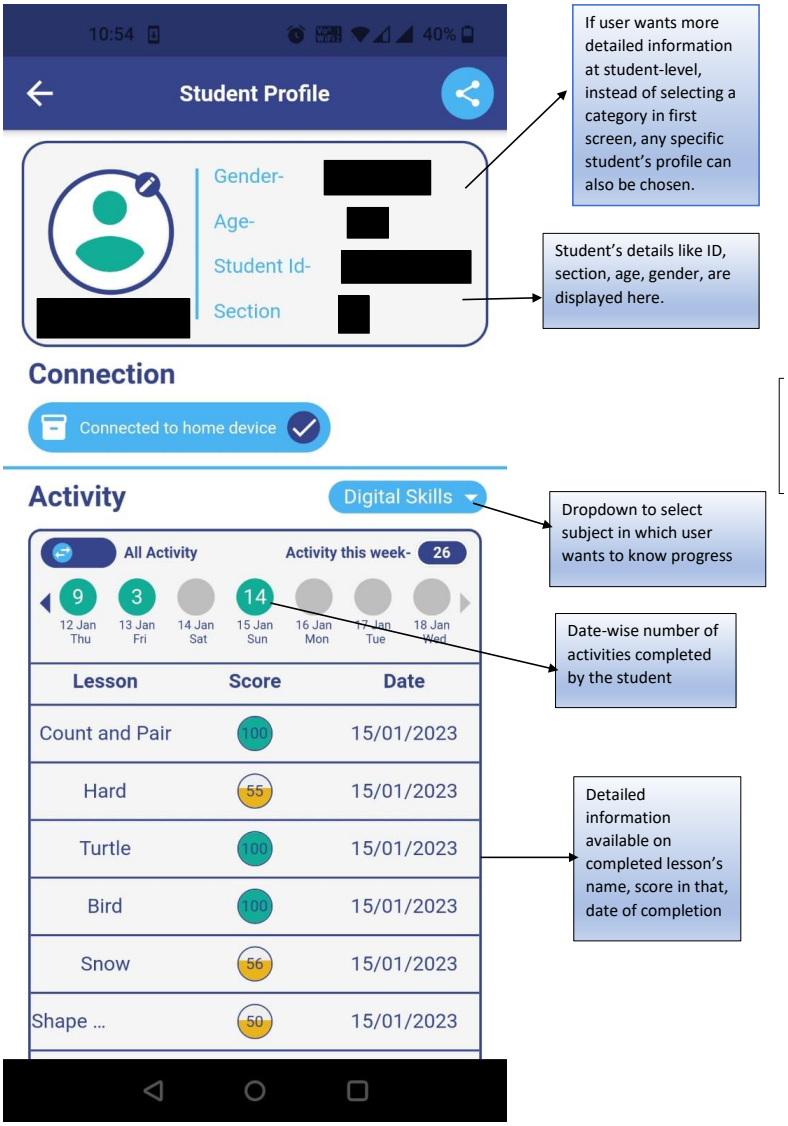
Note: This figure displays the landing page of Chimple's teacher dashboard.

Figure B.2. Chimple dashboard student list



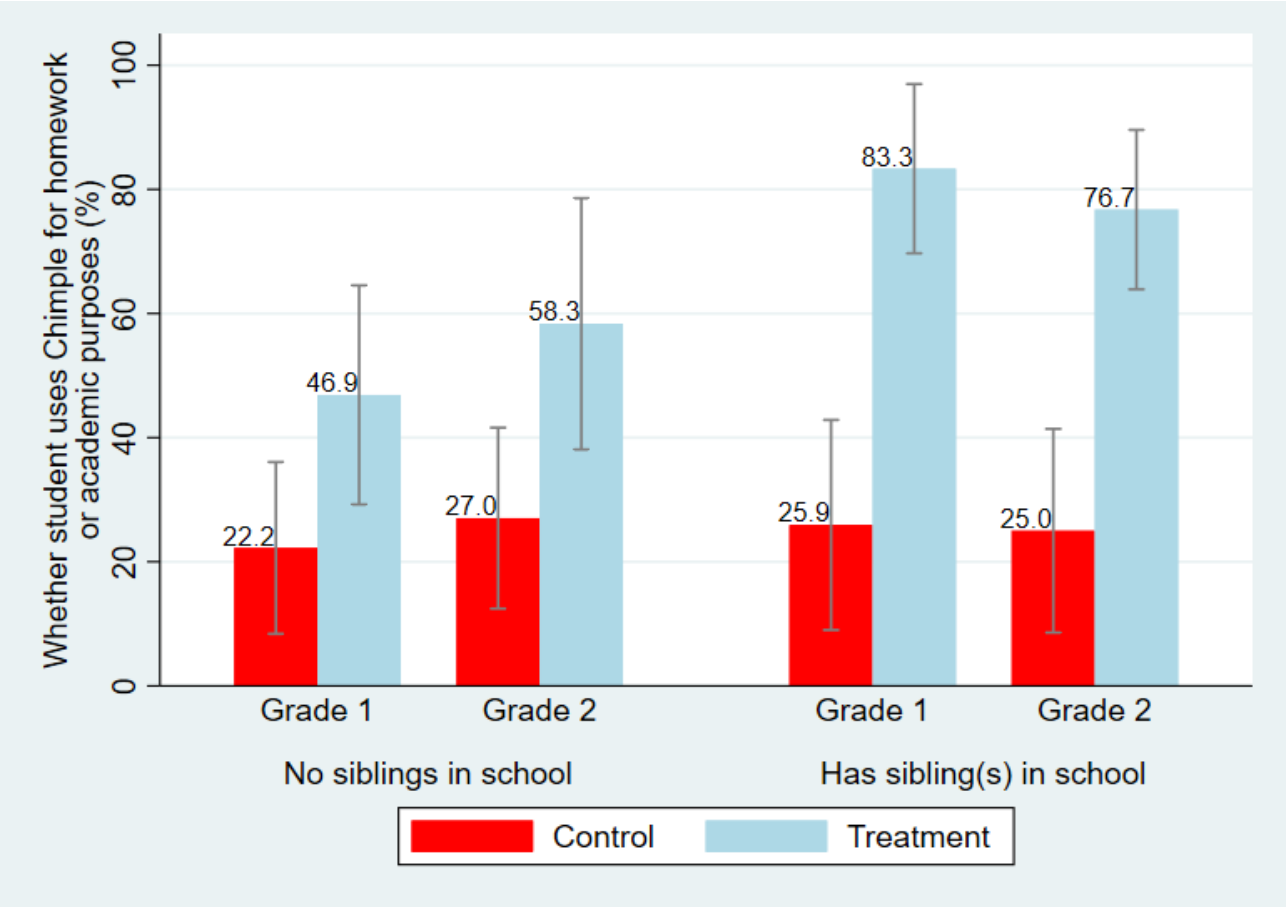
Note: Clicking on one of the panels on the landing page of the teacher dashboard displays a list of students with each student's scores on each completed activity. This figure displays those classified as "doing good."

Figure B.3. Chimple dashboard student profile



Note: Clicking on a student's icon displays a student profile.

Figure B.4. Parent-reported take-up and spillovers by presence of siblings



Note: This figure presents the fraction of parents who report that their children use Chimple for homework or academic purposes by grade, treatment status, and the presence of siblings currently in school from the May 2023 household survey with 95% confidence intervals.

C Nudges experiment

C.1 Study design

We nested an experiment within the treatment group to assess if text-based nudges to parents increased engagement with the app. To this end, we randomized the intensity of text-based nudges across students from treated classrooms. Using the enrollment list from the end of May 2022, students were randomly assigned to a low or high-intensity WhatsApp group in mid-June. The randomization was stratified by classroom and parental access to smartphones (access or no access). Table C.1 indicates that students in the high- and low-intensity groups share similar observable characteristics.

Households in the high-intensity group received two text messages per week while those in the low-intensity group received a text message twice a month.[a] The text messages reminded parents that their children should complete the tasks posted by teachers on the Chimple app, while at the same time highlighting the potential benefits of Chimple. An example of text messages is:

> "Hello! Your child's teacher has posted weekly learning activities on Chimple. Chimple uses games and simple language to teach children basic concepts in an engaging way. Please encourage your child to complete them in a timely manner."

C.2 Impact of nudges

We evaluate the impact of high-intensity nudging on measures of take-up from the Chimple dashboard with the following regression specification estimated on students in Chimple classes:

$$M_{igs} = \beta_0 + \beta_1 H_{igs} + \mu_k + \lambda_r + \beta_2 Y_{igst_0} + X'_{gst_0}\Phi + \epsilon_{igs} \tag{4}$$

where M_{igs} is the average number of hours student i in grade g in school s spent on the app per month and H_{igs} is an indicator for being in the high-intensity treatment arm. As above, our regressions control for strata and district fixed effects (μ_k, λ_r), students' baseline test scores (Y_{igst_0}), and other predetermined characteristics (X_{gst_0}).

Table C.2 presents results from specification 4, separately on English and math activities, adding in controls sequentially. We see small and statistically insignificant effects on time

a. Messages were sent every Tuesday and Friday for the high-intensity group and every other Tuesday for the low-intensity group. The first message to the low and high-intensity groups was sent on September 9, 2022 and the messages continued until the end of March 2023.

spent on the app. Table C.3 estimates the same specification with English and math test scores, finding similarly small and statistically insignificant impacts. We suspect this is because of the large volume of texts already going to these WhatsApp groups. The number of weekly messages sent to these WhatsApp groups from the teachers and Chimple coordinators ranged from 0 to 44 for the high intensity group and 0 to 41 for the low intensity group. On average, 10.5 messages were sent to the low-intensity WhatsApp groups, likely diluting the effect of the additional, experimental, messages.

Table C.1. Balance on observable characteristics-student randomization

	High-Frequency		Low-Frequency		Standard	RI
	N	mean	N	mean	P-Value	P-value
	(1)	(2)	(3)	(4)	(5)	(6)
Male	406	0.55	406	0.50	0.25	0.29
Age	406	6.11	406	6.14	0.18	0.16
Migrant Family	406	0.02	406	0.03	0.99	1.00
Father occupation: Agriculture	405	0.10	405	0.09	0.68	0.74
Father occupation: Labor	405	0.75	405	0.74	0.96	0.96
Father occupation: Private Job	405	0.07	405	0.07	0.96	1.00
Family income: Below 50 000	405	0.34	406	0.35	0.58	0.50
Family income: 50 000 to 100 000	405	0.52	406	0.50	0.51	0.53
Family income: Above 100 000	405	0.14	406	0.14	1.00	1.00
Mother's occupation: Wife	404	0.97	405	0.97	0.66	0.59
BLP family	406	0.16	406	0.17	0.68	0.68
Cast: Gen	406	0.17	406	0.17	0.85	0.93
Cast: OBC	406	0.38	406	0.33	0.04**	0.14
Cast: SC	406	0.45	406	0.50	0.19	0.17

Note: In this table, the unit of observation is the student. RI stands for Randomized inference. P-values in column 5 were calculated using strata fixed effects. The same strata were used to calculate p-values with RI. We used the *ritest* command in the Stata software for RI calculations.

Table C.2. Effects of High-Frequency Nudging on monthly usage (in hrs.)

	English				Math			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High Frequency	0.044	0.051	0.026	0.020	0.048	0.056	0.032	0.030
	(0.296)	(0.222)	(0.529)	(0.635)	(0.307)	(0.226)	(0.488)	(0.515)
	[0.281]	[0.217]	[0.510]	[0.598]	[0.295]	[0.210]	[0.461]	[0.488]
Observations	7860	7860	7860	7850	7860	7860	7860	7850
Classroom FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline scores	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Bharti scores	No	No	Yes	Yes	No	No	Yes	Yes
Demographic controls	No	No	No	Yes	No	No	No	Yes

Note: Conventional and RI p-values in parenthesis and brackets, respectively. * Significant at 10%; ** Significant at 5%; *** Significant at 1%.

Table C.3. Effects of High-Frequency Nudging on test scores

	English				Math			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High Frequency	0.033	0.049	0.049	0.033	-0.000	0.011	0.012	0.010
	(0.559)	(0.370)	(0.355)	(0.534)	(0.994)	(0.819)	(0.804)	(0.830)
	[0.547]	[0.351]	[0.337]	[0.530]	[0.999]	[0.837]	[0.797]	[0.835]
Observations	745	745	745	744	745	745	745	744
Classroom FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline scores	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Bharti scores	No	No	Yes	Yes	No	No	Yes	Yes
Demographic controls	No	No	No	Yes	No	No	No	Yes

Note: Conventional and RI p-values in parenthesis and brackets, respectively. * Significant at 10%; ** Significant at 5%; *** Significant at 1%.

D Endline tests

Invigilator's Copy

Endline Test:

Subject: Mathematics Duration: 80 minutes Full Marks: 40

Class: 1

Name of the School:

Date of Examination:

Name of Enumerator:

---

1. Write down the numbers being read out by the invigilator. (Time: 5 minutes, 1×4=4)

   Invigilator reads out slowly and loudly in Hindi, "***In the blank space marked a, write down the number twenty-seven.***"

   a. _____

   Invigilator gives a gap of 45 seconds and moves on to next question

   Invigilator reads out slowly and loudly in Hindi, "***In the blank space marked b, write down the number fifty-nine***"

   b. _____

   Invigilator gives a gap of 45 seconds and moves on to next question

   Invigilator reads out slowly and loudly in Hindi, "***In the blank space marked c, write down the number eighty-four***"

   c. _____

   Invigilator gives a gap of 45 seconds and moves on to next question

   Invigilator reads out slowly and loudly in Hindi, "***In the blank space marked d, one hundred and thirty-six***"

   d. _____

   Invigilator gives a gap of 45 seconds and then says, "***I will now repeat the numbers again. Listen to me carefully since I will not repeat again.***"

Invigilator reads out slowly and loudly in Hindi, "***In the blank space marked a, write down the number twenty-seven.***"

Invigilator gives a gap of 30 seconds

Invigilator reads out slowly and loudly in Hindi, "***In the blank space marked b, write down the number fifty-nine.***"

Invigilator gives a gap of 30 seconds

Invigilator reads out slowly and loudly in Hindi, "***In the blank space marked c, write down the number eighty-four.***"

Invigilator gives a gap of 30 seconds

Invigilator reads out slowly and loudly in Hindi, "***In the blank space marked d, write down the number one hundred and thirty-six***."

Invigilator gives a gap of 30 seconds and moves on to question 2

2. Write down the digits in ten's place: (Time: 5 minutes, 2×2=4)

   Invigilator reads out loudly and slowly, "***In question 2, you have been given two numbers. For each of these numbers, write down the digits that are in ten's place***"

   a. 34 –

   b. 182 –

   Invigilator gives a time of 5 minutes and then moves on to next question (Question 3)

3. Add the numbers: (Time: 10 minutes, 1+2 + 3 = 6)

   Invigilator reads out loudly and slowly, "***In question 3, you have been given three addition problems. For each of the problems, write down the answers in the blank boxes given for the respective question***."

   a. 7 + 2 = ☐

   b. 5 + 4 + 3 = ☐

c.

	T	O
	4	7
+	3	1

Invigilator gives a time of 10 minutes and then moves on to next question (Question 4)

4. Subtract the numbers: (Time: 10 minutes, 1+2 = 3)

   Invigilator reads out loudly and slowly, "***In question 4, you have been given two subtraction problems. For each of the problems, write down the answers in the blank boxes given for the respective question.***"

   a. 9 – 6 =

   b.

	T	O
	2	7
-	1	2

   Invigilator gives a time of 10 minutes and then moves on to next question (Question 5)

5. Write the answers to the questions being read out in blank boxes given below the same question. (Time: 15 minutes, 3 × 2 = 6)

   Invigilator reads out loudly and slowly, "***For question 5, I will read out two problems. These problems are also given in your answer sheet. Listen to the problems carefully. You will write down answers to each of these problems in the blank boxes given below them.***"
   Invigilator reads out and loudly and slowly the following problem,

a. ***Ravi went to a shop to buy 2 pencils. Each pencil costs 3 rupees. How much would 2 pencils cost Ravi?***

Invigilator gives a gap of 5 minutes for students to write down their answers. Then repeats, "***I will now repeat the problem. Listen to me carefully since I will not repeat it again.***
Ravi went to a shop to buy 2 pencils. Each pencil costs 3 rupees. How much would 2 pencils cost Ravi?"

Invigilator gives a gap of 2 minutes and moves on to the next question (question 5 part b)

Invigilator reads out and loudly and slowly the following problem,

b. ***Ravi went to the shop with 10 rupees. He spent 6 rupees to buy 2 pencils. How much money would be left with Ravi after buying the pencils?***

Invigilator gives a gap of 5 minutes for students to write down their answers. Then repeats, "***I will now repeat the problem. Listen to me carefully since I will not repeat it again.***
Ravi went to the shop with 10 rupees. He spent 6 rupees to buy 2 pencils. How much money would be left with Ravi after buying the pencils?"

Invigilator gives a gap of 2 minutes and moves on to the next question (question 6)

6. Fill in the blanks with missing numbers. (Time: 5 minutes, 1+2 + 3 = 6)

Invigilator reads out loudly and slowly, "***In question 6, there are 3 sequences of numbers with one number missing in each. Fill the gap with the missing number***"

a. 21 _____ 23 24 25

b. 136 137 _____ 139 140

c. 20 25 30 _____ 40 45

Invigilator gives a gap of 5 minutes and moves on to the next question (question 7)

7. Circle the correct answer to the question being read out, among the options given. (Time: 10 minutes, $3 \times 2 = 6$)
   Invigilator reads out the problem loudly and slowly, *"**For question 7, I will read out a passage. Based on information given in this passage, you will be asked 2 questions. You will circle the correct answers to each of these questions among the options given below.**"*

   Invigilator reads out loudly and clearly, "***Rani wants to buy 2 colour boxes. In shop A, each colour box costs 10 rupees. In shop B, each colour box costs 5 rupees. In shop C, each colour box costs 6 rupees***."

   Invigilator reads aloud, "***Now circle the correct answer for the following questions.***"
   Invigilator reads aloud the following questions

a. Which shop sells the colour boxes at lowest price?

Shop A ***Shop B*** ***Shop C***

b. Which shop sells the colour boxes at the highest price?

Shop A ***Shop B*** ***Shop C***

Invigilator gives a time of 5 minutes and then repeats, "***I am repeating the passage. Please listen to it carefully since I will not repeat again.***
Rani wants to buy 2 colour boxes. In shop A, each colour box costs 10 rupees. In shop B, each colour box costs 5 rupees. In shop C, each colour box costs 6 rupees.

Which shop sells the colour boxes at lowest price?

Shop A ***Shop B*** ***Shop C***

Which shop sells the colour boxes at the highest price?

Shop A ***Shop B*** ***Shop C"***

Invigilator gives time of 5 minutes.

8. Fill in the blank spaces with correct symbols >, < or = (Time: 10 minutes; 1+1+1+2 = 5)
   Invigilator reads out the problem loudly, "***For question 8, you have been given four pairs of numbers. Between two numbers in each pair, there is a blank space. Fill in***

the blank space with symbols indicating which number is greater and which is lesser, or if they are equal."

a. 24 _____ 36

b. 47 _____ 33

c. 28 _____ 62

d. 53 _____ 32 + 21

Invigilator gives a time of 10 minutes.

Note to Invigilator: Total Duration for the test is 1 hour 20 minutes, inclusive of the time taken by invigilator to read out the questions. If the test gets over before that, invigilator has to wait till the allotted time elapses before collecting answer-scripts.

Invigilator's Copy

Endline Test:

Subject: Mathematics Duration: 75 minutes Full Marks: 35

Class: 2

Name of the School:

Date of Examination:

Name of Enumerator:

Invigilator reads out, *"**For the next 75 minutes, you will be given a test of Mathematics. Please listen to my instructions carefully.***

There are 8 questions in the paper. Read the questions carefully and quietly. Spaces have been provided for writing your answers. Please write your answers in allotted spaces only. You will have 75 minutes to answer all questions.

Please look only at your answer sheet. Do not talk to others during the exam. All the best."

Note to Invigilator: There is no need to read out any question in this paper. Total Duration for the test is 1 hour 15 minutes, inclusive of the time taken by invigilator to read out the statement at the beginning. If the test gets over before that, invigilator has to wait till the allotted time elapses before collecting answer-scripts.

Please do not read out any question to the students

1. Write down the number in ten's place. (Time: 5 minutes, 1×3 = 3)
    a. 75 −
    b. 398 −
    c. 207 −
2. Fill in the blanks with the missing numbers. (Time: 5 minutes, 1×3 = 3)
    a. 145 146 ____ 148 149

b. 12 14 ___ 18 20 22

c. 10 15 ___ 25 30

3. Complete the following addition and subtraction problems: (Time: 15 minutes, 2×5 = 10)

a. 51 + 6 = _____

+		
Answer		

b. 34 + 23 = _____

+		
Answer		

c. 45 + 18 = _____

+		
Answer		

d. 18 – 5 = _____

–		
Answer		

e. 31 – 4 = _____

–		
Answer		

4. Read the following paragraph and write down the answers to the questions below in given blank spaces. (Time: 10 minutes, 2×2 = 4)

India is playing against England in a cricket match. England has scored 100 runs. For India, Virat has scored 50 runs and Rohit has scored 10 runs till now.

a. What is the total score of India till now?

_____

b. How many more runs does India need to score to have as many runs as England?

_____

5. Read the following paragraph and write down the answers to the questions below in given blank spaces. (Time: 15 minutes, 3×3 = 9)

Ravi went to the market with one 10-rupee note, one 20-rupee note and two 5-rupee notes.
He wants to buy flowers worth 5 rupees, mangoes worth 25 rupees and pencils worth 10 rupees.

a. Which note will he use to buy flowers?

_____ rupee note

b. Which notes will he use to buy mangoes?

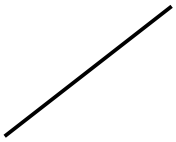
_____ rupee note and _____ rupee note

c. Which note will he use to buy pencils?

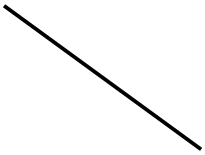
_____ rupee note

6. Identify the curved line. Put a circle around it. (Time: 5 minutes, 2×1 = 2)

a.

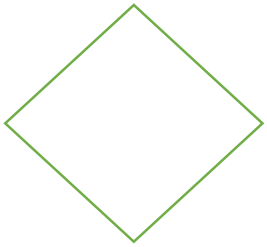
b. 

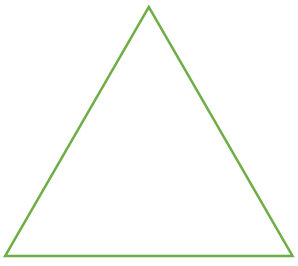
c. 

d. 

7. Identify the shape with 3 sides. Put a circle around it. (Time: 5 minutes, 2×1 = 2)

a. 

b. 

c. 

8. In how many ways can you create the number 30 (example: 60 – 30 = 30)? (Time: 5 minutes, 1×2 = 2)

   a. 10 + _____ = 30

   b. 18 + _____ = 30

Invigilator's Copy

Endline Test:

Subject: English Duration: 70 minutes Full Marks: 30

Class: 1

Name of the School:

Date of Examination:

Enumerator Name:

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1. Circle the words that are being read out. (Time: 5 minutes; 1×2 = 2)
   a. Invigilator reads out, "***Circle the word Red***".
      Invigilator gives a gap of 1 minute
      Invigilator repeats, "***I am repeating the word and will not be repeating it again. Circle the word Red***"
      Invigilator gives a gap of 30 seconds and moves to next word

      Real Red Road

   b. Invigilator reads out, "***Circle the word Boat***"
      Invigilator gives a gap of 1 minute
      Invigilator repeats, "***I am repeating the word and will not be repeating it again. Circle the word Boat***"
      Invigilator gives a gap of 30 seconds and moves to next question

      Boat Bout Bat

2. Match the pictures with words (Time: 5 minutes; 1×3 = 3)
   Invigilator reads out, "***In the second question, there are pictures of some objects. Match the objects with their names by drawing lines."***

a. 

b. 

c. 

1. Rabbit
2. Cap
3. Bell

3. Write down the words being read out. (Time: 15 minutes; 2×5 = 10)

Invigilator reads aloud, "***For question 3, I will read out 5 words. You will have to write them down in the blank spaces given***."

Invigilator reads: "***In space a, write down the word Big***"

a. _____

Invigilator gives a gap of 1 minute and repeats, "***In space a, write down the word Big***"

Invigilator gives a gap of 1 minute and moves on to b

Invigilator reads: "***In space b, write down the word Hand***"

b. _____

Invigilator gives a gap of 1 minute and repeats, "***In space b, write down the word Hand***"

Invigilator gives a gap of 1 minute and moves on to c

Invigilator reads: "***In space c, write down the word Lake***"

c. _____

Invigilator gives a gap of 1 minute and repeats, "***In space c, write down the word Lake***"

Invigilator gives a gap of 1 minute and moves on to d

Invigilator reads: "***In space d, write down the word Green***"

d. _____

Invigilator gives a gap of 1 minute and repeats, "***In space d, write down the word Green***"

Invigilator gives a gap of 1 minute and moves on to e

Invigilator reads: "***In space e, write down the word Elephant***"

e. _____

Invigilator gives a gap of 1 minute and repeats, "***In space e, write down the word Elephant***"

Invigilator gives a gap of 1 minute

Invigilator reads aloud, "***I am repeating the words again. Please listen carefully since I will not repeat again***."

Invigilator reads: "***In space a, write down the word Big***"

Invigilator gives a gap of 30 seconds

Invigilator reads: "***In space b, write down the word Hand***"

Invigilator gives a gap of 30 seconds

Invigilator reads: "***In space c, write down the word Lake***"

Invigilator gives a gap of 30 seconds

Invigilator reads: "***In space d, write down the word Green***"

Invigilator gives a gap of 30 seconds

Invigilator reads: "***In space e, write down the word Elephant***"

Invigilator gives a gap of 30 seconds and moves on to question 4

4. Write the name of the objects whose images are given. (Time: 10 minutes; 2×3 = 6)

   Invigilator reads out, "***In question 4, there are pictures of some objects given. Write down their names in the blank spaces given below.***"

a. 

_____

b. 

_____

c. 

_____

Invigilator gives a gap of 10 minutes for students to write down the answers and then moves on to question 5

5. Write 1 word that begins with each of the following letters. (Time: 10 minutes; 2×2 = 4)

Invigilator reads aloud, "***In question 5, you have been given 2 letters. Write 1 word that starts with each of these 2 letters***."

a. D –

b. T –

Invigilator gives a gap of 10 minutes for students to write down the answers and then moves on to question 6

6. A passage is given below and will also be read out. Answer the following questions, based on information from passage, in 1 word:
(Time: 15 minutes; 2.5×2 = 5)
Invigilator reads aloud, "***For question 6, I will be reading out a passage. After the passage, you will be asked 2 questions. You will have to write down the answer to the questions in the blank boxes given next to the questions***."

Invigilator reads out the passage, "***Ravi is a good student. He goes to school every morning. He completes English homework every day***."

Invigilator gives a gap of 1-2 minutes.

a. Invigilator reads aloud, "***For question a, write down in the blank box, where does Ravi go every morning? Write your answer in 1 word***"

Invigilator gives a gap of 3 minutes for writing the answer and then moves on to question b

b. Invigilator reads aloud, "***For question b, write down in the blank box, which homework does Ravi complete every day? Write your answer in 1 word***"

Invigilator gives a gap of 3 minutes for writing the answer

Invigilator repeats, "***I am repeating the passage once. Listen carefully since I will not repeat this again.***
Ravi is a good student. He goes to school every morning. He completes English homework every day."

Invigilator gives a gap of 1 minute

Invigilator reads aloud, "***For question a, write down in the blank box, where does Ravi go every morning? Write your answer in 1 word***"

Invigilator gives a gap of 2 minutes for writing the answer and then moves on to repeat question b

Invigilator reads aloud, "***For question b, write down in the blank box, which homework does Ravi complete every day? Write your answer in 1 word***"

Invigilator gives a gap of 2 minutes for writing the answer

Note to Invigilator: Total Duration for the test is 1 hour 10 minutes, inclusive of the time taken by invigilator to read out the questions. If the test gets over before that, invigilator has to wait till the allotted time elapses before collecting answer-scripts.

Invigilator's Copy

Endline Test:

Subject: English Duration: 70 minutes Full Marks: 45

Class: 2

Name of the School:

Date of Examination:

Name of Enumerator:

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1. Write down the words being read out by the teacher. (Time: 5 minutes, 1×5=5)

   Invigilator reads out, "***I am now going to read out 5 words. Write down each of these words in the blank spaces allotted.***"

   a. Invigilator reads aloud, "***In space a, write down the word Ant***"

   Invigilator gives a gap of 30 seconds

   b. Invigilator reads aloud, "***In space b, write down the word Books***"

   Invigilator gives a gap of 30 seconds

   c. Invigilator reads aloud, "***In space c, write down the word Mouse***"

   Invigilator gives a gap of 30 seconds

   d. Invigilator reads aloud, "***In space d, write down the word Yellow***"

   Invigilator gives a gap of 30 seconds

   e. Invigilator reads aloud, "***In space e, write down the word Rainbow***"

   Invigilator gives a gap of 30 seconds

   Invigilator repeats, "***I am now going to repeat the words. Please listen carefully since I will not repeat them again***."

   Invigilator reads aloud, "***In space a, write down the word Ant***"

   Invigilator gives a gap of 20 seconds

Invigilator reads aloud, "***In space b, write down the word Books***"
Invigilator gives a gap of 20 seconds

Invigilator reads aloud, "***In space c, write down the word Mouse***"

Invigilator gives a gap of 20 seconds

Invigilator reads aloud, "***In space d, write down the word Yellow***"

Invigilator gives a gap of 20 seconds

Invigilator reads aloud, "***In space e, write down the word Rainbow***"

Invigilator gives a gap of 20 seconds and reads aloud, "***We now move to question 2. From question 2 onwards, all the questions are given in your answer sheet. Read the questions carefully and answer them on your own. You will have 60 minutes to finish the exam. All the best.***"

Note to Invigilator: Question 2 onwards, there is no need to read out any question to the students. Total Duration for the test is 1 hour 10 minutes, inclusive of the time taken by invigilator to read out the questions. If the test gets over before that, invigilator has to wait till the allotted time elapses before collecting answer-scripts.

Please do not read out the following questions:

2. Can you identify any 3 out of the 5 objects whose images are given below? (Time: 10 minutes, 2×3=6)



a. _____

b. _____

c. _____

3. Read the following the passage and answer the following questions in 1-2 words. (Time: 20 minutes, 3×5=15)

Rani lives in a Bisalpur village. There is a river flowing near their village, called 'Paar'. Every Sunday, Rani and her brother go to play near the river, on the

riverbanks. They can see the fishes playing in the water as well. One of the fishes is Rani's friend. His name is 'Nemo'.

a. What is the name of the village where Rani lives?

_____

b. What is the name of the river flowing near Rani's village?

_____

c. On which day of the week does Rani go to play near the river?

_____

d. Who goes to play near the river, on the river-banks, with Rani?

_____

e. What is the name of the fish who is Rani's friend?

_____

4. Write down the opposites of the words given below. (Time: 5 minutes, 2×2=4)

a. Tall –

b. Happy –

5. Match the word with its collective nouns (Time: 10 minutes, 3×3=9)

a. Sheep

b. Wolves

c. People

1. Pack
2. Crowd
3. Herd

6. For each of the words given below, circle the rhyming word among the options given: (Time: 5 minutes, 1×2=2)

a. Hat - Gate Mat Map

b. Pain – Smile Sun Rain

7. Fill in the blanks with he/his/him: (Time: 5 minutes, 2×2=4)

Ravi is a good boy. _____ goes to school every day. _____ best friend is Rani.

E Surveys

Questions for Teachers:

Name of School:

Name of Teacher:

Grade in which she/he teaches:

Treatment Group Questions

A. General questions

A1. How long have you been teaching with Bharti?

_____ months

A2. How many students are enrolled in the class you teach?

_____

B. Questions related to non-Chimple homework

B1. Do you assign paper homework to the students? We will ask about Chimple homework later, so for these first questions please answer only about paper homework.

a. Yes, regularly.
b. Yes, occasionally.
c. No
d. Did not answer

If the answer to the above question is a or b, go to B2, otherwise skip and proceed to Section C

B2. On how many days in a typical week do you assign homework to students?

_____

B3. Do you assign the same homework to all students or different homework to different students?

a. Same homework to all students
b. Different homework to each student.
c. Other. Please specify:_____.
d. Did not answer.

B4. To what extent does the following information affect which homework you choose to assign? (Mark 0 for I don't know and -1 for Did not answer)

1	2	3	4	5
Never	Rarely	Sometimes	Often	Always

B4.1. Lesson plans provided by Bharti administration: _____

B4.2. Material covered in class that week: _____

B4.3. Review material that will be tested in upcoming exams: _____

B4.4. Class overall performance in the past exam/test: _____

B4.5. Class overall performance on past homework: _____

B4.6. Specific student's performance on past homework: _____

B5. How many students in your class complete more than 50% of the homework you assign, on average?

a. Most (more than half)
b. Half
c. Few (less than half)
d. None
e. I don't know
f. Did not answer.

B6. What do you do when students do not finish homework? (mark all that apply, options not to be read aloud)

a. Assign the same homework again
b. Make the student do the homework in school
c. Give the student a bad grade.
d. Other. Please specify: _____.
e. Nothing
f. Did not answer.

B7. Do you keep a record of whether the children do the homework and how many they get correct? If yes, can I see the record?

a. Yes, record viewed.
b. Yes, but record not viewed
c. No.
d. I don't know.
e. Did not answer.

C. Questions related to communicating with parents

C1. Other than Chimple messages, do you communicate or share information with parents

a. Yes
b. No (Skip to section D)
c. Did not answer. (Skip to section D)

C2. What do you communicate about? (mark all that apply, options not to be read aloud)

a. Academic performance
b. Irregularity in attendance
c. Non-participation in class
d. Student not completing homework
e. School activities
f. Other. Please specify:_____

C3. On average, how often do you communicate with a parent in one month?

_____

D. Questions related to Chimple

D1. Do your students use Chimple in the classroom? If so, how often?

a. Yes, every day
b. Yes, once a week
c. Yes, less than once a week
d. Never
e. Did not answer.

D2. Do you use Chimple to assign homework?

a. Yes, regularly
b. Yes, occasionally
c. No (Skip to E)
d. Did not answer (Skip to E)

If the answer to the above question is a or b, go to D3 otherwise skip and proceed to Question D13

D3. Do you assign the same Chimple homework to all students or different homework to different students?

a. Same homework to all students
b. Different homework to each student.
c. Other. Please specify:_____.
d. Did not answer.

D4. To what extent does the following information affect which homework you choose to assign on Chimple? (Mark 0 for I don't know and -1 for Did not answer)

1	2	3	4	5
Never	Rarely	Sometimes	Often	Always

D4.1. Lesson plans provided by Bharti/Chimple administration: _____

D4.2. Material covered in class that week: _____

D4.3. Review material that will be tested in upcoming exams: _____

D4.4. Class overall performance in the past exam/test: _____

D4.5. Class overall performance on past homework: _____

D4.6. Specific student's performance on past homework: _____

D4.7. School lesson plans: _____

D5. How many students in your class complete more than 50% of the Chimple assignments in a week, on average?

a. Most (over half)
b. Half
c. Few (less than half)
d. None
e. I don't know
f. Did not answer.

D6. What is the biggest obstacle to students completing assignments on Chimple?

a. Lack of interest
b. Difficulty level too high.
c. Insufficient internet access to download the assignments.
d. Insufficient access to smartphone.
e. Lack of encouragement from parents
f. Students distracted by the features
g. No obstacles.
h. Other: please specify:_____
i. I don't know.

D7. After your answer to D7, what is the second biggest obstacle to students completing assignments on Chimple?

a. Lack of interest
b. Difficulty level too high.
c. Insufficient internet access to download the assignments.
d. Insufficient access to smartphone.
e. Lack of encouragement from parents

f. Students distracted by the features
g. No obstacles.
h. Other: please specify:_____
i. I don't know.

D8. What do you do when students do not finish Chimple assignments? (mark all that apply/multiple select, options not to be read aloud)

a. Report non-completion to parents
b. Assign the same assignment again
c. Give the student time and a device to do the assignment in school
d. Give the student non-Chimple homework to fill the gap
e. Give the student a bad grade.
f. Other. Please specify:_____.
g. Nothing
h. Did not answer.

D9. Do you use the teacher dashboard to monitor student progress on the Chimple assignments? And if so, how often?

a. Yes, regularly.
b. Yes, occasionally.
c. No
d. Did not answer

Proceed with the following if D9 is a or b , otherwise skip to Section E

D10. How do you use the information from teacher dashboard? (mark all that apply, options not to be read aloud)

a. Assign more difficult material to students who are ahead.
b. Spend more time with students who are struggling in class.
c. Use the information to change lessons plans for following classes.
d. Share with parents.
e. Share with Bharti.
f. Other. Please specify:_____
g. Did not answer

D11. Can you show me the teacher dashboard? (Enumerator, gauge teacher fluency with dashboard)

a. Teacher is comfortable with dashboard.
b. Teacher is unable to navigate to dashboard.
c. Teacher did not have the app on her device.
d. Teacher is unwilling to show dashboard.

D12. If answer to question D2 was occasionally: Why do you not assign homework on Chimple more regularly? (mark all that apply/multiple select, options not to be read aloud)

a. Do not have time to assign Chimple activities

b. Run into technical errors using the app
c. Insufficient battery power/internet connectivity to assign homework regularly
d. Students do not have device access to complete Chimple assignments
e. Students do not have internet access to complete Chimple assignments
f. Students do not have time to complete Chimple assignments
g. Chimple is not helpful for children's learning
h. Other: please specify:_____

D13. Why do you not assign homework on Chimple? (mark all that apply/multiple select, options not to be read aloud)

a. Do not have time to assign Chimple activities
b. Run into technical errors using the app
c. Insufficient battery power/internet connectivity to assign homework regularly
d. Students do not have device access to complete Chimple assignments
e. Students do not have internet access to complete Chimple assignments
f. Students do not have time to complete Chimple assignments
g. Chimple is not helpful for children's learning
h. Other: please specify:_____

E. Questions related to Chimple Training

E1. Did you attend the training on how to use Chimple?

a. Yes
b. No (Skip to F)
c. I don't remember (Skip to F)
d. Did not answer. (Skip to F)

E2. If Chimple does another training, what should they spend more time on? (mark all that apply, options not to be read aloud)

a. How to assign lessons
b. How to use the dashboard to see student progress
c. How to help students who are having trouble
d. Other. Please specify: _____
e. Nothing, training was perfect.
f. Nothing, no need for another training.

F. Questions related to views on Chimple

F1. On a scale of 1 to 5, do you agree or disagree with the following statements? (Mark 0 for I don't know and -1 for Did not answer)

1	2	3	4	5

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

F1.1. Chimple assignments and non-Chimple homework are substitutes for each other; focusing on only one is best for student learning.

F1.2 Chimple assignments and non-Chimple homework are complements; using both is best for student learning.

F1.3 Assigning homework on Chimple takes time away from me doing more valuable things for my students' learning.

F1.4. Assigning homework on Chimple has increased my workload.

F1.5. Chimple interferes with other activities in class.

F1.6. Chimple is more fun for students than other homework because of the puzzles and games.

F1.7. Chimple helps students learn better.

F1.8. Other household members (parents, older siblings) often complete Chimple assignments for students.

F2. Have you discussed Chimple with other teachers or students in other grades?

a. Yes
b. No
c. I don't remember
d. Did not answer.

F3. Have you received any rewards for using Chimple in class?

A. Yes
B. No
C. I don't know
D. Did not answer

F4. If F3 is yes, what kind?

A. Monetary reward
B. Social Recognition
C. Psychological Encouragement
D. Other: please specify_____

Questions for Teachers:

Name of School:

Name of Teacher:

Grade in which she/he teaches:

Control Group Questions

A. General questions

A1. How long have you been teaching with Bharti?

_____ months

A2. How many students are enrolled in the class you teach?

_____

B. Questions related to homework assignment

B1. Do you assign paper homework to the students? We will ask about electronic homework to be done on phone or on educational app later, so for these first questions please answer only about paper homework.

a. Yes, regularly.
b. Yes, occasionally.
c. No
d. Did not answer

B2. If yes to B1, on how many days in a typical week do you assign homework to students?

_____

B3. If yes to B1, do you assign the same homework to all students or different homework to different students?

a. Same homework to all students
b. Different homework to each student.
c. Other. Please specify: _____.
d. Did not answer.

B4. To what extent does the following information affect which homework you choose to assign? (Mark 0 for I don't know and -1 for Did not answer)

1	2	3	4	5
Never	Rarely	Sometimes	Often	Always

B4.1. Lesson plans provided by Bharti administration: _____

B4.2. Material covered in class that week: _____

B4.3. Review material that will be tested in upcoming exams: _____

B4.4. Class overall performance in the past exam/test: _____

B4.5. Class overall performance on past homework: _____

B4.6. Specific student's performance on past homework: _____

B5. If yes to B1, how many students in your class complete more than 50% of the homework you assign, on average?

a. Most (more than half)
b. Half
c. Few (less than half)
d. None
e. I don't know
f. Did not answer.

B6. If yes to B1, what do you do when students do not finish homework? (mark all that apply, options not to be read aloud)

a. Assign the same homework again
b. Make the student do the homework in school
c. Give the student a bad grade.
d. Other. Please specify: _____.
e. Nothing
f. Did not answer.

B7. If yes to B1, do you keep a record of whether the children do the homework and how many they get correct? If yes, can I see the record?

a. Yes, record viewed.
b. Yes, but record not viewed
c. No.
d. I don't know.
e. Did not answer.

B8. Do you assign any homework to children that has to be completed on a phone or educational app?

a. Yes, regularly.
b. Yes, occasionally.
c. No
d. Did not answer

B9. If yes to B8, what app do you require the child use on the phone?

a. Chimple

b. Byju
c. Rocket Learning
d. Other: Please specify_____
e. I do not know
f. Did not answer

B10. If yes to B8, how many students in your class complete more than 50% of the phone homework you assign, on average?

a. Most (more than half)
b. Half
c. Few (less than half)
d. None
e. I don't know
f. Did not answer.

B11. If yes to B8, on how many days in a typical week do you assign phone homework to students?

_____

B12. If yes to B8, do you assign the same phone homework to all students or different homework to different students?

a. Same homework to all students
b. Different homework to each student.
c. Other. Please specify: _____.
d. Did not answer.

C. Questions related to communicating with parents

C1. Do you communicate or share information with parents

a. Yes
b. No
c. Did not answer.

C2. If yes to C1, what do you communicate about? (mark all that apply, options not to be read aloud)

a. Academic performance
b. Irregularity in attendance
c. Non-participation in class
d. Student not completing homework
e. School activities
f. Other. Please specify: _____

C3. On average, how often do you communicate with a parent in one month?

For the surveyor to fill up before survey:

Surveyor ID:

Survey Date:

1. Bharti Household ***(= yes if the student attends Bharti School)***: 1 (= yes), 0 (= no)

2. ***(Only if student attends Bharti school/ Bharti Household = 1)*** Household Type : A (Treatment) / B (Control)

3. Name of the Student:

4. School Name:

5. ***(Only if student attends Bharti school/ Bharti Household = 1)*** Student Admission ID (Bharti Admission ID):

6. Class:

7. Name of the respondent:

8. Relation to Student:

9. Village Name:

10. Can you start the survey with an adult member of the household?
    1. Yes 2. No

11. If No (option 2) to 10, why cannot you start the survey?
    1. No one there at household
    2. No adult member present
    3. Adult member present but unwilling to talk now

    99. Others, please specify: _____

12. Has the participant given consent to participate in the survey?

    1. Yes (proceed to next section)

    2. No (Stop the survey here)

A. Demographic Details

Surveyor reads: "I will be asking you some background questions related to all the members of the household, including you and children. "

A1. Number of members in household: _____

A2. ***Instruction to surveyor: In the following table, note down the names of the members of household; note down response according to codes given for A2.(D) – A2. (G)***

Person ID (A)	Name (B)	Age completed in years (C) Code: 877 = did not answer	Gender (D) Code: 1=Male 2=Female 3= Others 877= Did not answer	Relationship to student (E) Code: 1.=Father 2.=Mother 3= Brother 4.=Sister 5.=Grandparent 6= Brother-in-law 7.=Sister-in-law 99= Others (specify): ___ 877.=Did not answer	Marital Status (F) Code: 1=Married 2=Unmarried 3=Separated 4=Divorced 5= Widowed 877= Did not answer	Is (Name) literate in any language (G) Code: 1=Yes 2=No 877=Did not answer

A3. ***Instruction to surveyor: In the following table, note down the names of the members of household; note down response according to codes given for A3.(C) – A3. (G). Note that person codes corresponding to names should be same as A2.***

Person ID (A)	Name (B)	Can (Name) read in English (C) Code: 1=Yes 2=No 877. Did not answer	Can (Name) write in English (D) Code: 1=Yes 2=No 877. Did not answer	Highest Class completed by (Name) (E) Code: 1=Completed class 1 but did not finish 2 2= Completed class 2 but did not finish class 3 3= Completed class 3 but did not complete class 4. ….. …… 12=Completed class 12 but did not complete graduation 15= Completed graduation 0=Did not complete class 1 99= Others (specify):___ 877= Did not answer	Primary occupation of (Name) (F) Code: 1=Agriculture 2=Contract Labour 3=Salaried Employee in Private Sector 4=Salaried Employee in Government Sector 5=Self-Employed Non-agriculture 6=Retired 7=Unemployed 8=Student 9=Too young to attend school 10=Household work 99= Others (specify):____ 877= Did not answer	Any disability suffered by (Name) (G) Code: 1=Physical disability 2=Mental disability 3=No disability 99= Others (specify):____ 877= Did not answer

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B. Asset Ownership, Household Characteristics and Related Details

Instruction to surveyor: The respondent has the right to not answer any specific question, according to his/her will. In all such cases in this section, record the answer to that specific question as "877", which implies "did not answer".

B1. Does your household have?

a. Electricty – 1(if yes) 0 (if no)
b. Electric light - 1(if yes) 0 (if no)
c. Electric fan - 1(if yes) 0 (if no)
d. Radio(s) – 1(if yes) 0 (if no)
e. Cycle(s) - 1(if yes) 0 (if no)
f. Scooter/Motorcycle(s) – 1(if yes) 0 (if no)
g. Car(s) - 1(if yes) 0 (if no)
h. Tractor(s) – 1(if yes) 0 (if no)
i. Television set(s) - 1(if yes) 0 (if no)
j. Refrigerator(s) - 1(if yes) 0 (if no)
k. Table(s) - 1(if yes) 0 (if no)
l. Chair(s) - 1(if yes) 0 (if no)
m. Landline phone(s) - 1(if yes) 0 (if no)
n. Mobile phone(s) - 1(if yes) 0 (if no)
o. Desktop computer(s) - 1(if yes) 0 (if no)
p. Laptop computer(s) - 1(if yes) 0 (if no)
q. Tablet(s) - 1(if yes) 0 (if no)

B2. How many rooms are there in your household (including kitchen, excluding latrine)?

_____

B3. How many acres of land do you own? (100 Decimal = 1 Acre, 1 Maan = 25 Decimal, 25 Goonth = 1 Acre)? (in acres or convert it in acres)_____ Acre

B4. What is the type of the house?

1. Pucca
2. Semi-Pucca
3. Kuchha

B5. Does any member of the household own this house or any other house?

1. Owns this house and but no other house
2. Does not own this house but owns a separate house
3. Owns this house as well as separate house(s)
4. No member owns any house

99. Others (please specify):

999. Do not know

B6. Does your house have a separate kitchen?

1. Yes
2. No

T. Tech Access Module (Skip this module if response to **all** questions between B1.n-B1.q is no (0))

T1. How many mobile phones are there in your household? _____

T2. For how long has your household owned any mobile phone?

1. More than 5 years
2. Less than 5 years but more than a year
3. Less than a year ago

99. Others (specify): _____

999. Do not know

T3. Which of the household members own mobile phone(s)?

Person ID (A) Code: refer to A2/A3-A	Name (B)	Relation to Student (C) Code: refer to A2-E	Is the mobile owned a smartphone? (D) Code: 1 = yes, 0 = no

T4. How many mobile phones in your household has an internet (data) pack installed? _____(= 0 if no mobile phone has internet recharge)

T5. ***If T4 ≠ 0,*** In a typical week, what is the maximum number of days on which you have proper internet connection on the mobiles with internet recharge?

1. More than 5 days
2. 3-5 days
3. 0-2 days

T6. Other than mobile phones, is there any other device in your household which you use to access the internet?

1. Yes
2. No

T7. ***If yes to T6***, what is that device? ***(Select all that apply, do not read out options)***

1. Tablet
2. Computer (Desktop/Laptop)

99. Others (specify): _____

T8. ***If yes to T6***, in a typical week, what is the maximum number of days on which you have proper internet connection on the devices?

1. More than 5 days

2. 3-5 days

3. 0-2 days

Skip the following questions in this module if T4 = 0 and response to T6 is option 2 (No)

T9. What are the internet service providers you use? ***(Select all that apply, read out options if necessary)***

1. Jio
2. Vodafone
3. Airtel
4. BSNL

99. Others, specify: _____

999. Do not know

T10. In a typical month, how many times do you buy a data recharge for your household devices with internet? _____

T11. How much do you spend typically on recharges in a typical month? For example, if you recharge twice in a typical month and always buy Rupees 100 worth, you spend 200 in a typical month

_____ rupees

C. Questions related to the student

Instruction to surveyor: The following section has questions related to the student who has been selected to be a participant in our study. Please refer to the student's name in the list on basis of which you visited this household

The respondent has the right to not answer any specific question, according to his/her will. In all such cases in this section, record the answer to that specific question as "877", which implies "did not answer".

Enumerator reads: "Now I am going to ask you some questions about (Student's Name). These will mostly be related to his/her studies in school and at home."

C1. In a typical week, how many days does (Name of student) go to school? _____ days

C2. How long does it usually take to get to his/her school (1 direction)?

_____ hour _____ minutes

C3. On how many days in a typical week, is (Name of student) assigned homework by school? _____ days

C4. On how many days in a typical week does (Name of student) do homework?

1. Yes, regularly (more than 4 days in a typical week) (***skip to C6)***
2. Yes, on some days (less than 4 days in a typical week) ***(skip to C6)***
3. No

C5. ***If no is selected in C4***, why does he/she not study at home? ***(Select all that apply, do not read out options)***

1. Not interested in studies
2. Finds the lessons difficult and no one to help
3. Does not need to study at home, school study suffices

99. Others (specify): _____

C6. Is there anyone in the household who helps (Name of student) with his/her studies at home?

1. Yes
2. No one in household, but someone who is not member of household helps
3. No one helps ***(skip to C8)***

C7. ***If option 1 or option 2 is chosen in C6***, for those who help (Name of student) with his/ her studies at home, fill this

Person ID (A) Code: refer to A2/A3-A for household members; 1111 for non-members of household	Name (B)	Relation to Student (C) Code: refer to A2-E	Highest class completed (D) Code: refer to A3-E	How often does the person help in a week? (E) Code: 1= more than 5 days, 2 = 3 to 5 days, 3 = 0 to 2 days 999 = do not know	How does this person help with studies? (F) (Select all that apply; do not read out options) Code: 1= explain difficult concepts in homework 2 = helps to solve difficult question that student could not solve on his/her own 3 = finishes the homework for the student irrespective of difficulty level 4 = helps only with preparation for exams 99 = others (specify)

					999 = do not know

C8. Why did you choose (Name of school) for (Name of Student)'s schooling? ***(Select all that apply, do not read out options)***

1. Only school close to home
2. Other schools are expensive
3. The curriculum is better in this school compared with other schools
4. teaching and other educational attributes are better compared to others
5. Majority of students in the neighbourhood/locality go to the same schoo
6. Reputation is very good
7. Better extracurricular activities

99. Others (specify): _____

999. Do not know

C9. On a scale of 1 to 5, how satisfied are you with the following things?

1 = very dissatisfied

2 = dissatisfied

3 = neither satisfied nor dissatisfied

4 = satisfied

5 = very satisfied

999 = do not know

a. (Name of the student)'s knowledge of maths –
b. (Name of the student)'s knowledge of english –
c. School's study curriculum -
d. Teaching in school -
e. Teacher's assessment of student's progress –

C10. Does anyone from household other than (Name of student) interact with teacher in school about (Name of student)'s academic progress?

1. Yes

2. No (***skip to C12***)

C11. ***If yes to C10***, how often does such interaction happen in a month typically?

_____ days

C12. Does (Name of student) have access to any smartphone?

1. Yes, regularly
2. Yes, sometimes
3. No ***(skip to C17)***

C13: ***If 1 or 2 is chosen in C12***, what is the purpose for which (Name of student) uses smartphone? ***(Select all that apply, do not read out options)***

1. Homework
2. Academic purposes other than homework
3. Playing games
4. Entertainment other than playing games (Watching videos, listening to music, etc)

99. Others, specify: _____

C14. ***If 1 or 2 is among the options chosen in C13***, what is the name of the app which (Name of student) uses for this work? ***(Select all that apply, do not read out options)***

1. Chimple
2. Hello English
3. Byju's
4. YouTube
5. Rocket Learning
6. Google

99. Others, specify: _____

C15. Is there anyone at home who monitors his/her activities when he/she is using smartphone?

1. Yes
2. No

C16. If 1 or 2 is chosen in C13 **AND** 1 is chosen in C15, does this person who monitors (Name of student)'s phone usage, help him/her with his studies and homework?

1. Yes
2. No

999. I don't know

C17. ***If 2 or 3 is chosen in C12***, why does (Name of student) not have access to smartphone regularly?

1. No smartphone in household
2. Limited number of smartphones in household which is/are often taken out by others while going to work
3. Smartphone is available but access not given regularly to student due to distraction from study
4. Smartphone is available but access not given at all to student due to distraction from study

99. Others, specify:_____

C18. What percentage of your monthly expenditure is spent on education of (Name of Student)? _____ (999: does not know)

C19. Can you give us an estimated amount of monthly expenditure on education of (Name of Student)? _____ (999: does not know)

C20. What does (Name of the Student) do when he/she is not studying at home or attending school? ***(Select all that apply, do not read out options)***

1. Plays with friends
2. Plays with toys
3. Plays games on mobile/any other electronic device
4. Plays any sport
5. Watches cartoons/sports/movies/videos on mobile/any other electronic device
6. Writes/draws
7. Reads
8. Visits relatives
9. Helps out parents/other household members
10. Nothing

99. Others(specify): _____

999. Do not know

C21. ***If 9 (helps out parents/other household members) is chosen in C20 (skip otherwise)***, how much time does (Name of the Student) spend on helping out the parents/other household members on a typical day? ***(Do not read out options)***

1. More than 2 hours
2. Between 1-2 hours
3. Less than an hour
4. Does not help out every day but at least once every week
5. Does not help out every week but at least once every month

99. Others (specify): _____

999. Do not know

C22. Did (Name of the Student) ever drop out from (School Name)?

1.Yes

2.No (Skip to section C26)

C23. ***If yes to C22***, why did (Name of the Student) drop out? ***(Select all that apply, do not read out options)***

1. Had to relocate to some other place
2. Not satisfied with curriculum
3. Books/uniform/study materials too expensive
4. Fees too expensive
5. (Name of the Student) did not enjoy going to school
6. (Name of the Student) needed to help family

99.Others (Specify):_____

C24. ***If yes to C22***, where does (Name of the Student) study now? (***do not read out options***)

1.Different school under Bharti

2.Different government school (Not a Bharti school)

3. Different private school (Not Bharti school)

4.Same school where student used to study before dropping out (that is, School Name in the roster)

5.Home schooling

6. Does not attend school

99. Others (Specify): _____

C25. ***If yes to C22 and 4 is chosen in C24***, why did (Name of the Student) rejoin the same school? (***do not read out options***)

1. Family moved back to the same locality

2. Educational curriculum of the school (that is, School Name in the roster) is very good

3. Other schools have expensive fees

4. Other schools do not have a good educational curriculum

5. (Name of the Student) did not enjoy going to any other school

6. No other school is there in locality

99. Others (specify): _____

C26. Did (Name of the Student) attend any other school before this school?

1. Yes
2. No (Skip to section S)

C27. ***If yes to C26***, Where did (Name of Student) study before joining this school? (Do not read out options)

1. Bharti school
2. Private School other than Bharti
3. Government School
99. Others (specify): _____

C28. ***If yes to C26***, Why did (Name of Student) move away from previous school? (Select all that apply, do not read out options)

1. Curriculum of current school is better
2. Had to relocate and previous school is at a great distance after relocation
3. Books/uniform/study materials too expensive in previous school
4. Fees too expensive in previous school
5. Current school has better extracurricular activities

99. Others (specify):_____

S. Spillover-related Questions (Only for Bharti students/household)

Instruction to surveyor: Proceed to the following section only if the Household is that of a student belonging to Bharti.

Surveyor reads: "We will now be asking you some questions regarding other siblings of (Name of Student) who are school students. If (Name of Student) does not have any siblings studying in school, we will skip these questions."

Instruction to surveyor: If (Name of Student) does not have any sibling studying in school, skip this section (Section S).

The respondent has the right to not answer any specific question, according to his/her will. In all such cases in this section, record the answer to that specific question as "877", which implies "did not answer".

S1. Does (Name of Student) have any sibling studying in school?

1. Yes
2. No (Skip this section – Section S and proceed to D)

S2. ***For all the siblings of (Name of Student) going to school,*** fill up the following table

Person ID (A)	Name of the sibling (B)	School (C) Code: 1 = Same school as (Name of the Student) 2 = Different Bharti school 3 = Private School other than Bharti 4 = Government School 99 = Others(specify): _____	Name of School (D)	Class (E) Code: 1 = Class 1 2 = Class 2 3 = Class 3-5 4 = Class 6 or any higher class	Does the sibling study at home with (Name of the Student)? (F) Code: 1 = Yes 2 = No 99 = Others (Specify): _____

D. App related Questions (Only for Household Type – A (Treatment) among the Bharti households)

Instruction to surveyor: Proceed to the following section only if the Household is that of Bharti school student and household type is A (Treatment) .

Surveyor reads: "We will now be asking you some questions regarding apps used for studies . If you are not familiar with studies of (Name of Student), we will request you to ask someone from your household who helps (name of the student) with his/her studies to answer the following questions."

The respondent has the right to not answer any specific question, according to his/her will. In all such cases in this section, record the answer to that specific question as "877", which implies "did not answer".

If there is no one who supervises (name of the student)'s studies or helps him/her with her studies, surveyor reads: "If there is no one present who helps the student with his/her studies, we will request to ask the person in the household with whom (Name of the Student) interacts the most, to answer the following questions."

D1. Do you agree to answer the following questions? You have every right not to answer any question among the following.

1. Yes, I agree
2. No, I do not (***End the survey here***)

D2. Are you familiar with studies of (Name of Student)?

1. Yes
2. No ***(End the survey here)***

D3. Does (Name of Student) use smartphone for his/her homework?

1. Yes
2. No (End the survey here)

999. Do not know

D4. If yes to D3, what is the name of the app? **(Do not read out any option, select all that apply)**

1. Chimple
2. Hello English
3. Byju's
4. YouTube
5. Rocket Learning
6. Google

99. Others (specify): _____

D5. Have you seen the activities that are there on the app(s) ?

1. Yes
2. No ***(skip to D7 if this is selected)***

D6. On a scale of 1 to 5, how difficult do you think the assignments are?

1. Very Easy
2. Easy
3. Neither easy nor difficult
4. Difficult
5. Very difficult

999. Do not know

D7. What does (name of the student) do when he/she gets stuck using the app(s)? ***(Select all that apply, do not read out the options)***

1. Leaves it and solves other assignments
2. Discusses the problem with his/her school teacher the next day
3. Asks you,family member or tutor for help

99. Others (specify):_____

999. Do not know

D8. How have you found that smartphone use for homework affected child's learning

1. Has improved child's knowledge relative to a year ago
2. No Change
3. Has decreased child's knowledge relative to a year ago

999. Do not know

D9. Should Schools Use Homework on a smartphone to reinforce class material?

1. Yes
2. No

999. Do not know

D10. Which statement do you agree with? ***(Select the statement number respondent agrees with)***

1. Such apps are very useful and help my child to learn better
2. Such apps distract my child and impede his/her learning
3. Such apps are neither good nor bad for my child's learning

D11. How much time does the child spend on such apps?

_____minutes per day

D12. Does someone else ever do these app-based activities for the child (you or siblings)?

1. Yes
2. No

999. Do not know

D13. ***If yes to D12***, Who?

1. Father
2. Mother
3. Friend
4. Sibling
5. Relative

99. Others (Specify): _____

D14. ***If yes to D12***, why? ***(Do not read out options; select all that apply)***

1. Child does not get how to use the app
2. Child does not understand the problem
3. Child has not finished assignment which is due

99. Others (Specify):_____

D15. Do you encourage your child to use such apps ?

1. Yes
2. No

999. Do not know

D16. ***If yes to D15***, why? ***(Do not read out options; select all that apply)***

1. Pays attention due to game format
2. Material Accessible and clear
3. Interactive so likes to use and learns
4. Boosts the child's confidence

99. Others (Specify):_____

D17. ***If no to D15***, why not?

1. Too distracting
2. Needs smart phone and access is an issue
3. Needs data and we cannot afford it

99. Others (Specify):

D18. Have you discussed about the app with others?

1. Yes
2. No

999. Do not know

D19. ***If yes to D18***, with whom (***Do not read out options; select all that apply***)

1. Parents of children in same class
2. Parents of children in same school but not same class
3. Other friends whose children attend other schools
4. Far off relatives whose children attend Satya Bharti school in same grade

99. Others (Specify): _____

D20. Have you yourself experienced any benefit of the app on top of any benefits to your child?

1. Yes
2. No

999.Do not know

D21. What Benefit have you experienced? (***Do not read out options; select all that apply***)

1. Have been learning to read and write
2. Have been learning math

3. Child teaching English
4. Spending time with child
99. Others (Specify): _____