Budget Recording Tools Improve Financial Skills Among Youth: Experimental Evidence from a Financial Diaries Study[*]

Veronica Frisancho[†]   Silvia Prina[‡]   Alejandro Herrera[§]

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Abstract

Little is known about youth's financial lives and the type of programs that can be effective to enhance their financial skills and behavior. We conducted a six-month-long study with graduating high school students, where access to an smartphone mobile app to record daily financial transactions was randomized to half of our sample. While the treatment group received access to a financial diaries app, the control group was instead offered a placebo app to record daily meals. Adopting the tool and the regular recording of financial transactions has a positive and statistically significant effect on financial literacy scores and awareness of market prices. Among students without previous exposure to financial lessons during high school, the treatment effect is comparable to the effect size measured for school-based financial education programs that target teenagers. Overall, this study shows that experiential learning might be a promising alternative to standard financial education delivery methods among youth.

KEYWORDS: financial inclusion, financial diaries, financial literacy, impact evaluation.
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[†]Corresponding author: Research Department - Inter-American Development Bank - 1300 New York Ave. NW, Washington, DC 20577. Email: vfrisancho@iadb.org.

[‡]Department of Economics, Northeastern University, 310A Lake Hall, Boston, MA 02115-5000.

[§]Research Department - Inter-American Development Bank - 1300 New York Ave. NW, Washington, DC.

1 Introduction

Low levels of financial inclusion are still a regular hurdle for developing countries.[1] Among youth, participation in formal financial systems is even lower[2]. Interactions of young adults with the financial system in the developing world begin late, and youth's needs end up being matched with inadequate products and services, making them vulnerable to starting their financial lives at a disadvantage. Moreover, results from the OECD Program for International Student Assessment (PISA) test of financial literacy in 2018 show that one in four students aged 15 can not make even simple everyday spending decisions (OECD, 2020). As youth come unprepared to deal with more complex financial systems than previous generations, they have become a priority target in the arena of financial education (OECD, 2014; OECD-INFE, 2015).

Recent experimental evidence on the provision of financial education suggests that focusing on youth delivers large and robust impacts on financial skills, especially when the delivery of interventions occurs in the classroom and relies on a conventional lecture format.[3] However, less has been done to teach healthy financial habits to youth through more hands-on delivery strategies, partly because some believe that financial lives are practically non-existent at young ages.[4] Using a simple smartphone mobile application (app, from now on) that enables users to keep track of their finances, we study whether awareness about one's financial behavior can help youth become savvier and more responsible financial agents.

We randomly assigned graduating high school students aged 16 to 18 in Peru to two treatment arms. The treatment group received access to a financial app plus biweekly individual monitoring visits and text messages encouraging saving. The control group received access to a placebo app to record daily meals. The financial app allowed youth to record all their financial transactions over six months, thus creating a "financial diary".[5]

Budgeting and keeping track of expenses and income are efficient ways to allocate scarce resources among the most pressing financial needs. These habits may thus exert an awareness effect about past financial choices that can potentially lead to behavioral changes among the treatment group. We thus measure the effects of regularly recording monetary transactions on youth's financial skills and behavior. Our study is the first to assess the potential impact of an innovative financial education delivery method for youth, a population with a high and

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[1] In developing economies 63 percent of adults have an account at a financial institution, compared with 94 percent in developed countries (Demirguc-Kunt et al., 2018)

[2] According to Demirguc-Kunt et al. (2018), in developing countries about 4 in 10 unbanked adults are in the age group 15–24.

[3] See Kaiser and Menkhoff (2019) for a meta-analysis and Frisancho (2019) for a survey on experimental studies.

[4] A few notable exceptions are Hinojosa et al. (2009) and Batty et al. (2020), who study school-based programs that successfully deliver financial content through classroom games. Others have instead tried to foster responsible financial behavior by bundling financial education lessons with school savings tools, as in the case of Berry et al. (2018), with less encouraging results.

[5] Financial diaries were developed over the past two decades to collect more accurate and high-frequency information on spending and income patterns. Collins et al. (2009) were pioneers in using these data collection strategies, which have since then been used by many to study financial habits among diverse populations. See Somville and Vandewalle (2019) as well as https://bfaglobal.com/portfolio/ and https://www.microfinanceopportunities.org/ for several examples.

increasing usage of apps in their daily lives. Besides, the data collected via the financial diaries provide us with dynamic information on youth's income, spending, and savings patterns over six months.

Data recorded through the financial diary app reveal that approximately half of the transactions carried out by youth relate to expenditures. However, the value of income transactions represents 46 percent of youth's budgets, while expenses only account for 30 percent of the total portfolio value, and loan savings operations represent the remaining 24 percent. Young users exhibit an interesting degree of sophistication in their financial lives, with lumpier income flows and savings and loan operations relative to expenditures.

Keeping a financial diary improves financial literacy test scores by 0.08 standard deviations and knowledge of market prices by 0.34 standard deviations. However, there are no statistically significant impacts on adopting budgeting habits or the probability to save. This result is probably a reflection of the still limited scope of youth's transactions early on during their financial lives. Heterogeneity analysis reveals interesting patterns that shed light on the mechanisms behind the average impacts. For instance, students from households with higher socioeconomic status (as measured by an asset index) benefit relatively more from access to the financial app.

Moreover, we find that the impact of the app is driven by graduating students who did not benefit from school-based financial lessons while in high school. Keeping a financial diary yields a 0.22 standard deviation increase in financial literacy scores among those who did not participate in a randomized controlled trial providing financial education lessons in the classroom. Financial experiential learning may thus be a promising alternative to conventional financial education delivery methods in school. Experimental studies that measure the effect of school-based delivery methods with a similar population find lower impacts on financial literacy in Spain (0.17 standard deviations), Peru (0.16 standard deviations), and Brazil (0.21 standard deviations).[6] The usage of the app also leads to differential gender effects: males seem to learn relatively more about prices, and they do exhibit a 9.6 percentage point increase in their probability to budget after the financial diaries period was over.

Our study contributes to the literature on the impact of financial education on knowledge and behavior among youth. It is the first to document a positive impact on financial literacy stemming from experiential learning among teenagers.[7] Previous experimental studies targeting youth have used a more conventional approach through school-based financial education programs (Bruhn et al., 2016; Bover et al., 2018; Frisancho, 2018). More in general, we also contribute to the literature on the link between exposure to financial products and services and progressive adoption and new technology usage. Bachas et al. (2020) show that access to a debit card in Mexico corrects misperceptions or biases emerging from lack of knowledge and previous bad experiences while Breza et al. (2020) study the effect of repeated use of payroll accounts in Bangladesh. We provide access to a budget recording tool and evaluate the impact of exposure and usage on the probability of keeping a budget after the observation period is over.

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[6]See Bover et al. (2018); Frisancho (2018); Bruhn et al. (2016)

[7]Hinojosa et al. (2009); Batty et al. (2020) show successful experiences of experiential learning among children.

A byproduct of our study are detailed records on the financial lives of youth transitioning out of secondary school. This group is particularly vulnerable to financial shocks given their dependence on family support and low savings, and access to financial markets. Unfortunately, there is very limited data on youth's financial choices during this stage, which poses a challenge for designing adequate financial tools and instruments that can be affordable and useful for them. Conventional survey data on individuals' financial activities may hide significant money flows that are not reflected in measured stocks. Our financial diaries' records provide a novel opportunity to learn more about young adults' lives in a developing country.

2 The Experiment

2.1 Sample Selection and Randomization

Our study is embedded in a larger project that randomized access to a financial education program in secondary public high schools (see Frisancho 2020). The pilot targeted the last three high school grades, equivalent to grades 9 to 11 in the US. The intervention was rolled out in six regions of the country where financial education lessons were imparted in treated schools between 2016 and 2018.

Our sample frame corresponds to 60 public schools in urban areas from one of the regions targeted by the financial education program, Piura. Piura is one of the 24 departments in Peru and ranks second in population size among all departments, representing 6.6 percent of the country's population. Piura's population is predominantly urban (78.6 percent) and mostly young, with youth (15-24-year-olds) making up for 16.3 percent of its population. About a third of Piura's population is poor as defined by national poverty lines (INEI, 2018).

While 11th grade students were in the last two-month period of classes in 2018, we approached them at the school and gave them an informed consent form for them to take home. Since most target students were minors, we asked them to show the form to their parents and asked them to sign and return it to the school if they approved their children's participation in the study. The informed consent did not let them know which app the kid was getting if she were to enroll in the study.

We then ranked schools depending on the quality of internet connectivity in the area and the number of consent forms collected.[8] We grouped the 60 schools into three strata: the first stratum corresponded to high connectivity areas, regardless of the number of signed consent forms collected ($N_1 = 31$). The second group corresponded to schools with regular and low connectivity but at least one consent form signed ($N_2 = 15$), while the third stratum grouped schools with low connectivity and no returned consents ($N_3 = 14$). Within each stratum,

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[8]Although users of the financial diaries and nutrition apps were able to record transactions on their cellphones regardless of whether they were connected to the internet or not, the transmission of data from each smartphone to the information storage server depended on connectivity. Data collected off-line was uploaded to the apps server whenever the respondent's cellphone was connected to an internet network, either through a cellphone internet connection or WiFi.

we randomized access to the financial diaries at the school level. Since both treatment arms imply the use of an app, we relied on pre-intervention survey records on individual access to a smartphone to condition eligibility.[9] The final sample of eligible students consists of 982 soon-to-be high school graduates, 25 percent of whom had informed consent before graduation.

We instructed the fieldwork team to recruit at least 400 students during December 2018, once the academic year was over. We asked them to prioritize students in the first stratum to guarantee the success of the intervention. If the student did not have a signed informed consent, the surveyor had to obtain the consent during her first visit to the child's home. The surveyors were instructed to try to recruit students from stratum two whenever all their efforts had been exhausted to recruit enough participants in the first stratum. Stratum three was reserved as the last resource to enroll participants.

Eventually, we recruited 390 participants in 47 schools. Sixty-five percent of the schools in the sample belonged to the high connectivity stratum, while 20 percent and 15 percent corresponded to the second and third strata, respectively. At baseline, 43 percent of our sample lived in districts with more than 30 percent of their population under monetary poverty, and 20 percent were located in very small districts with less than 20,000 households (see Appendix Table A.1).

Pre-recruitment randomization and stratified random assignment by connectivity level and parental interest in the study ensure balance between the 203 recruited participants assigned to the financial diaries app and the 187 who were offered the nutrition app. Table 1 presents the balance check and confirms that the randomization was successful. Notice that the treatment's random assignment yields balance in the share of students who had received financial education lessons in the school between 2016 and 2018.

2.2 The Intervention: Financial Diaries

Our treatment package consists of an app that allows users to record their daily financial transactions, bi-weekly visits by a monitor, and text messages encouraging savings.[10] The financial diaries app provided a friendly and easy-to-use platform that allowed participants to record their financial transactions, classified into income, expenditures, and financial tools. The transactions were recorded via the app by either the user or the monitor during her visits.

To record a transaction, the user needed to choose the type of transaction from a drop-down menu, then entered the transaction amount, and finally chose a sub-category from a second drop-down menu. The sub-categories for income included family or friends' allowances, cash gifts, permanent or temporary job earnings, and sale of own assets. Expenditures were subdivided into food, personal items, health, education, entertainment, clothing, gifts, and mobile data for cellphones. Finally, financial tools were classified into savings deposits, savings withdrawals, giving loans to others, receiving payment from loans to others, receiving loans from

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[9]Access to a smartphone comes from a baseline survey conducted in the sample of 60 schools in Piura during November 2018.

[10]See Appendix Sub-section B.1 for illustrations and brief description about the intervention materials, specifically the apps developed for treatment and control groups.

others, and repayment of loans from others. Three months after the study launch, participants started receiving personalized text messages to encourage savings based on participants' past performance.[11]

Compliance with the treatment was expected to be a challenge if potential benefits from using the app were not immediately evident for participants. Hence, we offered all study participants (in treatment and control groups) weekly recharges equivalent to a dollar worth of megabytes for mobile internet. These incentives were provided as long as the participant did not explicitly withdraw from the study or stopped attending the scheduled meetings with her monitor. Besides, active participants in the treatment group were entered into a monthly raffle for a hundred dollars smartphone during the period February-June.[12]

After an initial compliance level of 79 percent in the first month of the observation period (January 2019), app usage dropped to 64 percent (see row (A) in Appendix Table A.2). At the end of the analysis period, in June 2019, there were 62 dropouts out of 203 initial users of the financial diaries app.[13] Students' engagement levels also decreased over time. As rows (B) and (C) of Appendix Table A.2 show, initially, almost half of the transactions were recorded through the app directly by the participants. However, towards the end of the study, the bulk of the transactions were entered by the monitor during the monitoring visits.

The control group received access to an alternative application, which allowed participants to keep a diary of their daily meals. Developed under the exact specifications and format of the financial app, the nutrition app required reporting whether or not the user had eaten breakfast, lunch, dinner, or snacks and the location in which she ingested each of those meals. Users of the nutrition app in the control group were visited by an enumerator only twice (that is, at the start and the end of the study). Thus, app usage rates are much lower among them. During the first month of the study, only 14 percent of the students in the control group reported their meals through the app, and at the end of the study, only 21 percent had nutritional records.

2.3 Study Timeline

Figure 1 chronologically presents the intervention activities (in bold) and the data collection activities (in italics). The baseline survey and financial literacy test took place in the school, at the end of the 2018 academic year (i.e., while participants were still attending high school).

The recruitment and enrollment of participants started shortly after the data collection (i.e., November and early December). While potential participants were still in school, we gave them informed consent forms for them to take home and get parental approval to join the study. Low response rates forced the fieldwork team to try to obtain parental consent in the field during

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[11]See Appendix Sub-section B.2 for a description about personalized text messages to encourage savings.

[12]A total of seven cellphones were awarded between these months. We also sent regular text message reminders about the benefits of participating in the study, such as the raffles and the weekly megabytes credit.

[13]Recurrent challenges in the data collection process were internet connectivity and cellphone ownership. A few individuals reported the loss, theft, or malfunction of their cellphones. The fieldwork team provided physical notebooks as an alternative for financial diaries participants to record their transactions when facing any of these difficulties. At the end of the study, 55 participants had recorded their transactions only through notebooks.

their first visit to the teen. Enumerators met with potential participants for the first time in mid-December. If parental consent had been previously obtained, the enumerators helped participants to install the app corresponding to their treatment assignment on their cellphones and trained them to use it. If parental consent had not been obtained while the student was still in school, the enumerator first talked to the parents and tried to convince them to let their child join the study. After the consent was obtained, the assigned app was installed on the participant's phone. Recording of financial transactions (or food intake for the control) started right after enrollment. The biweekly meetings started in late December and continued for six months. Halfway through the observation period, participants received text messages encouraging savings.

The endline survey and financial literacy test were applied about a year after the baseline survey, two months after the observation period was over. These instruments allowed us to collect data on financial literacy and behavior to measure the impact of adopting the financial diaries app and the regular recording of financial transactions.

2.4 Data

The baseline survey contains information about the socioeconomic characteristics of the individual and her parents and basic information on household assets. Besides, we collected information on graduating students' educational and employment prospects. We also measured past experiences with financial education programs and collected data on savings habits, use of budgets, consumption habits, and knowledge about the market prices of essential goods and services.

The endline survey collected mainly the same information from the baseline. Additionally, it contained a lengthier section on employment or educational status and aspirations, as individuals in the sample were transiting from school and into the labor market and/or tertiary education. We also included a final section for individuals in the treatment group to assess their experience with the financial diaries app. We enquired about the main reasons that motivated or dissuaded them from continuing using the app, the technical difficulties they faced, and whether they were still using the app after the study ended.[14]

The financial literacy test applied at baseline consisted of fifteen questions. The questionnaire included direct questions or short cases about the best alternatives to save money for a future purpose, situations that justify a debt, basic calculations related to savings goals, and time management. We also had questions about saving capacity, the best use of those savings, responsible use of a credit card, spending plans in situations of income constraints, consumer rights, credit history, and financial regulation.

To develop our endline test, we started from the fifteen questions of the baseline questionnaire.

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[14]According to these data, 19.23 percent of the 182 users of the financial app users claimed to have had some difficulty using the app. Of these 35 users who experienced difficulties, 48.72 percent pointed to internet access, 15.38 percent to limited cellphone memory, 12.82 percent to lack of time to complete the recording, among other minor issues.

We then excluded three questions exclusively focused on financial consumer rights since we did not expect our intervention to impact this specific type of knowledge. With the remaining twelve questions, we performed an Item Response Theory analysis, keeping the questions that reflected the highest levels of variability, considering the criteria of discrimination and difficulty.[15] We then added questions from the PISA 2018 Financial Literacy Framework that asked the respondent to choose the best consumption choices based on the information provided (OECD, 2018). In the end, we applied an endline exam of twelve questions, combining baseline and PISA questions.

We also have access to the transactions stored in the financial diaries app during the intervention's six-month duration. Between January and June of 2019, a total of 17,204 transactions were recorded. We exclude data from the nutrition app as usage rates were extremely low in the control group.

2.5   The Financial Lives of the Youth

We briefly describe the income and spending patterns among youth in our sample. The first two columns of Table 2 provide a general overview of the relative frequency and magnitude of youth's transactions by type of record during the entire observation period. Transactions related to expenses turn out to be the most frequent, representing over half of the total recorded transactions. Income flows and savings/loans transactions only represent 38.1 percent and 9.7 percent of the recorded transactions, respectively. In terms of magnitude, income flows represent the largest share of youth's budget, with 46.2 percent of the total value of transactions recorded over the entire six-month period. On average, expenditures represent a little under a third of the portfolio's total value, while more sophisticated financial tools related to savings and loans account for almost a quarter of the budget.

Columns 3 and 4 in Table 2 present monthly-level information on the average number of transactions and the corresponding dollar value for each type of operation.[16] Once more, it is clear that expenditures are the most recurrent financial flow, with 12.5 average transactions of this sort per month. Income flows are also quite frequent (8.6 transactions), indirectly revealing that the sample is not engaging formal sector jobs with fixed payment schemes. Average monthly income amounts to US$ 62 while average expenses are US$ 43. Average flows in/out of the financial tools account for nearly as much money allocated to expenditures, signaling that youth are modestly engaging in sophisticated transactions related to loans and savings. This data also tells us that income flows and transactions related to savings and loans seem to be lumpier than those about expenses. Young adults in our sample exhibit fewer income and savings/loans transactions relative to those related to expenditures, but the average value of a monthly transaction is the highest in the case of financial tools (US$ 15.1 mobilized per transaction) and the

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[15]We kept those referring to the ability to save, the best use of savings, adequacy of acquiring loans to finance negative net income, budgeting for future goals, and investment.

[16]Since our intervention included biweekly visits where we verified transactions with app users, the months reported hereafter are not exactly *calendar months*, but there are some gaps of days between calendar months. This is detailed in Appendix Table A.3.

lowest in the case of expenditures (US$ 3.5 per transaction).

The transaction records also allow us to identify trends and patterns over the six-month analysis period. For instance, Figure 2 shows that youth consistently exhibit positive net income flows. Expenditures closely follow income fluctuations over time, but their share is relatively stable at two-thirds between January and June. The expense-to-income ratio across these months averages at 0.68, with a standard deviation of 0.08.

3 The Impact of Keeping a Financial Diary

3.1 Main Outcome Variables

We hypothesize that the use of the diaries may induce a learning-by-doing effect, which could improve participants' financial skills in an active way. The intensive use of the app and the salience and awareness effects it generates in relation to participants' budgets may influence youth choices. Myopic behavior may become more tangible for participants as they are able to review and reflect on their transactions afterward. Thus, this awareness effect may affect financial behavior: even if treated individuals cannot answer questions about inflation or interest rates correctly, they could still become more conscious and responsible consumers due to the diaries' use.

App usage may also have an impact on other forward-looking choices beyond the financial realm. Awareness about present-biases may spillover onto youth's non-financial choices that imply intertemporal trade-offs. For instance, the treatment group may become more likely to enroll in tertiary education after graduating from high school.

Specifically, we measure the impact of the financial diaries on the endline financial literacy score. We also estimate the effects on four financial behaviors captured in the endline survey: the probability to keep a budget, a shopping habits index that captures consumer savviness, the degree of knowledge about market prices, and the probability of saving. We use a standardized index to measure good shopping habits, including strategies such as bargaining, comparing prices, not buying unplanned items, comparing prices on the Internet, and planning purchases. To measure the degree of knowledge about market prices, we considered a list of consumption items and asked respondents to give their best price guess in each case. Each respondent scores higher when the price she reports is within the range of minimum and maximum market prices derived from price data coming from two local retail sources.[17] The respondent's score is then standardized relative to the control group. The probability of saving includes both formal and informal savings. Finally, we also measure the treatment effect on the probability to continue onto tertiary education as reported in the endline survey.

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[17]The list of items included food staples such as a kilo of rice, a can of evaporated milk, a kilo of potato, a dozen of eggs, a kilo of fish, a kilo of poultry, a liter of oil, and a liter of sugar, as well as products/services that youth were more likely to demand such as a liter of ice cream, a movie ticket, a pair of shoes, and 200 MB for the cellphone. To benchmark the given prices, we consulted the websites https://preciosmundi.com/peru/ y https://www.metro.pe/ at the time of the interview.

3.2 Estimation Strategy

We assess the impact of the financial diaries intervention on financial knowledge and behavior estimating the following OLS regression:

$$Y_{ij} = \alpha + \beta T_{ij} + \delta X_{ij} + \phi_j + \mu_{ij} \tag{1}$$

where Y_{ij} is the outcome of interest and T_{ij} is equal to one whenever individual i in strata j was randomized into the treatment group and zero otherwise. Regressions include individual- and household-level controls, X_{ij},[18] and fixed effects at the strata level, ϕ_j. Moreover, μ_{ij} denotes the error term, which is clustered at the school and strata levels. Furthermore, we include the baseline level of the outcome variable as control.[19] Thus, β captures the Intention-To-Treat (ITT) effect.

We also estimate the Treatment-on-Treated Effect (TOT) effects defining "effective treatment" through a dummy, Z_{ij}, which is equal to one if the individual was a frequent user of the financial app. Frequent user status is defined as having at least three user-entered transactions per month.[20] TOT effects can then be obtained from estimating β^{TOT} by instrumenting Z_{ij} with the random assignment of the treatment:

$$Y_{ij} = \alpha + \beta^{\text{TOT}} \widehat{Z_{ij}} + \delta X_{ij} + \phi_j + \varepsilon_{ij} \tag{2}$$

The main results presented in the next sub-section will focus on the ITT effects. Appendix C reports the results for the TOT estimator (see Appendix Tables C.1 and C.2).

3.3 Results

Table 3 presents the average ITT effects of providing youth with a tool to record their financial transactions regularly. Panel A shows the effects of the treatment on financial literacy and the probability of enrolling in tertiary education. The treatment had a positive and statistically significant effect on financial literacy (0.08 standard deviations). The intervention, however, did not affect the probability of pursuing technical or college education.

Panel B of Table 3 presents the treatment impacts on budgeting, shopping and saving habits, and price knowledge. First, the habit of recording transactions did not lead to an increase in the probability of using a budget. Second, the recording of financial outflows and inflows did not lead to improved shopping strategies. Third, the treatment leaves the probability to save unaffected,

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[18]Specifically, controls include: gender, age, baseline working status, dwelling overcrowding, a household asset index, and an indicator that both parents live with the participant.

[19]Implementation of an analysis of covariance (ANCOVA) to estimate the treatment effects leads to considerable improvements in power compared to a difference-in-difference specification (McKenzie, 2012). The only outcome for which we cannot add the baseline level as a control is the probability to pursue tertiary education.

[20]This cutoff determines the top 25th percentile in the distribution of user-entered transactions in the treatment group.

despite the specific reminders we sent to foster savings (see Appendix Sub-section B.2). However, keeping a financial diary did induce greater awareness about the prices of different goods and services. Relative to the control group, participants became considerably savvier when searching for price information, recording a marginal improvement in their knowledge of prices equivalent to a third of a standard deviation. This effect could reflect that users of the financial diaries app learn to search for relevant information such as current market prices that can help them to plan their future expenses.

The TOT effects reported in Appendix Table C.1 confirm and reinforce the treatment impacts identified for financial literacy and price knowledge. Among high-intensity users, the effect of the provision of the financial app on the financial literacy endline test amounts to a 0.13 standard deviation. Similarly, the average effect on price knowledge among high-intensity users increases to 0.56 standard deviations.

To dig deeper into the channels driving the financial diaries intervention's impact, we study heterogeneity in our sample. Table 4 presents the impact of the treatment depending on the household's socioeconomic status at baseline, school of origin's participation in the program delivering school-based financial education during high school, sex of the participant, and working status at baseline.

Panel A displays ITT effects by socioeconomic status as measured by an asset index. The treatment has a large, positive, and statistically significant impact on individuals' financial literacy and price literacy among wealthier households. The latter effect could reflect that wealthier households have greater purchasing power that can expose diaries' users to a greater diversity of purchased items. It could also be driven by greater access to different sales outlets in the areas wealthier households live in. Youth who become more aware of the cost of different products and services through the app's continued use have greater access to information networks on prices when they live in wealthier and likely better-connected areas.

Since a random sub-sample of our study sample was previously exposed to a school-based financial education program, Panel B explores whether the financial diaries app led to differential benefits depending on having received financial lessons during high school. As the estimates show, those who did not receive the financial education program and subsequently used the financial diaries app performed better in the endline's financial literacy exam. Indeed, app's usage did not lead to any significant impacts in the treatment group who received the financial education program. The effect among those who did not receive lessons during high school is quite large (0.22 standard deviations) and robust to multiple hypothesis testing. Similarly, most of the gains in price knowledge come from the control group in the financial education program.

These findings suggest that experiential learning could be a substitute for traditional lecture delivery methods. The effect size of the recording app on financial literacy is greater than those identified in experimental studies that measure the effect of school-based delivery methods with a similar age group. For instance, the school-based financial education program in Peru led to 0.16 standard deviations improvement in financial literacy test scores, while similar programs in Brazil and Spain find effect sizes of the order of 0.21 and 0.17 standard deviations, respectively.

Panel C moves on to present the gendered effects of the treatment. Female students exhibit improved shopping practices, while male students become more likely to keep a budget after the observation period is over. Both females and males become more knowledgeable about market prices, but the latter exhibit much larger effects. Finally, Panel D shows that those who declared not working at baseline are the main drivers of the positive effect of the treatment on financial literacy (though not significant) and knowledge of market prices.

Heterogeneity estimates of the TOT effects in Appendix Table C.2 confirm the direction and significance of the ITT results. Indeed, when focusing on high-intensity users of the app, the differences by socioeconomic status, previous exposure to financial education, and sex become even larger and more significant.

Overall, youth benefited from having access to an app allowing them to record their financial transactions. These findings are consistent with the youth's positive evaluation of the financial app. As described in Sub-section 2.4, the endline survey included a set of questions to capture self-perceptions of the treatment group about the use, benefits, and potential problems of the financial diaries app. Panel A in Table 5 shows that users report having learned from the app. Columns 1 and 2 report that close to 90 percent of the treated individuals said that the application helped them understand money usage and taught them that saving is not easy. Over 90 percent of the treatment group reported that the app allowed them to understand the need to save money, spend less on some things, taught the importance of saving, taught them how to better plan expenses, and made them think about savings use.

Panel B in Table 5 reports the opinions of the treatment group on the app usage itself. Once more, either close to 90 or over 90 percent of the respondents claimed that the app made it easy to keep track of income and expenses, was more useful than other apps in their cellphones, and was simple and easy to use (see columns 1 and 2). Columns 4-6 in Table 5 show no statistically significant differences between the opinions of app users who received the school-based financial education program in high school vis-a-vis those who did not.

Furthermore, Columns 1 and 2 in Table 6 presents users' reasons to continue to use the app during the analysis period. Almost 90 percent of the respondents claim that the motivation to use the app was to understand better the use of their money (i.e., experiential learning). The incentives we provided (credit recharges and cellphone raffles) and peer motivation played a role in keeping up the compliance levels, but they do not seem to be the primary drivers of usage.

The survey records also allowed us to measure app fidelity once the observation period was over and incentives were discontinued. Two months after the end of the field monitoring period and the biweekly visits, almost 60 percent of the treatment group continued to use the app at least four times per month on their own, as shown in Appendix Figure A.1. This result reinforces the claim that users found it helpful to keep track of their financial transactions.

4 Conclusions

Financial education has become a popular prescription to complement financial inclusion strategies. A focus on youth in recent years has facilitated the production of evidence on the effectiveness of financial education programs targeting this segment. These studies show promising and robust effects on financial skills and down-stream behavior. However, most evidence available focuses on school-based or voluntary interventions that rely on a conventional lecture format. We implement a six-month-long financial diaries intervention in Peru and test if the use of a budget recording phone application provides participants the opportunity to improve their financial skills and behavior. To our knowledge, this is the first study to explore the effects of experiential learning on financial literacy among youth.

Our sample comprises youth aged sixteen to eighteen. The results uncover that youth in a middle-income country such as Peru engage in active, modestly sophisticated financial lives. They consistently exhibit positive net income flows, with a third of their monthly income being allocated to savings and/or loans transactions.

Overall this study shows that financial, experiential learning might be a promising alternative to standard financial education delivery methods. Regular recording of transactions using the financial diaries app has a positive and statistically significant effect on financial literacy scores (0.08 standard deviations) and awareness of market prices (0.33 standard deviations). Heterogeneity analysis reveals interesting patterns that shed light on the mechanisms behind the average impacts. For instance, students from households with higher socioeconomic status benefit relatively more from access to the financial app. Additionally, we find that the impact of the app is driven by participants without prior exposure to financial education lessons during high school. Keeping a financial diary yields a 0.22 standard deviation increase in the financial literacy scores of those who did not receive financial education lessons in the classroom.

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Figure 1: Study Timeline
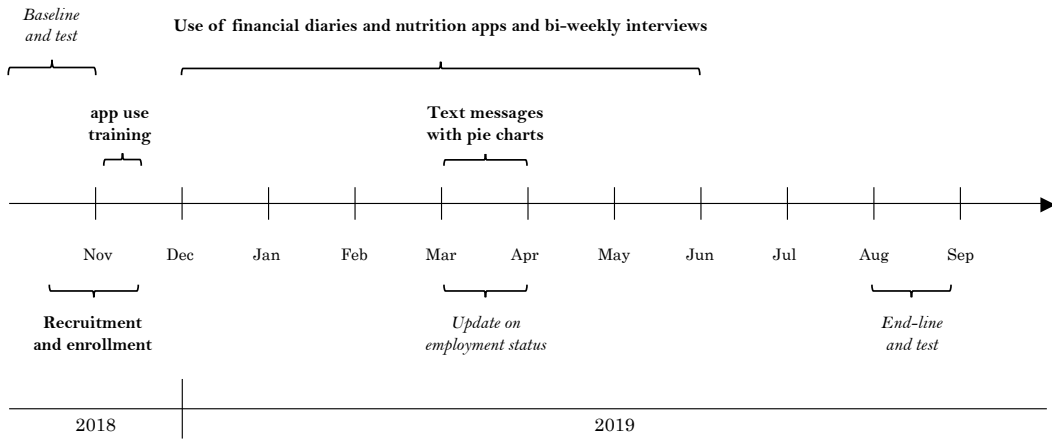
NOTE: Intervention activities in **bold** and data collection activities in *italics*.

Figure 2: Average Monthly Income and Expenditure
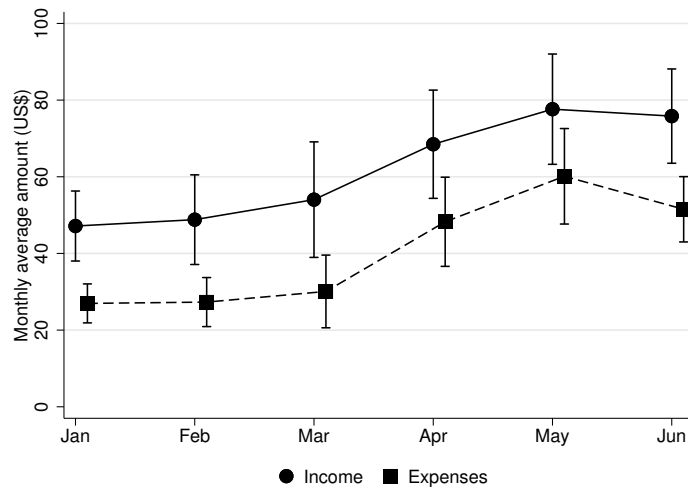
NOTE: Round (square) markers depict monthly average income (expenditures) while the lines are 95% CI.

Variable	Control mean (1)	T-C (2)	N (3)
Table 1: Balance check			
Male	0.567	0.059	390
	[0.497]	[0.056]	
Age	16.572	-0.055	390
	[0.873]	[0.101]	
Works	0.209	0.151	390
	[0.407]	[0.067]**	
Ratio of household members to bedrooms	2.059	-0.024	386
	[1.080]	[0.132]	
Lives with both parents	0.690	0.059	390
	[0.464]	[0.049]	
Asset index	-0.000	-0.119	390
	[1.000]	[0.197]	
High level of parental supervision	0.813	-0.079	390
	[0.391]	[0.053]	
Has dinner with parents 7 days a week	0.374	0.025	390
	[0.485]	[0.055]	
Financial autonomy (0-100)	49.385	-0.213	390
	[11.396]	[1.220]	
Time inconsistency: hyperbolic	0.235	0.065	390
	[0.425]	[0.044]	
Risk averse	0.701	0.014	390
	[0.459]	[0.054]	
Self-control	-0.000	0.050	390
	[0.858]	[0.123]	
Impulsiveness: Planning	0.000	0.105	390
	[0.813]	[0.103]	
Financial literacy raw score (0-15)	12.123	0.128	390
	[2.937]	[0.405]	
Price knowledge (0-9)	6.176	-0.196	390
	[1.645]	[0.225]	
Prepares a personal budget	0.719	0.006	381
	[0.451]	[0.059]	
Saves	0.615	0.040	390
	[0.488]	[0.059]	
Bargains	0.733	-0.033	390
	[0.444]	[0.051]	
Saves to buy something unaffordable	0.930	-0.004	390
	[0.255]	[0.027]	
Compares prices before shopping	0.722	-0.082	390
	[0.449]	[0.062]	
Buys something not planned for	0.283	0.052	390
	[0.452]	[0.058]	
Total expenditures in last month (USD)	95.211	32.156	390
	[115.106]	[16.440]*	
Total earnings in last month (USD)	32.250	15.000	390
	[43.864]	[6.389]**	
Financial Education Program	0.481	-0.003	390
	[0.501]	[0.165]	

NOTE: Significance levels (* 10%; ** 5%; *** 1%) captured through OLS estimation accounting for clustered (school) standard errors. Standard errors(deviations) of coefficients(control means) are in brackets.

Table 2: Frequency and Average Amounts by Transaction Category

	All months		Monthly average	
	Fraction of total number of transactions (1)	Fraction of total amount in US$ (2)	Mean number of transactions (3)	Mean amount in US$ (4)
Income	38.1%	46.2%	8.6	62.0
Expenditure	52.2%	30.2%	12.5	43.1
Financial tools	9.7%	23.7%	2.7	41.0
Total	100%	100%	7.9	48.9

NOTE: The first two columns of the table reflect the fractions of the totals recorded between the months of January to June 2019. The last two columns show the average between the six monthly averages.

Table 3: Intention-To-Treat (ITT) Effects

	Obs. (1)	Control (2)	ITT (3)
(A) EFFECTS ON LITERACY AND EDUCATIONAL CHOICES			
Financial Literacy	349	0.000 (0.076)	0.079* (0.025)
Pr(Tertiary)	349	0.713 (0.036)	-0.053 (0.068)
(B) EFFECTS ON SHOPPING AND SAVINGS HABITS			
Pr(Budgeting)	349	0.413 (0.038)	0.012 (0.029)
Shopping index	349	-0.000 (0.086)	-0.175 (0.120)
Price knowledge	349	-0.000 (0.078)	0.335* (0.081)
Pr(Save)	349	0.497 (0.039)	0.014 (0.017)

NOTE: All specifications include a set of controls: gender, age, currently working, ratio of household members to bedrooms, lives with both parents, district fixed effects, and the value of the dependent variable level at baseline. Standard errors clustered at the district and school level are reported in parentheses. Stars denote significance levels (* 10%; ** 5%; *** 1%) based on unadjusted p-values. Dags denote significance levels † 10%, †† 5%, ††† 1%) based on sharpened FDR q-values.

Table 4: Heterogeneous Intention-To-Treat (ITT) Effects

	FinLit Score	Pr(Budgeting)	Shopping index	Price knowledge	Pr(Save)
	(1)	(2)	(3)	(4)	(5)
(A) ASSET INDEX					
Low assests	-0.064‡	0.058	-0.200	0.127	-0.017
	(0.031)	(0.098)	(0.074)	(0.111)	(0.059)
High assets	0.181*	-0.025	-0.162	0.494**	0.036
	(0.054)	(0.064)	(0.184)	(0.102)	(0.043)
(B) FINANCIAL EDUCATION PROGRAM					
FinEd Control	0.218***†††	0.080	-0.178	0.225***†††	0.009
	(0.013)	(0.040)	(0.071)	(0.013)	(0.025)
FinEd Treated	-0.108	-0.072	-0.178	0.484	0.023
	(0.140)	(0.132)	(0.299)	(0.220)	(0.074)
(C) SEX					
Female	0.117	-0.102	-0.172	0.173*‡‡	-0.153
	(0.125)	(0.073)	(0.207)	(0.058)	(0.086)
Male	0.052	0.096*	-0.188	0.454*	0.135
	(0.107)	(0.030)	(0.069)	(0.111)	(0.066)
(D) WORK STATUS					
Not works	0.142	0.015	-0.221	0.352**	0.010
	(0.070)	(0.037)	(0.128)	(0.075)	(0.045)
Works	-0.087	0.004	-0.077	0.290*	0.025
	(0.225)	(0.199)	(0.131)	(0.094)	(0.096)

NOTE: All specifications include a set of controls: gender, age, currently working, ratio of household members to bedrooms, lives with both parents, district fixed effects, and the value of the dependent variable level at baseline. Standard errors clustered at the district and school level are reported in parentheses. Stars denote significance levels (* 10%; ** 5%; *** 1%) based on unadjusted p-values. Spades denote significance levels († 10%, 5%, 1%) based on sharpened FDR q-values. Dags denote statistical difference (‡ 10%, ‡‡ 5%, ‡‡‡ 1%) of parameters between groups.

Table 5: Self-reported Perceptions about app by Financial Education Program

	Overall (n=182)		T0 (n=96)		T1 (n=86)	
	Mean (1)	S.D. (2)	Mean (3)	S.D. (4)	Mean (5)	S.D. (6)
(A) EXPERIENTIAL LEARNING THROUGH THE APP USE						
Helped to better understand money usage	0.890	(0.314)	0.906	(0.293)	0.872	(0.336)
Understood need to save more money	0.934	(0.249)	0.958	(0.201)	0.907	(0.292)
Understood need to spend less on some things	0.923	(0.267)	0.927	(0.261)	0.919	(0.275)
Taught the importance of saving	0.918	(0.276)	0.948	(0.223)	0.884	(0.322)
Taught that saving is not so easy	0.885	(0.320)	0.896	(0.307)	0.872	(0.336)
Taught how to better plan expenses	0.923	(0.267)	0.938	(0.243)	0.907	(0.292)
Made think about savings use	0.929	(0.258)	0.948	(0.223)	0.907	(0.292)
(B) FEEDBACK ABOUT THE APP						
Made easy to keep track of income and expenses	0.918	(0.276)	0.958	(0.201)	0.872	(0.336)
More useful than other apps in cellphone	0.885	(0.320)	0.896	(0.307)	0.872	(0.336)
Considered the app user-friendly and easy to use	0.896	(0.307)	0.917	(0.278)	0.872	(0.336)

NOTE: Columns 3 and 4 correspond to the financial app users who corresponded to the Financial Education Program's treatment group, while columns 5 and 6 correspond to the control group. Standard deviation in parentheses. Dags denote statistical difference († 10%, †† 5%, ††† 1%) between groups.

Table 6: Self-reported Reasons for Keep Using the app by Intensity of Use

	Overall (n=182)		Low use (n=85)		High use (n=97)	
	Mean (1)	S.D. (2)	Mean (3)	S.D. (4)	Mean (5)	S.D. (6)
To understand better the use of her money	0.896	(0.307)	0.918	(0.277)	0.876	(0.331)
Monthly cell-phone raffle	0.445	(0.498)	0.518	(0.503)	0.381	(0.488)
Peer motivation	0.291	(0.456)	0.353	(0.481)	0.237	(0.428)
Three soles recharge every two weeks	0.390	(0.489)	0.447	(0.500)	0.340	(0.476)
Other	0.060	(0.239)	0.059	(0.237)	0.062	(0.242)

NOTE: Columns 3 and 4 correspond to the financial app users who revealed low-intensity use, while columns 5 and 6 correspond to those with high-intensity use.. Standard deviation in parentheses. Dags denote statistical difference († 10%, †† 5%, ††† 1%) between groups.

A Appendix

Table A.1: Districts of Piura by Monetary Poverty and Fraction of the Sample

Districts	Percentage of sample (%)	District's Total Population	Fraction of district's population under Monetary Poverty
Chulucanas	14.6	89735	30.6
Sullana	13.3	189351	19.4
La Arena	9.2	41286	38.1
Piura	8.5	177748	9.8
Castilla	6.7	183759	16.3
Miguel Checa	5.9	10210	28.1
Tambo Grande	4.9	124028	38.1
Buenos Aires	4.1	10211	30.6
Catacaos	3.3	80950	31.9
Salitral	2.8	9086	40.1
La Huaca	2.6	14170	23.1
Veintiséis De Octubre	2.6	187787	16.3
Marcavelica	2.3	32265	24.9
La Unión	1.3	44355	31.9
Tamarindo	1.3	5330	29.2
Querecotillo	1.3	28130	24.9
Colan	1.0	16953	29.2
Paita	1.0	101905	20.6
Huancabamba	0.8	29446	43.5
Pacaipampa	0.5	23262	67.2
Bellavista	0.5	38905	19.4
Lagunas	0.3	5816	68.0
Frías	0.3	21370	61.4
Sicchez	0.3	1642	46.2
San Miguel De El Faique	0.3	9395	43.1
La Matanza	0.3	15047	38.7
Vice	0.3	17732	33.4
Ignacio Escudero	0.3	21676	28.1
La Brea	0.3	13192	15.6
Arenal	0.3	1249	14.9
N.A.	9.2	-	-

SOURCE: Own elaboration based on the Poverty Map INEI (2018).

Table A.2: Treatment Compliance

	Jan	Feb	Mar	Apr	May	Jun
(A) Compliance	79.3	68.5	63.1	65.5	65.5	64.1
(B) Transactions recorded by user (%)	45.9	40.5	24.3	15.4	5.2	3.4
Non-edited transaction (as % of (B))	72.7	66.7	77.7	71.2	65.0	59.7
Edited transactions (as % of (B))	27.3	33.3	22.3	28.8	35.0	40.3
(C) Transactions recorded by enumerator (%)	54.1	59.5	75.7	84.6	94.7	96.6

NOTE: Row (A) shows the fraction of compliers over the total number of treated. Rows (B) and (C) shows the fraction of monthly transactions recorded by the user and those recorded by the surveyor, respectively.

Table A.3: Bi-weekly Interview Schedule and Definition of Months

	Month (approximate)	Bi-week reference for the interview	Start date	End date
	Enrollment	1	10-Dec-18	30-Dec-18
1	"January"	2	31-Dec-18	13-Jan-19
		3	14-Jan-19	27-Jan-19
2	"February"	4	28-Jan-19	10-Feb-19
		5	11-Feb-19	24-Feb-19
3	"March"	6	25-Feb-19	10-Mar-19
		7	11-Mar-19	24-Mar-19
4	"April"	8	25-Mar-19	7-Apr-19
		9	8-Apr-19	21-Apr-19
5	"May"	10	22-Apr-19	5-May-19
		11	6-May-19	19-May-19
6	"June"	12	20-May-19	2-Jun-19
		13	3-Jun-19	16-Jun-19

Figure A.1: Average app Use Two Months after Biweekly Visits Finished
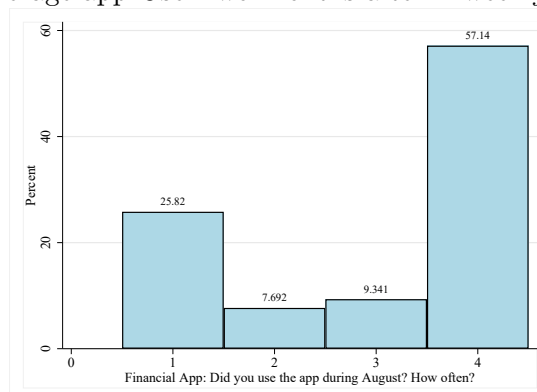
NOTE: The bars represent the percentages of users of the financial diaries app.

B Intervention Materials

B.1 Smartphone Apps

In this Appendix Sub-section, we illustrate the main instruments we use during the intervention: an enrollment app, and two different apps according to the treatment assignment.

Enrollment App

Before installing and using the app that corresponded to each participant according to random assignment, a first instrument was the enrollment app. This app collected basic personal information from the respondents so that the field team knows the respondent's names and how to contact them, as seen in Figure B.1. The app linked the respondent to data already collected from them through the baseline survey. This app was installed only when there was a signed informed consent, as described in Section 2.

Figure B.1: Enrollment App Illustration
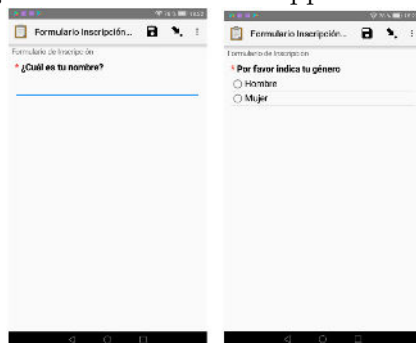
Treatment and Control Apps

Individuals in the treatment group recorded their daily financial transactions in the financial app, entering as many transactions as they had each day. The app was organized into three main categories of transactions: income, expenses, and financial tools, as seen in Panel (a) of Figure B.2. On the other hand, individuals in the control group just recorded their daily meals in the nutrition app, entering as many meals as they had each day. The app was organized into four categories: breakfast, lunch, dinner, and snacks, as seen in Panel (b) of Figure B.2.

Figure B.2: Treatment and Control Group Apps Illustrations
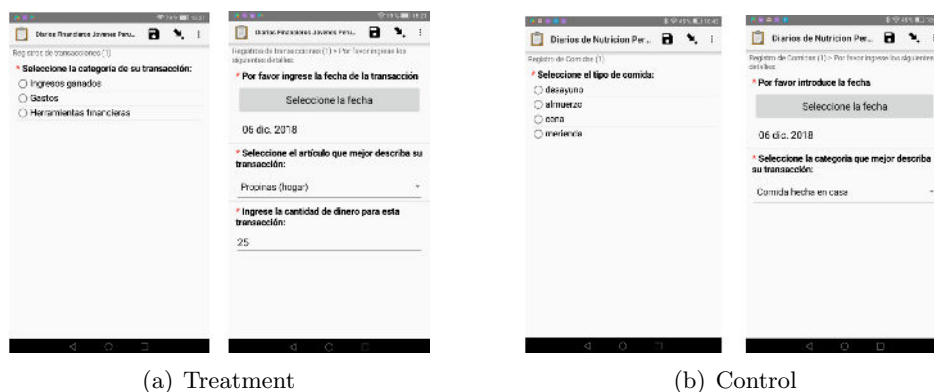
(a) Treatment   (b) Control

B.2 Personalized Text Messages to Encourage Savings

In this Appendix Sub-section, we briefly describe the procedure for sending text messages to encourage savings. The first part of the message contained general information analyzed in the last visit:

> "Hello, thank you for recording your daily transactions in the Financial Diaries app. You are doing it very well. Let me remind you of the information you shared in our last meeting. During the past two weeks you earned 203 soles and spent 147 soles..."

The second part of the message was conditional on how individual savings levels. The messages were always positively framed, avoiding shaming that could backfire. Depending on the different scenarios, three types of messages were delivered:

a) Users who did not save in the last two weeks and had cumulative savings equal to zero were encouraged to save:

> "... and you saved 0 soles. We encourage you to try hard and start developing the habit of saving. You can do it!"

b) Users who did not save in the last two weeks, but had a positive balance of cumulative savings, were reminded of their total balance:

> "... and you saved 0 soles. Your current savings balance is 170 soles. Congratulations!"

c) Users who saved something in the last two weeks were told how much they would get if they were to keep saving at the same rate:

> "... and you saved 7 soles. If you keep saving the same amount until the end of May, you will have 35 soles. Your current savings balance is 13 soles. Congratulations!"

Figure B.3: Example of a Pie Chart Sent
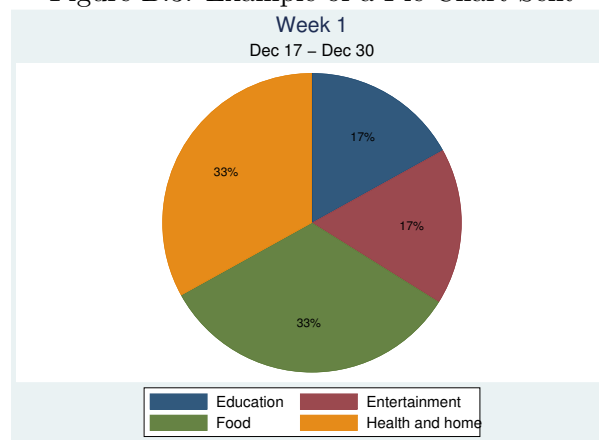
In addition to the text messages fostering savings, we also sent pie charts that summarized participants' expenditure patterns by category (see example in Figure B.3 in the Appendix). This tool intended to highlight non-essential expenditures as a potential margin to adjust and redirect resources towards savings. The pie charts were sent with the following message:

"Hello. We send you this graph with the detail of your expenses in the past two weeks. It is essential to know what we are spending on and to have some reasonable control over our financial lives. This graph is the first step in building a budget that can help you meet your needs and could guide you in deciding whether to spend less on some items and thus save more. During our next meeting, we can comment and discuss any questions you have about the graph. See you soon!"

C Treatment-On-Treated (TOT) Effects

Table C.1: Treatment-On-Treated (TOT) Effects

	Observations (1)	Control (2)	TOT (3)
(A) EFFECTS ON LITERACY AND EDUCATIONAL CHOICES			
Financial Literacy	349	0.000 (0.076)	0.130* (0.035)
Pr(Tertiary)	349	0.713 (0.036)	-0.087 (0.110)
(B) EFFECTS ON SHOPPING AND SAVINGS HABITS			
Pr(Budgeting)	349	0.413 (0.038)	0.020 (0.047)
Shopping index	349	-0.000 (0.086)	-0.287 (0.203)
Price knowledge	349	-0.000 (0.078)	0.555* (0.163)
Pr(Save)	349	0.497 (0.039)	0.023 (0.026)

NOTE: All specifications include a set of controls: gender, age, currently working, ratio of household members to bedrooms, lives with both parents, district fixed effects, and the value of the dependent variable level at baseline. Standard errors clustered at the district and school level are reported in parentheses. Dummy on frequently high app use instrumented by random treatment assignment used for TOT effect estimation. Stars denote significance levels (* 10%; ** 5%; *** 1%).

Table C.2: Heterogeneous Treatment-On-Treated (TOT) Effects

	FinLit Score	Pr(Budgeting)	Shopping index	Price knowledge	Pr(Save)
	(1)	(2)	(3)	(4)	(5)
(A) ASSET INDEX					
Low assests	-0.116‡ ‡ ‡	0.105	-0.349	0.216‡ ‡ ‡	-0.030
	(0.052)	(0.181)	(0.143)	(0.184)	(0.108)
High assets	0.285*	-0.039	-0.254	0.782**	0.056
	(0.085)	(0.098)	(0.287)	(0.167)	(0.065)
(B) FINANCIAL EDUCATION PROGRAM					
FinEd Control	0.392***‡‡	0.142	-0.311	0.391***	0.015
	(0.032)	(0.072)	(0.113)	(0.039)	(0.047)
FinEd Treated	-0.177	-0.114	-0.268	0.745	0.036
	(0.208)	(0.201)	(0.464)	(0.350)	(0.115)
(C) SEX					
Female	0.216	-0.194‡	-0.316	0.314‡ ‡ ‡	-0.284‡‡
	(0.244)	(0.146)	(0.400)	(0.128)	(0.150)
Male	0.077	0.150*	-0.285	0.702*	0.209
	(0.164)	(0.045)	(0.103)	(0.203)	(0.098)
(D) WORK STATUS					
Not works	0.225	0.024	-0.348	0.560*	0.016
	(0.126)	(0.066)	(0.223)	(0.159)	(0.072)
Works	-0.161	0.007	-0.142	0.538*	0.047
	(0.404)	(0.361)	(0.230)	(0.179)	(0.182)

NOTE: All specifications include a set of controls: gender, age, currently working, ratio of household members to bedrooms, lives with both parents, district fixed effects, and the value of the dependent variable level at baseline. Standard errors clustered at the district and school level are reported in parentheses. Stars denote significance levels (* 10%; ** 5%; *** 1%). Dags denote statistical difference (‡ 10%, ‡‡ 5%, ‡ ‡ ‡ 1%) of parameters between groups.