Fundación Sergio Paiz Andrade

Evaluation Report

Assessing the use of technology and Khan Academy to improve educational outcomes in Sacatepéquez, Guatemala

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Table of Contents

EXECUTIVE SUMMARY

This report presents the results of an independent evaluation of the Sergio Paiz Andrade Foundation's (Funsepa) pilot program in Sacatepéquez. The pilot aimed to take an innovative approach to Funsepa's traditional programming and enhance student academic performance in mathematics. Specifically, Funsepa wanted to test the benefits of incorporating Khan Academy's tools, which include online and offline resources such as practical exercises, instructional videos, and a self-paced learning dashboard, into the organization's existing programs (i.e. computer labs and teacher training).

The foundation also aimed to understand whether the use of Khan Academy with different technologies (computers and tablets) and Internet connectivity had a differentiated effect on academic performance. The evaluation specifically tested four sub-interventions that made up the pilot: 1) schools with 16-computer labs with Khan Academy (with and without Internet); 2) schools with 30-computer labs and Khan Academy (with and without Internet); 3) tablets and Khan Academy (without Internet);[1] and 4) one-Endless Mobile computer[2] and Khan Academy (with and without Internet).

Funsepa hired MANAUS, a third-party evaluation consulting firm, to perform an external evaluation on the pilot. MANAUS utilized a quasi-experimental design that combined both quantitative and qualitative methods. This approach incorporated quantitative data, gathered through surveys and standardized math exams, along with qualitative information, gathered through focus group discussions. It also employed data extracted from the Khan Academy platforms to understand how students used this tool. This mixed-method strategy allowed the evaluation team to gain a holistic understanding of the pilot's benefits to academic performance.

The assessment used three evaluation groups comprising 30 schools: 1) the pilot intervention group, including 14 schools with the sub-interventions described above (technology and Khan Academy, with/without Internet); 2) the Funsepa group, comprising six Funsepa schools that received its traditional program (technology and teacher training, but not Khan Academy); and 3) a comparison group of 10 schools with no access to technology or Khan Academy. To determine whether the pilot intervention produces higher student math outcomes than Funsepa's traditional program, the evaluation compared the scores of students in the pilot intervention group and in the Funsepa group, separately, against those of students in the comparison group.

Funsepa

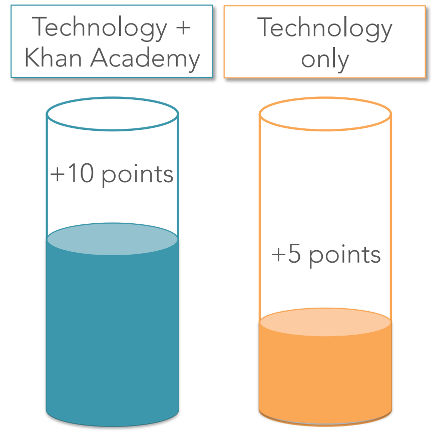
Funsepa is a nonprofit organization that supports the use of technology as a tool for improving education to contribute to the social and economic development of Guatemala. FUNSEPA's core program, *Tecnología para Educar* (TPE), focuses on the provision of computer equipment to public schools and teacher training to complement traditional methods of teaching.

[1] Funsepa rolled out the tablets sub-intervention using only the offline platform (KA Lite) because the operating system of the tablets did not support the online platform.

[2] Endless Mobile is an organization that provides computers that utilize a Linux-based operating system that can be plugged into an affordable monitor and keyboard, creating an inexpensive and user-friendly desktop environment. Given its potential cost-effectiveness, Funsepa wanted to explore the effect of using Endless Mobile as part of the different technology combinations of the pilot intervention.

The evaluation found that **combining technology with Khan Academy produces a higher positive effect on student math performance than the traditional Funsepa intervention**. Relative to the comparison group, the pilot intervention leads to an average increase of 10 points in math scores, out of a maximum possible score of 100 points, which is double the increase of five points produced by Funsepa's traditional program.

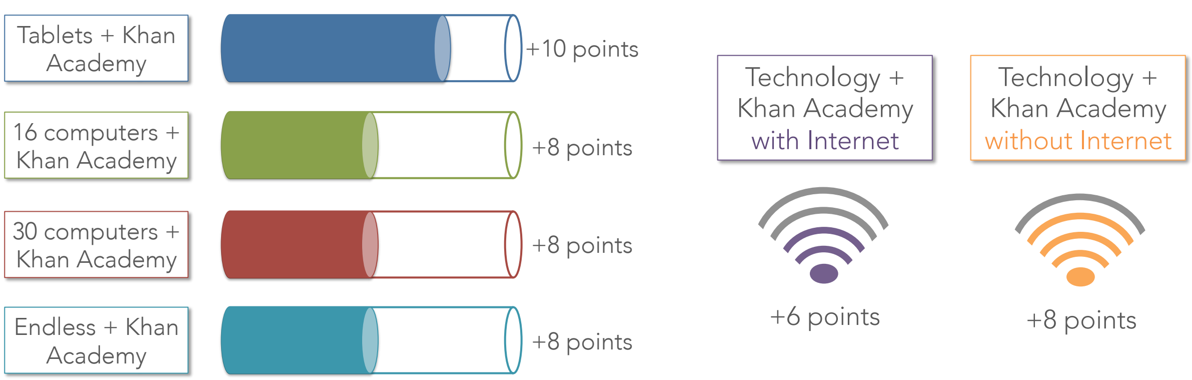
The evaluation arrived at these findings by controlling for other factors that could have an influence on academic performance, such as gender, socioeconomic status, class size, teacher's math score, grade repetition, availability of computers or tablets at home, and frequency and time of technology use at school, among other factors.



Statistically significant results

When comparing the different sub-interventions against the comparison group, the evaluation found that **the provision of tablets and Khan Academy has a larger effect on student math performance than the other sub-interventions.** On average, the combination of tablets with Khan Academy leads to a 10-point increase in math scores, while the use of computers with Khan Academy leads to an average increase of eight points.

In terms of Internet connectivity, the study found that sub-interventions with no Internet produced a larger effect on math scores, an eight-point increase, than sub-interventions with Internet, a six-point increase, when compared to the comparison group. However, schools in the sub-interventions with Internet faced challenges with the Internet connection. It is thus possible that these sub-interventions may have led to higher math outcomes if the Internet connection had been reliable throughout the implementation of the pilot.



Results for the sub-interventions and for internet connectivity are statistically significant and controlled for factors such as gender, socioeconomic status, class size, teacher's math score, grade repetition, having technology at home, frequency of technology use at school, and exposure to the interventions.

Discussion on Impact Size

The results shown above reflect the benefits of the pilot intervention as it was implemented on the ground. However, the combination of computers and tablets and Khan Academy may have an even larger potential impact on academic performance. The evaluation identified various elements that possibly hindered a more successful integration of Khan Academy into traditional instruction, which can help Funsepa and other organizations better implement and scale similar interventions in the future:

- **Limited exposure to Khan Academy.** Students generally used the technology at school one to two times a week for less than one hour at a time and had little to no access to technology outside of the school. Limited access to the technology consequently constraints exposure to Khan Academy.
- **Inadequate computer lab size.** With the exception of the tablet sub-intervention, the number of computers provided to schools was usually based on average class size. This approach does not consider the number of classrooms in a school and so it inadequately estimates the number of hours students can be exposed to the computer. For instance, one school in the evaluation sample has an average class size of 32 students, which makes the provision of a 30-computer lab reasonable. However, the school has eight third grade and seven sixth grade sections, which limits the time students are exposed to the computer and Khan Academy.
- **Unreliable Internet connection.** Schools that used the online platform experienced significant issues with the Internet connection, which caused inconsistent exposure to Khan Academy, limiting its benefits on student academic performance.
- **Restricted use of Khan Academy.** Teachers generally restricted what students could do on Khan Academy. One of the advantages of Khan Academy is precisely that students can self-pace their learning process, so that they can spend more time on concepts that are difficult for them and move faster on concepts that are easier. This restriction reduces the benefits of the platforms.

Recommendations

Funsepa should make scaling-related decisions by weighing three key factors: the characteristics of the school, primarily its size and number of classrooms; the average cost of implementation of the selected sub-intervention; and the actual capacity of Funsepa to scale the selected sub-intervention as it was implemented for the pilot or with an enhanced design (e.g. a greater number of computers or tablets). This will ensure that the selected sub-intervention produces, at a minimum, the effects on math scores reported in this study.

Based on Internet reliability, along with the overall infrastructural and financial challenges of public schools in Guatemala, Funsepa should use the offline platform as the default set-up for its program. Where exceptional infrastructure and Internet connection exist, Funsepa can provide computers or tablets along with the online platform.

Funsepa must ensure that the number of computers is proportional to both classroom size and school size, so that students can work individually with the technology and be sufficiently exposed to Khan Academy. Further, the foundation should estimate the sizes and number of computer labs assuming that students will work with the technology at least twice a week for one hour at a time.

Funsepa should carry out additional and more regular teacher trainings, beyond the initial introduction to Khan Academy, to ensure that teachers are constantly supported and guided on how best to integrate Khan Academy in their teaching. Additional training can also serve as a monitoring tool to make sure teachers do not restrict how students use the platforms.

INTRODUCTION

Funsepa's pilot intervention in Sacatepéquez integrated the use of technology, Internet access and digital content from Khan Academy, an open educational platform, into classroom instruction. With this pilot, Funsepa aimed to enhance student learning and academic performance in mathematics among primary school students. The evaluation sought to assess the extent to which the pilot intervention contributed to improve math achievement among students, as well as to gauge differences in math scores across the various technology and Internet connectivity combinations employed in the pilot program. The evaluation ultimately aimed to identify the best strategy for Funsepa to improve student educational achievement through its programs. To this end, the study utilized a quasi-experimental methodology that combined quantitative and qualitative techniques to measure the benefits of the pilot.

This report is organized into five sections. The first section provides a background of the study, including an overview of Funsepa as well as a description of Khan Academy and the pilot project in Sacatepéquez. The second section outlines the evaluation methodology used to assess the implementation and results of the pilot project. It details both the quantitative and qualitative approaches along with a description of the sampling technique and data collection tools used. This section also outlines the data analysis strategy utilized and the methodological limitations of the study.

The third section presents the major findings of the evaluation, starting with an overview of student and teacher characteristics. It later provides findings on the overall impact of the pilot intervention, as well as results across the different technology combinations, with and without Internet. This section concludes with a discussion of the benefits of the pilot intervention and its cost-effectiveness, elaborating on the implications of results for scaling up purposes. Finally, drawing from these findings, the fourth and fifth sections present the main conclusions of the study and provide Funsepa with a set of recommendations to inform future programming.

The Sergio Paiz Andrade Foundation

The Sergio Paiz Andrade Foundation (Funsepa) is a nonprofit organization established in 2004 with the mission of contributing to the social and economic development of Guatemala through the use of technology as a tool to improve education. Funsepa was created in memory of Guatemalan businessman Sergio A. Paiz Andrade, who worked for the sustainable development of the country using technology and education as key instruments.

Funsepa implements its activities through a core program, *Tecnología para Educar* (TPE). TPE provides computers to public schools in Guatemala as well as training to public school teachers in the use of computers and their effective incorporation into traditional teaching methods. After ten years of demonstrated success, Funsepa sought to augment its core program with a platform to support student learning in mathematics. The organization turned to the Khan Academy and KA Lite platforms as innovative tools to improve student engagement and achievement in this critical subject area.

Khan Academy

Khan Academy is a nonprofit organization that provides free digital educational materials online. Its resources include practical exercises, instructional videos and a personalized learning dashboard that allows students to study at their own pace in and out of the classroom. Educational tools are offered in math, science, and computer programming, as well as other subjects. Specifically, math 'missions' guide students through different mathematic concepts using an adaptive system that identifies the individual's strengths and learning gaps.

Learning Equality

In cases where Internet access is not available, users can employ KA Lite, an open-source software platform that makes Khan Academy's videos and exercises available on offline devices. KA Lite, created and maintained by the nonprofit organization Learning Equality, has been widely deployed in developing communities around the world.[3]

Endless Mobile

Endless Mobile is an organization that provides affordable access to technology worldwide. Endless utilizes a Linux-based operating system that can be plugged into an affordable monitor and keyboard, creating an inexpensive and user-friendly desktop environment. Endless is an application-based operating system tailored to meet the needs of its target audience, those around the world who currently cannot afford technology.[4] Given the potential cost-benefits of and the donation of computers from Endless Mobile at the time of the pilot design, Funsepa wanted to leverage the evaluation and explore the effect of using Endless Mobile as part of the different technology combinations in the pilot.

Pilot Project in Sacatepéquez

In 2012, results from an independent evaluation of Funsepa's programming found that the academic performance of students in schools that received the foundation's core program was better than that of students in schools without Funsepa's programming.[6] Schools that received both computer labs and training for their teachers saw additional positive effects on academic performance, such as reduced dropout rates and an increased likelihood that students would pass on to the following grade.

Given the demonstrated success of its core program, Funsepa sought to test an innovative approach to its programming that combines the use of technology, Internet connection and access to open educational material offered by Khan Academy and KA Lite. By piloting this augmented intervention, Funsepa created a unique opportunity to understand how educational technology affects student performance, as well as to assess which types of technology provide the most added value in terms of student engagement and academic achievement.

Funsepa implemented the pilot in 14 randomly selected schools, with each school receiving access to Khan Academy, through the online or offline platforms, along with different combinations of technology and Internet access. All grades in each school participated in the pilot intervention, reaching over 3,600 students. To minimize the costs associated with data collection activities, the evaluation sampled a

[3] Additional information can be found on https://www.khanacademy.org and https://learningequality.org/ka-lite/.

[4] Sources: Endless Mobile's (https://endlessm.com) and external interview with Endless Mobile's CEO (https://endlessm.com/press/).

Funsepa's servers also include complementary content, such as World Possible's RACHEL Offline. World Possible is a nonprofit organization that supports the development of RACHEL Offline, a tool that provides offline communities worldwide with access to a high-quality, digital education. Like a copy machine for books, RACHEL Offline content is a copy machine for websites. It includes educational material such as an encyclopedia and video lectures from KA Lite. By making copies of websites available for free download and physical transport to offline communities, RACHEL Offline enables a wide variety of educational content to be physically delivered in digital form to communities that do not have Internet access. For more information, please visit http://worldpossible.org and http://racheloffline.org.

[6] In 2010, Funsepa commissioned MANAUS Consulting to conduct the evaluation of its core programs. More information on the findings of this evaluation can be found in document: FUNSEPA Monitoring and Evaluation Final Report, July 2012.

subset of these students, as detailed in the Methodology section of this report. Table 1 illustrates the different intervention combinations.

Table 1. Funsepa's pilot intervention by subgroups

Pilot sub-interventions	With Internet (Khan Academy)	Without Internet (KA Lite)	Total schools in subgroup
16 Funsepa computers + Khan Academy This subgroup includes students in schools that were provided a 16-computer lab with access to the online or offline Khan Academy platforms.	1	2	3
30 Funsepa computers + Khan Academy This subgroup includes students in schools that were provided a 30-computer lab with access to the online or offline Khan Academy platforms.	2	2	4
Tablets + KA Lite This subgroup includes students in schools that were provided with one tablet per student in each classroom with access to the offline KA Lite platform.	N/A**	3	3
1-Endless Mobile computer + Khan Academy This subgroup includes students in schools with one Endless computer in each classroom with access to the online or offline Khan Academy platforms.	2	2	4

** Funsepa rolled out the tablets subgroup using only the offline platform because the operating system of the tablets did not support the online platform.

It is important to mention that the evaluation team originally selected 16 schools at random to be part of the different pilot subgroups, but due to implementation constraints, some schools were later excluded from the pilot. Annex 1 provides more information on the changes to the original sampling strategy.

The pilot began in April 2014 and incorporated both the provision of technology and teacher training. Funsepa matched Khan Academy's content with the Guatemala's National Base Curriculum standards to guide teachers in the integration of teaching tools and topics equivalent to their class level and curriculum.

EVALUATION METHODOLOGY

The evaluation of the pilot program aimed to quantify the benefits of the integration of Khan Academy with technology and teacher training on student math performance and, more specifically, to identify the most effective combinations to inform Funsepa's strategy to scale specific interventions. Each evaluation sub-intervention was compared against the comparison group to determine the overall benefit, as well as the comparative benefits of computers, tablets and Endless Mobile technologies.

Methodology

The evaluation utilized a quasi-experimental design that combined quantitative and qualitative methods to measure the effect of the pilot intervention on students' math achievement. The mixed-method approach specifically incorporated quantitative data, gathered through surveys and standardized math exams, along with qualitative data, gathered through focus group discussions. The evaluation also used data extracted from the Khan Academy and KA Lite platforms to better understand how students used these tools. This mixed-method strategy allowed the evaluation team to gain a holistic understanding of the pilot's benefits by giving context to quantitative findings to explain overall results.

Quantitative Component

The quantitative approach utilized standardized math tests and structured, face-to-face surveys with students to assess the pilot's effect on student achievement. Within all 30 schools that participated in the study, the evaluation tested and surveyed third- and sixth-grade students at the beginning and end of the implementation of the pilot.

Sampling

The study employed a two-stage randomization strategy to select the evaluation sample. In the first stage, the evaluation team randomly selected schools into each of the evaluation groups. In the second stage, evaluators selected students at random within the schools for data collection.

At the school level, 14 schools were randomly selected from all public primary schools in Sacatepéquez that had no computer labs or access to any other technology to receive the pilot intervention. These 14 pilot schools were further subdivided into seven pilot subgroups to receive computers, tablets or Endless Mobile computers, and different modalities of access to Khan Academy (online or offline). Ten schools were similarly selected to receive no technology or access to Khan Academy and served as the comparison group. Six schools received Funsepa's core program, TPE, but did not have access to Khan Academy (hereinafter referred to as the Funsepa group). These six schools were randomly selected from among schools that had recently received Funsepa's core program (Table 2).[7]

It is important to note that the evaluation team originally sampled 33 schools, but due to on-the-ground constraints faced during implementation of the pilot, Funsepa excluded three schools from the pilot intervention. Annex 1 provides more information on the changes to the original sampling strategy.

At the student level, the sample included students from the third and sixth grades only to reduce evaluation costs and to minimize school disruption at the time of data collection. The evaluation team

[7] The six schools in the Funsepa group received the TPE program between June 2012 and December 2013.

calculated sample sizes based on a 95% confidence level[8] to arrive at a statistically representative sample. The team then randomly selected students from the class rosters to be surveyed and tested. The desired sample of students per school was evenly distributed across grades. Where there was more than one section per grade, the target school sample was divided accordingly across classrooms. Annex 2 describes in detail the strategy for the random selection of schools and students.

Figures in Table 2 show the sample originally drawn for the evaluation and not the actual sample collected. After data collection activities, the final sample included 2,356 students: 1,146 interviewed and tested at baseline and 1,210 interviewed and tested at endline. Though the evaluation intended to interview and test the same students at baseline and endline, delays in the implementation of the pilot intervention prevented the evaluation team from polling the same students at endline. The evaluation instead randomly selected different third and sixth graders from the same schools at endline.[9]

Table 2. Evaluation Groups

Evaluation Group		Desired Sample	
		Schools	Students
Pilot Intervention	**Technology + Khan Academy** This group included students in schools that had some type of technology (computers or tablets) with access to either the online Khan Academy platform or the offline KA Lite platform.	14	480
Funsepa	**16-Funsepa computer lab (no Khan Academy)** This group included students in schools that received the TPE program (i.e. 16-computer lab and teacher training) but that did not have access to the Khan Academy platforms.	6	420
Comparison	**Nothing (no technology or Khan Academy)** This group included students in schools that did not have access to technology nor Khan Academy.	10	420
TOTAL	**3 evaluation groups**	**30**	**1,320**[10]

Math Test

To gauge changes in students' math performance, the evaluation utilized standardized tests comprised of 30 questions. The Ministry of Education's National Base Curriculum standards for math evaluation rigorously guided the design of the standardized math exams for each grade. The exams specifically evaluated four cognitive areas and 10 math topics (Figures 1 and 2). Students had 60 minutes to complete all components of the test. In addition, a standardized test for teachers, with a similar format and content of that of the student tests, served as a control for how teachers' mastery of math concepts could affect student outcomes. The evaluation team administered the standardized tests on

[8] A 95% confidence level means that we can be 95% certain that the answer observed in the study sample accurately represents that of the true population.
[9] Evaluators compared demographic characteristics between students at baseline and endline and ensured they were statistically comparable.
[10] The desired sample size for findings to be statistically representative of the total population of students in Sacatepéquez is 1,200 students. This number oversamples students by 10% to account for potential attrition.

students and teachers both at baseline and endline.[11] Final scores, originally based on a maximum of 30 points, were scaled to 0-100 points to facilitate the interpretation of results.[12]

Figure 1. Number of questions per math topic assessed by the standardized exams

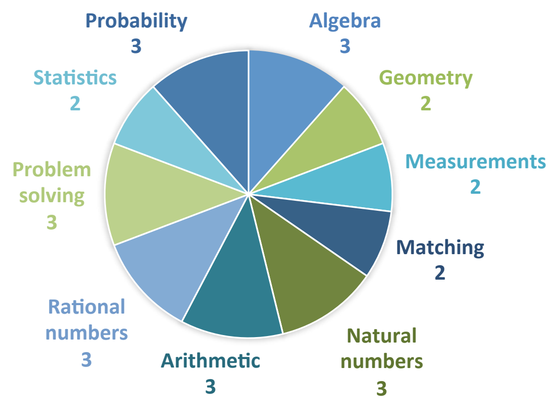
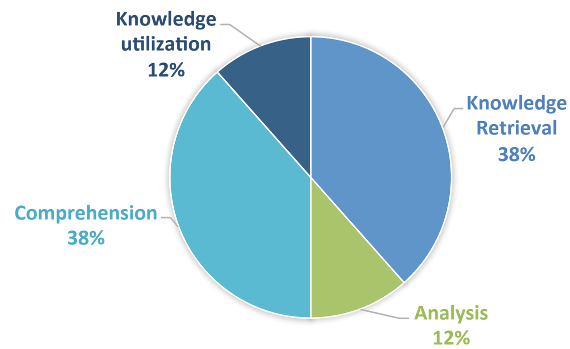


Figure 2. Proportion of cognitive areas assessed by the standardized exams



Student Survey

The evaluation also employed a structured, face-to-face survey with students. The survey collected demographic information and household characteristics from each student. It also asked students about their experiences with technology inside and outside of school. The purpose of collecting this data was to understand how the demographic characteristics of students and their households, as well as their experiences with technology, could affect their performance in the classroom. To determine socioeconomic status, the evaluation used the Progress out of Poverty Index developed by the Grameen Foundation for Guatemala. Annex 3 provides detailed information on this index.

The enumeration team deployed the survey using mobile phones through Magpi, an open access platform that collects data in real-time via mobile technology.[13] Survey questions were entered into Magpi and uploaded to mobile phones used by the enumerators. This allowed the evaluation team to receive survey data in real time as soon as enumerators administered the surveys.

Annex 4 includes the complete student survey utilized for the study.

Qualitative Component

The qualitative approach aimed to gather contextual information about the achievements and challenges experienced throughout the implementation of the pilot to help explain the quantitative findings. The qualitative component employed two main data collection techniques: desk review and focus group discussions with teachers.

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[11] The evaluation only gave math tests to classroom teachers, as they were usually the ones taking students to the computer lab to work with Khan Academy. In very few cases, the school employed a computer lab teacher who was different than the classroom teacher and who was not tested.
[12] Cronbach Alpha reliability coefficients: 3rd grade test α = 0.9442; 6th grade test α = 0.8856; teacher test α = 0.9427.
[13] For more information, please visit www.magpi.com.

Desk review

MANAUS conducted extensive literature review on Khan Academy and similar interventions for student learning. The goal of the desk review was to understand the impact of educational technology on student academic performance to inform the design and evaluation of Funsepa's pilot intervention in Sacatepéquez.

The desk review found various studies on interventions implemented in both developed and developing countries. While these studies did not always demonstrate the quantitative effect of the interventions, as most were generally qualitative in nature, they provided important methodological findings on the effects of educational technology interventions on student performance. The studies particularly emphasized the importance of teacher training to incorporate digital content and technology into daily classroom activities.

While the adoption of technology in education is a relatively nascent phenomenon, a vast number of educational technology interventions are being implemented in developing countries. Consequently, there is little documentation about their results and this evaluation aims to add to the available literature on the effectiveness and challenges of this type of interventions.

Focus group discussions

The evaluation team implemented a series of focus group discussions (FGDs) with primary school teachers in intervention schools at endline to better understand teachers' perspectives and experiences integrating technology into their curricula. Specifically, the FGDs aimed to gather teachers' opinions on the advantages and challenges of integrating this technology into traditional teaching methods. To guide the FGDs, the evaluation team developed a protocol with key questions to cover during the discussions. The evaluation team held a total of four FGDs, one for each sub-intervention (i.e. Khan Academy with 16 computers, 30 computers, tablets, and Endless Mobile computers). Each group included teachers from schools with and without Internet access. A total of 36 teachers participated in the focus groups. Annex 5 includes a copy of the FGD protocol.

Other data sources

In addition to the data collected through the research tools designed for the evaluation, namely the student survey, math exam, desk review and focus groups, the evaluation team also employed other data sources to complement key findings and gain a holistic understanding of the overall impact of Funsepa's pilot in Sacatepéquez. Additional data sources included a teacher survey and data extracted from the Khan Academy platforms.

Teacher Survey

The evaluation employed a structured survey targeted at teachers to collect demographic information, such as age, gender, education level and years working as teacher, among others. The survey also asked teachers how they use the technology available at school and whether they received any training on technology use, math or Khan Academy in the past 12 months. The survey included 11 questions that were placed at the beginning of the math test. The evaluation team administered the teacher survey only at endline to gain a broader understanding of teachers' background and how they utilize the school technology. The survey was not intended to collect teachers' demographic characteristics and use these as control variables in the analysis, as the literature review indicated that such characteristics are not determinants of student performance. Annex 6 shows the questions included as part of this survey.

Khan Academy Data

Funsepa provided the evaluation team with data from the Khan Academy online and offline platforms. The analysis of this data aimed to provide insight on how students use the platforms. The datasets included information such as time spent on the platform, points achieved and exercises completed, among others. It is worth noting that these datasets included all students for whom accounts existed, regardless of whether these students were in the evaluation sample or not. For the purpose of this study, the analysis of this data only included students in third and sixth grades. The dataset from the offline platform covered six months of platform use, February-July 2015, and the dataset from the online platform covered approximately two academic years, from February 2014 to September 2015.

Interviewee Consent and Confidentiality Protection

Interviewees' participation in the evaluation was voluntary and data collectors were required to obtain verbal consent from all stakeholders prior to any data collection or evaluation activity. The evaluation team diligently communicated to all interviewees the purpose of the evaluation, the voluntary nature of their participation and how the information would be used. All information provided by interviewees, whether individually or in groups, will be kept strictly confidential and only aggregate data is presented in this evaluation report.

Data Analysis

The information collected through primary and secondary sources was systematically analyzed to arrive at the findings presented in this report. Data from standardized tests and demographic surveys was analyzed using Stata, a statistical analysis software. The main analysis evaluated the overall impact on student achievement by measuring the statistical difference between students in intervention schools and students in comparison schools on the average standardized test score across time. In addition, the evaluation analyzed differences in test outcomes among intervention subgroups to provide Funsepa with a good understanding of which sub-intervention leads to the greatest increase in math scores.

Regarding the quantitative data analysis, the evaluation team conducted a multivariate regression analysis to estimate the difference in differences—i.e. difference between evaluation groups across time—and gauge the effect of receiving the pilot intervention on math performance. The analysis was conducted in stages to examine changes in core coefficients as control variables were added or removed from the regression specification. The evaluation team explored two approaches to analyze the standardized test results:

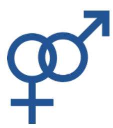
- **Model using total raw scores:** This model used the total scores achieved by students in the standardized math test as the dependent variable. A limitation of this approach is that it compares scores equally and not based on the relative difficulty of each question included in the math exam. As such, student performance is assessed based on total number of questions answered correctly, regardless of their difficulty level.
- **Model using standardized scores calculated with a joint maximum likelihood (JML) estimator:** The JML estimator identifies the relative difficulty of questions correctly answered

by students and produces standardized scores (z-scores) based on such relative difficulty. Through this method, a student who correctly answered 10 hard questions received a higher final score than a student who correctly answered 10 easy questions.

As shown in Annex 7, both models led to similar results and statistical significance levels. To score the exams, enumerators first manually graded each question, counted the total number of correct answers and wrote that number (total score) on the cover of the exam. They later entered the score of each individual question (i.e. whether the answer was correct, incorrect, or unanswered) and, separately, the total score written on the cover. The evaluation team found that, for approximately 250 students, the total score did not match the sum of points of the individual questions. The team also found that the total scores were generally accurate whereas enumerators made mistakes when entering the scores for individual questions. Because the total score was more reliable than the individual question scores and given that the two approaches produced similar results, the findings shown in this evaluation report are based on the first approach, the model estimating student performance based on the total raw scores.

Control Variables

The evaluation controlled for a series of factors that can influence academic performance beyond receiving the pilot intervention. The evaluation generally controlled for the following factors:

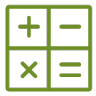


Gender. This variable controls for whether the student is a female or a male. Some studies have found that gender importantly explains variances in academic achievement, reporting significant differences between male and female student performance in subjects like science and math (DeBaz, 1994; LoGerfo, Nichols, and Chaplin, 2006; Guiso et al., 2008; Bedard and Cho, 2010, Niederle and Vesterlund, 2010).

Class Size. This variable controls for the number of students in the classroom of each student in a given year. Research shows that smaller classes result in a higher level of student academic performance (Hou, 1994; Franklin et. al., 1991; Goldfinch, 1996; Vanderberg, 2012). Other studies found that small classes also have a positive effect on factors beyond academic performance, such as student retention (Lopus & Maxwell, 1995).

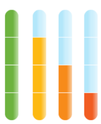
Household socioeconomic status. This variable controls for the socioeconomic characteristics of the household of the student, as measured by the Progress out of Poverty Index (PPI). The PPI is a poverty measurement tool that scores answers to 10 simple questions on household characteristics and asset ownership to compute the likelihood that those in the household are living below the poverty line (Annex 3). Children from low socioeconomic households develop academic skills more slowly than children in higher socioeconomic groups (Morgan, Farkas, Hillemeier & Maczuga, 2009). Socioeconomic level has also been identified as a cause of the "digital divide," the gap between students who have access to digital technology and students who do not (Mason & Dodds, 2005).

Availability of technology at home. This variable controls for whether students are exposed to computers or tablets at home. Past research has found a positive association between technology usage and academic performance in math and science (Fletcher, 2003; Galuszka, 2007). Thus, students who have access to technology at home are more likely to benefit from the use of the intervention technology and Khan Academy, as they may be more confortable working with technology in general.



Favorite subject at school. This variable controls for whether math is the subject that student likes the most. Students who like math are more likely to perform better in the subject (Raza & Shah, 2011; Schenkel, 2009; Waxman & Houston, 2012). It is also possible that students who like math may take more advantage of the use of the Khan Academy platforms than students who prefer other subjects.

Grade repetition. This variable controls for whether the student has repeated any grade at least once. Available literature shows that grade repetition can have important effects on academic achievement, including long-term implications associated with grade-repeaters eventually falling further behind. Research has found that grade repetition has adverse effects on student self-esteem, peer relationships and attitudes towards school. Grade repetition also has negative effects at the school level, as high levels of grade repetition can lead to increased class sizes and classroom management problems due to large age differences among pupils in the same classroom (UNESCO, 2006).



Length of exposure to intervention. This variable controls for the number of months that the school and its students have been exposed to the pilot intervention, as the different pilot sub-interventions did not all start at the same time. Students in schools where Funsepa rolled out the pilot intervention earlier are more likely to have benefited from it more and hence, have higher academic performances than students in schools where the pilot intervention was introduced later.

Frequency and time of technology use. This variable controls for how often (days per week) the student used the technology and the time (in hours) s/he spends working with the technology and Khan Academy. Students who spend little time working with the technology and Khan Academy are more likely to underperform in math than students who work with it more frequently or for longer time. The analysis included this control variable in the form of an interaction between frequency and time.

Teacher's math performance. This variable controls for the performance of teachers on the standardized math exam, as a proxy for teacher quality. Students in classrooms with teachers who demonstrate subpar knowledge of primary education level math content are more likely to perform poorly in the math test. Research has found that when it comes to performance on reading and math tests, a teacher has two to three times the impact of any other school factor, including services and facilities. Evidence also suggests that a teacher's impact on student achievement remains consistent even if the teacher changes schools and regardless of whether the new school is less advantaged than the old one (Rand, 2012).

NOTE: Variables *age* and *grade* were highly correlated (0.8131). Controlling for both variables generally made standard errors larger, making the model less precise. For this reason, the model was run using both variables together and also separately to choose the best model. The evaluation team ultimately decided to use the model that only includes *age* to report findings.

Annex 8 provides a more detailed description of the variables used for the analysis.

Methodological Limitations

Quasi-experimental studies and the difference-in-differences statistical analysis technique are among the most rigorous research methods for program evaluations. Nonetheless, the methodological and logistical limitations outlined below can affect the validity of the findings presented in this report:

The design and implementation of the pilot sub-interventions varied significantly in terms of level of access to the technology. Because school administrators typically assign visits to and time in the computer lab evenly among all grades in the school, access to the technology is more limited for students in the 16- and 30-computer lab sub-interventions. In contrast, the tablets and Endless Mobile sub-interventions are less affected by this issue because the technology was usually available within the classroom and, for the pilot intervention, it was generally available for the exclusive use of third and sixth graders (i.e. no need to share computers and tablets with the rest of the school). The design of the tablets sub-intervention also differs in that each student received his/her own device. For instance, teachers in schools with tablets and Endless Mobile said students sometimes used computers/tablets during their breaks or during classes other than math when students had already completed other assignments. Given these differences in the design and implementation of each of the different sub-interventions, the findings of the evaluation may be misestimating the real effect on academic performance of specific technology combinations.

Schools in the Funsepa group had been exposed to the technology before schools in the pilot intervention. Evaluators randomly selected six schools into the Funsepa group from a list of schools that had received Funsepa's TPE program. These schools received computer labs between June 2012 and December 2013, approximately six months earlier than the schools in the pilot group. The computers provided as part of the TPE program included a very simple program with math exercises. This program differs significantly from Khan Academy, as it is not self-paced, it does not provide individualized assessments of student performance, the math content is more limited, and explanations of concepts and performance rewards are not delivered interactively. Regardless of this, students in the Funsepa group may have benefitted from being exposed to the computers and this basic math program for a longer time.

Schools in the Funsepa group may have different characteristics than schools in the intervention and comparison groups. Schools in the Funsepa group had to submit an application to participate in TPE. This means schools in this group chose to receive computer labs and teacher training. In contrast, schools in the pilot and comparison groups were selected fully at random, regardless of whether they had a previous interest in receiving Funsepa's program or not. Because of this, schools in the Funsepa group may have characteristics that differ significantly from schools in the pilot and comparison groups, such as better administrators who understand the benefits of technology for education. Though these issues do not affect the estimation of the effect of using Khan Academy on the math performance of students in the pilot group, as these estimations are derived from comparing the pilot group with the comparison group (and not the Funsepa group), any comparisons between the effect of the pilot intervention and that of Funsepa's traditional program should be interpreted cautiously.

School size varied importantly across sub-interventions, affecting the degree of exposure to Khan Academy. Though the evaluation randomly selected schools into the different sub-intervention groups, Funsepa modified the subsample of schools allocated to the tablets and Endless Mobile subgroups due to logistical issues and implementation costs. Schools in the computer sub-interventions are significantly larger than in the other sub-interventions, in particular, the tablets sub-intervention, as shown in the table below. Specific characteristics associated with school size—such as school management or school principals' capacity to closely oversee student progress—can also have an effect on student academic performance and the evaluation did not control for such characteristics. This means that the findings of the study may be misestimating the real effect of the different sub-interventions on math performance.

Pilot sub-intervention	School Size (# of students in primary level)				Class Size (# of students in 3rd and 6th grade)			
	Mean	Min.	Max.	p-value*	Mean	Min.	Max.	p-value*
16 computers	259	94	533	<0.001	29	9	43	<0.001
30 computers	518	110	804		31	21	43	
Tablets	88	70	110		13	9	21	
Endless	237	50	440		27	12	43	

** p-values for the difference in mean sizes across pilot sub-interventions.*

The quality of the Internet connection varied significantly across the sub-interventions that combined technology and the online Khan Academy platform. Sub-interventions incorporating Internet faced significant challenges during the implementation phase. Given the overall infrastructural challenges in Guatemala, Funsepa had difficulties installing Internet in the schools randomly selected into this subgroup. In focus group discussions with teachers, a common constraint mentioned was the unreliability and lack of speed of the Internet connection, without which these students could not use Khan Academy. Teachers reported that issues with the Internet connection were relatively frequent and some indicated that their students were unable to use Khan Academy for up to a month. As such, the findings of the evaluation may be underestimating the effect the online Khan Academy platform could have on student math performance had the Internet connection been consistent across sub-interventions and students had not experienced interruptions in their exposure to the platform.

The use of teacher performance on the standardized math exam provides a limited indicator to assess teacher quality. The evaluation tested teachers' math knowledge as a proxy for teacher competency. However, quality of teaching involves many teacher characteristics beyond content knowledge. Recent research indicates the best way to assess teachers' effectiveness is to look at their on-the-job performance, specifically what they do in the classroom, regardless of where they went to school, whether they are licensed or how long they have taught for (Rand, 2012). Though teachers' math knowledge is correlated with their effectiveness in teaching math and controlling for it is better than not controlling for any teacher characteristic, the evaluation may be misestimating the pilot intervention's effect by only controlling for teachers' knowledge of the math content.

EVALUATION FINDINGS

This section presents the overarching findings of the evaluation. Student results are based on a final sample of 2,356 students: 1,146 interviewed and tested at baseline and 1,210 interviewed and tested at endline.[14] In the case of teachers, findings are based on a sample of 206 teachers: 99 tested at endline and 107 surveyed and tested at endline. Annex 9 provides detailed information on the collected samples and the degree of comparability between the evaluation groups.

Student Characteristics and Use of Technology

On average, students are 11 years old and generally do not have access to computers or tablets at home (73%). Among those who do have technology at home, 33% said their parents do not know how to use the technology. The majority of students (91%) said they attended the same school the previous academic year. Nearly all students (99%) said they like school and over half (60%) said math is their favorite subject, followed by science (12%) and literature (8%). More than half of the students (60%) said they do not use computers or tablets outside of the school.

73% do not have technology at home

33% said their parents do not know how to use the technology

91% were enrolled in the same school the previous academic year

60% of students said math is their favorite subject

61% do not use technology outside of school

Among those who use technology outside of school, 54% said they mostly use it for playing games

Among students who said they use computers or tablets at school, more than half said they work with it one to two days a week (62%) and that they usually use the technology for less than an hour at a time (56%). The majority of students (84%) said the frequency and time of use of the technology at school is about the same from week to week. Over two-thirds of students (68%) said they work with the technology individually, while over a quarter (27%) said they share the technology with another student and the rest (5%) said they sometimes use it individually and sometimes share it with another student.

62% said that they use the technology available at school 1-2 days a week

56% said they normally use the technology at school for less than one hour at a time

84% said the frequency and time of technology use at school is about the same

27% share the technology available at school with another student

[14] As explained in the Methodology section, the desire sample for the evaluation was 1,320 students, including a 10% cushion to account for attrition. After data collection activities, the final sample included 2,356 students (1,146 at baseline and 1,210 at endline). Though the evaluation intended to interview and test the same students at baseline and endline, delays in the implementation of the pilot intervention prevented the evaluation team from using the same students at endline. The evaluation instead randomly selected different third and sixth graders from the same schools at endline.

More than half of the students (61%) said they use the technology at school for studying or completing school assignments, while over a third (34%) specifically mentioned using the technology at school to practice math. Most students (81%) said their teacher helps them when they are working with the technology, with the classroom teacher being the most commonly mentioned helper (51%) followed by the computer teacher (36%).

61% said they use the technology available at school for assignments or to study

34% said they use the technology available at school to practice math

81% said their teacher helps them with use of the technology at school

51% said the classroom teacher helps when they have questions while working with the technology

Student use of Khan Academy

This section presents a broad overview of how students used the Khan Academy platforms. The objective of analyzing the data extracted from the platforms was primarily to ensure that students had indeed used the platforms throughout the implementation of the pilot. However, the results presented below for each platform must be compared carefully as the platforms operate very differently. Results are presented at the aggregate level and not by sub-intervention because students often shared user accounts and disaggregated results at the student level could misestimate how students in each sub-intervention actually used the platforms.

The findings show that students spent 13 hours a month using the KA Lite (offline) platform and mastered[15] an average of 15 exercises per month. Students spent an average of seven hours on Khan Academy (online platform) and completed an average of 35 exercises a month (Table 3).

Table 3. Khan Academy Data – Descriptive Statistics

Statistics	KA Lite (N=618)	Khan Academy (N=746)
Average hours spent on the platform	13.30	7.00
Average number of exercises mastered	14.81	35.46

Though students who used the online version spent less time on the platform than students who used the offline version, students who used the online version appear at first glance to have completed more exercises. However, this is likely because the platforms work differently in terms of tracking student progress. In the focus groups, teachers mentioned that one drawback of the offline platform is that when students answer one exercise wrong, the platform takes them back to the beginning of the exercise set and erases all the exercises already answered.[16] This explains why students using the offline platform mastered fewer exercises than students who used the online platform even though the former spent more time using Khan Academy than the latter.

[15] Mastery Challenges mix a number of questions from different exercises already practiced by the student. Mastery is the highest level of exercise progress and the 'mastered' status means that the student has excelled in the practiced exercises.

[16] According to KA Lite developer, Learning Equality, the KA Lite version used in the study (version 0.12) requires users to get 10 out of the last 10 questions correct in order to complete an exercise. In newer versions, users only need to get eight out of 10 questions correct, making the platform more tolerant to occasional student errors.

Teacher Characteristics and Use of Technology

Teachers in the study have an average of 13 years of teaching experience, ranging from one to over 30 years. Among the 107 teachers surveyed at endline, the majority (89%) worked at the same school during the previous academic year. Teachers who said there was technology available at school mentioned there is an average of 16 computers or tablets available.

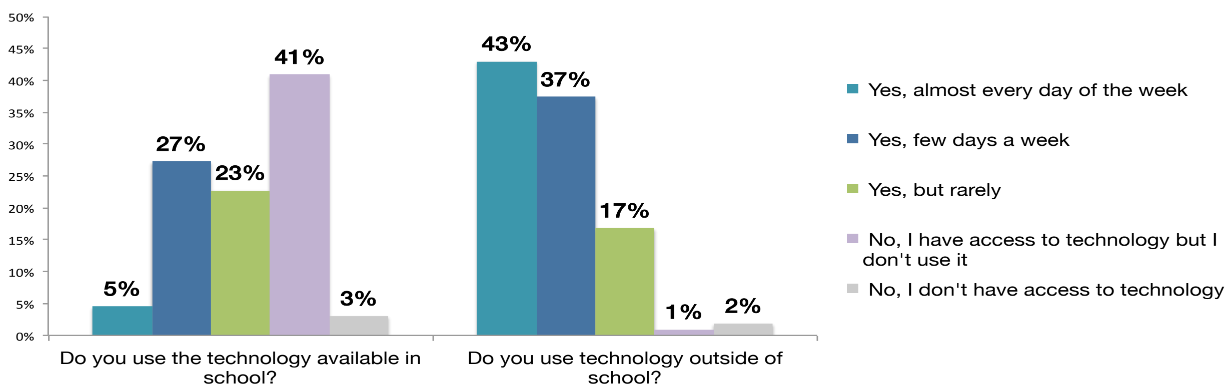
Teachers have, on average, 13 years of teaching experience

89% worked at the same school during the previous academic year

Teachers said they have an average of 16 computers or laptops available at school

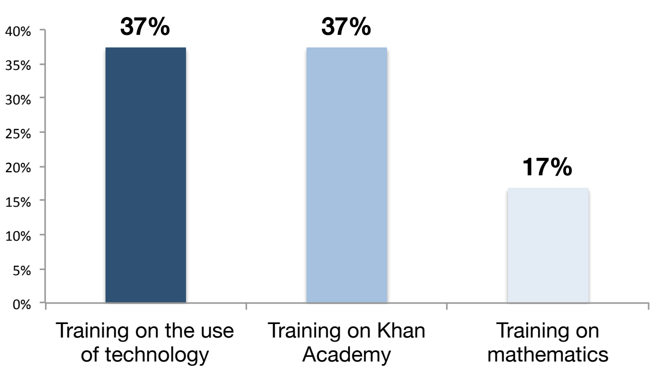
There is a higher tendency among teachers to use technology outside of the school than at the school. For instance, 43% of teachers said they use technology outside of school almost every day whereas 41% said they do not use the technology available at school.

Teachers' use of technology in and outside of the school



Among teachers who said they do use the technology available at school, 75% said they use the technology to reinforce content taught in the classroom, 61% use it to track the progress of their students and 44% said to use it to improve their own knowledge and teaching techniques.[17]

Teachers who received training in the current academic year



Slightly over a third of surveyed teachers (37%) said they received training on the use of technology and Khan Academy in the current academic year. In all of these cases, teachers mentioned Funsepa as the organization that provided the training.

A smaller proportion of teachers (17%) said they received math training in the current academic year, with 72% mentioning Funsepa as the organization providing the training while 22% said they received the training from another organization.

[17] These statistics were collected using a multiple selection question in which teachers could choose more than one answer; therefore, percentages do not add up to a 100%.

In terms of math performance, there was a wide variance in teachers' scores, with the lowest score at 18 points and the highest at 100 points, the maximum possible. Nonetheless, teachers generally scored low in the standardized test, with an average score of 64 points.[18] This average score underscores the poor preparation of teachers to instruct students.

Across evaluation groups, the difference in math scores for teachers between baseline and endline is small and statistically insignificant, which means that teachers obtained a similar average score at baseline and at endline. In contrast, students across evaluation groups generally increased their math score between baseline and endline, with students in the pilot group showing the largest increase in math scores (Table 4). In addition, the standard deviation of math scores of students in the pilot group decreased from baseline to endline, suggesting that the pilot also helped to close the gap between good and bad math performers (Annex 10).

Table 4. Teachers' and Students' Average Math Scores

Evaluation Group	Teacher Mean Math Score (0-100 points)			Total Teachers (N=205)	Student Mean Math Score (0-100 points)			Total Students (N=2,356)
	Total	Baseline	Endline		Total	Baseline	Endline	
Pilot	66	65	67	94	39	34	45	782
Funsepa	60	63	58	52	42	37	47	788
Comparison	65	66	65	59	37	33	41	786

Mean teacher scores are statistically similar across evaluation groups (p-value: 0.1081). The difference in mean teacher scores between baseline and endline is also statistically similar for all evaluation groups (p-values: Pilot 0.668; Funsepa 0.331; Comparison 0.797). Mean student scores are statistically different across evaluation groups and between baseline and endline (p-values: <0.001).

The following are the most relevant findings from the focus group discussions with teachers who participated in the different pilot sub-interventions:

Benefits of using technology and Khan Academy

- **Teachers found the Khan Academy platforms useful to reinforce in-classroom traditional teaching.** All teachers use Khan Academy as a tool to complement the concepts they teach in the classroom. In most cases, teachers first introduce students to a specific math concept on the board and then direct them to a specific set of exercises on the Khan Academy platform to supplement explanations and practice with the exercises available.
- **Students receive individualized feedback that contributes to higher levels of student engagement, peer interaction, and excitement about math.** Teachers believed that because students receive immediate feedback on their work when using Khan Academy, they have the opportunity to learn as they complete each exercise, as opposed to waiting to receive a graded homework or exam back from the teacher. All teachers believed this ability to track immediate individual progress led to increased student engagement and created positive competition and collaboration among students.

[18] Raw scores were based on a 0-30 point scale. These scores were later scaled to a 0-100 point scale to facilitate interpretation.

- **Teachers use the platform to reinforce their own knowledge and find alternative ways to explain math concepts.** Though lecture preparation varied across sub-interventions, with some teachers indicating they do not have enough time to prepare, teachers generally said they review the Khan Academy material before the class to better guide students to the exercises that best complement the math concepts they are learning. This helps teachers explore alternative and simpler ways of introducing students to specific math concepts.
- **Teachers found Khan Academy beneficial to identify areas in which students have difficulties.** Teachers said the platforms allow them to identify the concepts that are more challenging for a specific student, which gives them the opportunity to work one-on-one with the student and provide more tailored support.

Challenges of using technology and Khan Academy

- **Computer and user account sharing limits the benefits of the Khan Academy platforms.** Teachers explained that when classes are large, they often must pair up students to use the computers, which limits the amount of time each student has to practice math concepts. Some teachers mentioned that students occasionally have issues with their user accounts and they end up logging in with their classmate's account. This limits the teachers' ability to track individual progress and provide personalized support to students.
- **Some of the Khan Academy content has not been translated into Spanish.** Teachers reported that though the platform is mostly in Spanish, some of the content still appears in English. For example, some math problems are written in Spanish, but need to be answered by looking at graphs or tables that are in English. Teachers said this often prevents students from progressing, even though they know how to solve the exercise, which causes frustration.
- **The KA Lite platform does not memorize the progress completed by students unless they complete all exercises correctly.** Teachers explained that the offline platform, KA Lite, erases all of the student's progress when s/he answers one of the exercises wrong. When this happens, the student must begin the exercise set all over again. Teachers explained that students view the completion of one level of exercises as a goal and compete among themselves to see who completes it faster. Most teachers thought the deletion of the students' progress is discouraging for them and that this is detrimental to their overall learning process. However, some teachers thought the contrary, seeing it as forcing students to really think through the problem to answer it correctly and reinforcing knowledge and math problem solving processes.[19]
- **Teachers found more drawbacks than benefits to having Internet connectivity.** Other than how much more interactive the online platform is compared to the offline platform, teachers with the sub-interventions with Internet access reported that the connection tends to be slow, which prevents students from using the platform consistently. Some teachers even reported having spent a month without access to the Internet and to the platform. These teachers also said that students often get distracted accessing other online content on the computers.
- **Teachers generally restrict what students can do on the Khan Academy platforms.** While some teachers said they allow students to explore advanced content on Khan Academy once they are done with the exercises s/he assigned, most teachers said they do not let students

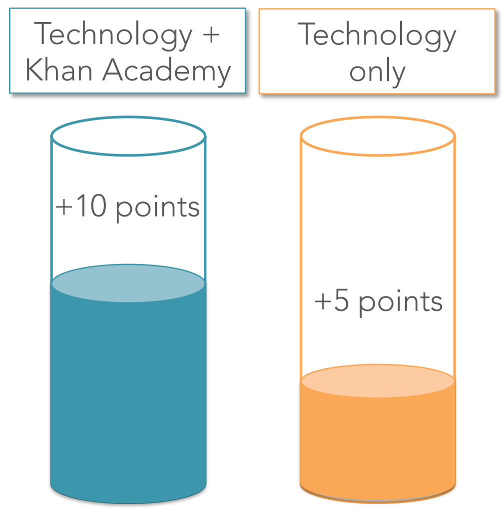
[19] According to KA Lite developer, Learning Equality, the KA Lite version used in the study (version 0.12) requires users to get 10 out of the last 10 questions correct in order to complete an exercise. In newer versions, users only need to get eight out of 10 questions correct, making the platform more tolerant to occasional student errors.

explore the platforms on their own. This limits the benefits of the self-paced, individualized learning environment that the Khan Academy platforms offer.

- **Teachers found Funsepa's training on technology and Khan Academy to be too brief.** Teachers reported attending computer training sessions twice for less than 30 minutes. They also said such training did not address the use of the Khan Academy platforms in detail. Overall, teachers said they would like to receive more comprehensive and more frequent training—as opposed to only an introductory training—on how to best incorporate the use of the technology and the platforms into their teaching.

Pilot Intervention Impact

The evaluation found that **combining technology with Khan Academy and KA Lite produces a higher positive effect on student math performance than the traditional Funsepa intervention** of providing the technology without the Khan Academy and KA Lite platforms. Relative to the comparison group, participation in the pilot intervention leads to an average increase of 10 points in math scores, out of a maximum possible of 100 points, which is double than that produced by Funsepa's traditional intervention, a five-point increase.



Statistically significant results

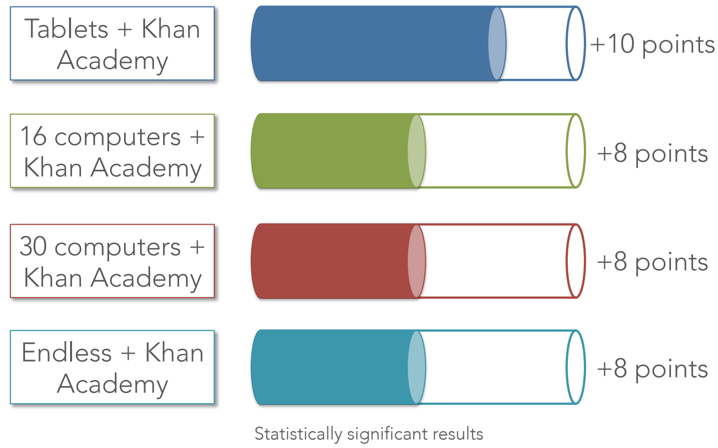
When exploring the effect of the pilot intervention by grade, the study found a similar effect on math performance, with sixth grade students benefiting slightly more. Relative to the comparison group, third graders increase their math score by an average of eight points, while sixth graders increase their scores by an average of nine points.

Though Funsepa's traditional program has half of the effect of the pilot intervention, it also shows a positive impact on student performance. This finding validates the results of a previous evaluation[20] (2012) on the foundation's traditional program, which found that the provision of computer labs (without Khan Academy/KA Lite) and teacher training increases math scores in non-standardized tests by an average of five points. This is likely due to the basic math material included in the TPE computers. Further, these findings highlight that the availability of these complementary math content programs can benefit student academic performance, even in the challenging context of limited resources and poorly qualified teachers.

These findings are statistically significant and controlled for other factors that can have an influence on student academic performance, such as gender, socioeconomic status, class size, teacher's math score, whether the student had repeated a grade at least once, availability of computers or tablets at home, and frequency of technology use at school, among other factors.

[20] In 2010, Funsepa commissioned MANAUS Consulting to conduct the evaluation of its core programs. More information on the findings of this evaluation can be found in document: FUNSEPA Monitoring and Evaluation Final Report, July 2012.

Technology Combination Impact



When comparing the different technology combinations against the comparison group, the evaluation found that **the provision of tablets and Khan Academy has a larger effect on student math performance than the other technology sub-interventions.** On average, the combination of tablets with KA Lite leads to a 10-point increase in math scores, out of a maximum of 100 points, while the use of computers with Khan Academy/KA Lite leads to an average increase of eight points. These results are also statistically significant and controlled for factors such as gender, socioeconomic status, class size, teacher's math score, grade repetition, availability of computers or tablets at home, and frequency of technology use at school, among others.

The evaluation team expected the 30-computer sub-intervention to have a larger effect on math scores than the other computer sub-interventions, as more computers, in theory, should prevent students from needing to share the computer with other students, leading to increased exposure to the computer and Khan Academy/KA Lite. However, as explained in the Methodological Limitations section, schools in the 30-computer sub-intervention were among the largest schools in the sample and had a greater number of classrooms. Thus, students in these schools were more likely to share computers and to use the labs for less time, affecting both the quantity and quality of exposure to Khan Academy/KA Lite. Though the evaluation controlled for the time and frequency of exposure to Khan Academy/KA Lite, it did not control for whether students shared computers.

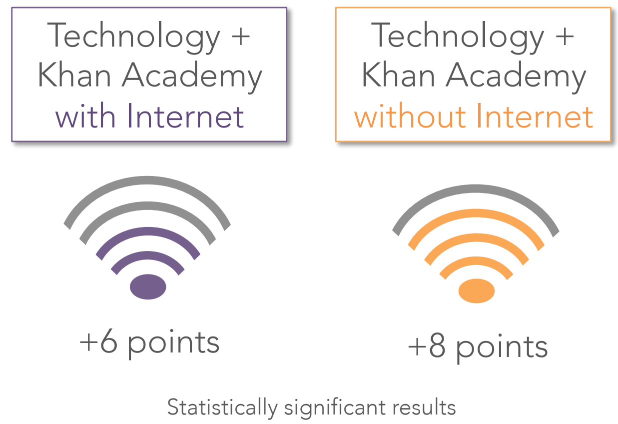
Similarly, the evaluation team expected the Endless Mobile sub-intervention to have a smaller effect on math scores than the other computer sub-interventions, as the entire classroom has to share one computer. Nonetheless, as explained in the Methodological Limitations section, it is possible that specific characteristics of the design of this sub-intervention—such as having the technology within the classroom and not having to share it with other grades—may explain why this subgroup shows a larger effect than expected and similar to that of the sub-interventions with more computers.

Internet vs. No Internet

The evaluation found that sub-interventions with no Internet produced a slightly larger effect on student performance, an average eight-point increase in math scores than sub-interventions with Internet, at six points, when compared to the comparison group. These findings are statistically significant and also controlled for factors such as gender, socioeconomic status, class size, teacher's math score, grade repetition, availability of technology at home, and time of technology use, among other factors.

However, schools in the sub-interventions with Internet faced significant challenges during the implementation phase, as explained in the Methodological Limitations section. It is then possible that the subgroup with Internet may have had similar or higher math outcomes if the Internet connection had been consistent and students had not experienced interruptions in their exposure to Khan Academy.

On the other hand, it is also possible that the sub-interventions without Internet are showing a higher effect due to differences in the way the online and offline platforms work. Specifically, the offline platform deletes the progress of a student when s/he responds a problem incorrectly, forcing the student to start all over again.[21] It is possible that this "forced" review of the exercises helps reinforce knowledge on key math concepts and the overall process to approach the exercise, leading to better performance in the math exam.

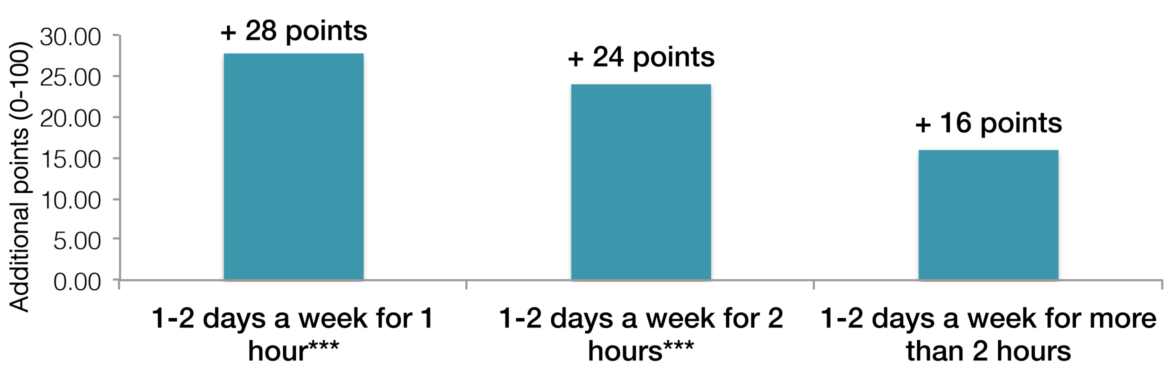


Annex 11 includes the outputs of the statistical analyses. Annex 12 includes the output of the statistical analysis by grade level.

Khan Academy Use Time

On average, students used Khan Academy/KA Lite one to two times a week for less than one hour at a time. Findings also show that increased exposure to Khan Academy/KA Lite leads to additional benefits on math performance. For instance, students who said they used the platform one to two times a week for a full hour at a time attained, on average, 28 additional points on the math test than students in the comparison group (Figure 3). While additional hours per day lead to diminishing marginal effects, possibly due to student's fatigue, more than one hour at a time of exposure to Khan Academy/KA Lite also leads to important positive academic outcomes. Students who said they used the platform one to two times a week for two hours at a time obtained an average of 24 additional points (Annex 13).

Figure 3. Additional benefits of increased exposure to Khan Academy/KA Lite



*** p<0.01, ** p<0.05, * p<0.1

[21] According to KA Lite developer, Learning Equality, the KA Lite version used in the study (version 0.12) requires users to get 10 out of the last 10 questions correct in order to complete an exercise. In newer versions, users only need to get eight out of 10 questions correct, making the platform more tolerant to occasional student errors.

Though there is little research on the optimal time for computer-assisted instruction in math, the findings of this evaluation are consistent with other studies that have assessed the impact of this type of instruction on academic outcomes. Studies have found that the effect of computer-assisted instruction on overall academic performance is significantly higher for interventions that provide more than 30 minutes per week of computer use, compared to programs that expose students for 30 or less minutes per week to computers (Cheung & Slavin, 2011; Slavin & Lake, 2007).

Discussion on Impact Size

The results shown above reflect the impact of the pilot intervention as it was implemented on the ground. However, the combination of technology and Khan Academy/KA Lite may potentially have an even larger effect on student performance. The evaluation identified various elements that possibly hindered a more successful integration of Khan Academy/KA Lite into traditional instruction, which can help Funsepa and other organizations better implement and scale similar interventions.

- **Students' limited exposure to Khan Academy.** Information collected through the surveys, focus groups with teachers and analysis of the data extracted from the Khan Academy and KA Lite platforms indicate that students' exposure to the technology is limited, with students generally using the technology one to two times a week for less than one hour at a time. Limited access to the technology consequently constraints exposure to Khan Academy/KA Lite. Findings also show that only a small proportion of students accesses technology outside of the school, which further limits the opportunities students have to access the platform.
- **Disproportional number of computers provided to schools relative to school size.** With the exception of the tablets sub-intervention, the number of devices Funsepa provides to schools is usually based on the average class size. The problem with this approach is that it does not account for the total number of classrooms and students in the school. For instance, one of the schools in the sample has an average classroom size of 32 students, based on which the provision of a 30-computer lab is reasonable. However, this school has eight sections of third grade and seven sections of sixth grade. Estimating computer lab size only based on the average class size is hence inadequate to ensure sufficient exposure to Khan Academy/KA Lite.
- **Unreliable Internet connection.** As explained earlier, schools that used the online platform experienced significant issues with the Internet, hindering their ability to access Khan Academy. These sub-interventions also include the four largest schools in the sample, so there is a possibility that students may have needed to pair up to use the computer or share the lab with other grades in the school. The combination of possibly having to share the technology and the unreliable access to Khan Academy further limits students' exposure to Khan Academy.
- **Restricted use of Khan Academy.** In focus groups, most teachers said they restricted what students could do on Khan Academy/KA Lite. Some indicated they did not want students to get ahead in the curriculum, so they discouraged students from exploring the platform on their own. One of the advantages of Khan Academy/KA Lite is precisely the possibility of self-pacing one's learning process, so that one can spend more time on concepts that are harder and move faster on concepts that are easier. This restriction limits student's capacity to maximize the benefits of the platforms.

Intervention Cost & Scalability

The cost of the pilot intervention varied according to the technology used in each sub-intervention as well as whether it required Internet connectivity or not (Table 5). The least costly intervention was the 16-computer sub-intervention, costing GTQ 24,464 (USD 3,283) for labs without Internet and GTQ 31,904 (USD 4,282) for Internet-connected labs per school. The second least expensive intervention was the 30-computer sub-intervention without Internet, costing GTQ 31,953 (USD 4,288) per school. The Endless Mobile sub-intervention cost GTQ 35,134 (USD 4,715) for an average of three computers without Internet in each school and GTQ 36,535 (USD 4,903) for three computers connected to the Internet in each school. The next least costly sub-intervention is the 30-computer labs with Internet connection at GTQ 36,849 (USD 4,945) per school. The most costly intervention was the tablets sub-intervention, at GTQ 37,267 (USD 5,002) for an average of 30 tablets per school.

Differences in costs across the computer sub-interventions are associated with whether the computers are new devices, as in the case of the Endless Mobile computers, or whether they are used, refurbished computers, as it is the case of the 16- and 30-computer labs. Funsepa could implement the Endless Mobile sub-intervention using refurbished computers, which would cost approximately GTQ 4,969 (USD 667) for an average of three computers without Internet and GTQ 6,480 (USD 870) for three computers with Internet per school.

In addition to the cost of the computers and tablets, the abovementioned costs include the fixed cost of a server (GTQ 6,739; USD 904) and the fixed cost of training teachers (GTQ 10,000; USD 1,342), along with other costs related to transportation, network system, device refurbishment, and installation, among others.

The selection of sub-interventions to scale up will depend on the characteristics of each school, primarily the size of the school. For instance, the Endless Mobile sub-intervention can be cost-effective to scale in small and medium size schools, but not necessarily in large schools. For example, in the case of a school with eight sections of third grade and seven sections of sixth grade, providing one computer per classroom may not be the most cost-efficient approach (assuming there are a similar number of sections for other grades). Similarly, scaling the tablets sub-intervention is only reasonable in small schools where Funsepa can provide one tablet per student.

Table 5. Average Implementation Cost per Sub-intervention

Pilot sub-intervention	Effect on math score	Average Cost per School in Quetzals		Average Cost per School in U.S. Dollars[22]		Average # of devices provided per school
		Internet	No Internet	Internet	No Internet	
16 computers	**8**	Q 31,904	Q 24,464	$ 4,282	$ 3,283	16
30 computers	**8**	Q 36,849	Q 31,953	$ 4,945	$ 4,288	30
Tablets	**10**	N/A	Q 37,267	N/A	$ 5,002	30
Endless Mobile	**8**	Q 36,535	Q 35,134	$ 4,903	$ 4,715	3

Note: The costs shown in the table include the cost of the server (GTQ 6,739; USD 904) and the cost of training teachers (GTQ 10,000; USD 1,342).

[22] Currency conversion as of January 27, 2016 using oanda.com

RECOMMENDATIONS

The evaluation outlined the following key recommendations for programmatic improvement:

Funsepa should make scaling-related decisions by weighing three key factors: the characteristics of the school, primarily the total number of students and number of classrooms; the average cost of implementation of the selected sub-intervention; and the actual capacity of Funsepa to scale the selected sub-intervention as it was implemented for the pilot or with an enhanced design (e.g. a greater number of computers or tablets). This will ensure that the selected sub-intervention produces, at a minimum, the effects on math scores reported in this study.

Given the findings around Internet reliability, along with the overall infrastructural and financial challenges of public schools in Guatemala, the evaluation team recommends using the KA Lite platform as the default program platform. Where exceptional infrastructure and connectivity conditions exist (i.e. a school that already has consistently reliable, strong Internet in place), Funsepa may consider providing the technology along with the online platform.

Funsepa must ensure that the number of computers or of labs is proportional to both classroom size and school size, so that students can work individually with the technology and be sufficiently exposed to Khan Academy/KA Lite. Further, the foundation should estimate computer lab sizes assuming that students will work with the technology at least twice a week for one hour at a time.

Funsepa should carry out additional and more regular teacher training activities, beyond the initial introduction to Khan Academy/KA Lite, to ensure teachers are constantly supported and guided on how to best integrate Khan Academy/KA Lite in their teaching. Additional training can also serve as a monitoring tool to ensure teachers do not restrict how students use the platforms.

CONCLUSIONS

The evaluation found that the provision of technology and access to Khan Academy in public schools in Sacatepéquez, Guatemala led to positive effects on student learning and achievement in math. Overall, the combination of technology with the Khan Academy and KA Lite platforms led to a higher point-increase in math scores than the Funsepa's traditional intervention of providing the technology without the platforms. The evaluation also found positive effects across the different technology combinations, with the tablets sub-intervention having a larger effect on student math performance than the other technology combinations. In terms of Internet access, the study found that sub-interventions with no Internet produced a slightly larger effect on student performance than sub-interventions with Internet, suggesting that the combination of technology with Khan Academy/KA Lite leads to positive math performance outcomes, regardless of Internet connectivity.

The evaluation also outlined a number of elements that play a role in the successful integration of technology and Khan Academy/KA Lite into traditional teaching. Specifically, addressing challenges related to these elements could lead to an even greater impact on academic performance than the one reported in this study. These elements include students' amount of exposure to Khan Academy/KA Lite, the provision of computers or tablets vis-à-vis classroom and school size, Internet connection reliability and flexibility on how to use the platforms. These elements served as basis to a series of recommendations for Funsepa to enhance its programmatic strategies moving forward. Lastly, Funsepa will need to carefully consider the differences in the design of sub-interventions, overall infrastructure limitations in Guatemala and its own capacity to replicate the sub-interventions when making scale-up decisions.

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ANNEXES

Annex 1. List of schools per intervention groups and subgroups

Evaluation Group	Number of students per group	School ID
Pilot intervention	782	
16 computers	200	03-12-0179-43 | 03-12-0026-43 03-12-0010-43
30 computers	230	03-16-0210-43 | 03-04-0105-43 03-01-0041-43 | 03-09-0159-43
Tablets	139	03-10-1159-43 | 03-13-0190-43 03-08-0143-43
Endless Mobile	213	03-04-0106-43 | 03-06-0897-43 03-01-0028-43 | 03-05-0008-43
Funsepa	788	03-08-0142-43 | 03-08-0145-43 03-13-0189-43 | 03-13-0984-43 03-14-0196-43 | 03-14-0985-43
Comparison	786	03-01-0036-43 | 03-01-0038-43 03-01-0242-43 | 03-01-0817-43 03-02-0012-43 | 03-02-0081-43 03-04-0113-43 | 03-04-0114-43 03-09-0160-43 | 03-12-0182-43
Total	**2,356**	**30 schools**

The evaluation team had originally sampled at random 33 schools. However, a number of logistical issues during the implementation of the pilot intervention led Funsepa to make changes to the original sample. Specifically, Funsepa dropped three schools from the sample and re-allocated two schools to different sub-interventions than they had originally been selected for.

Schools dropped from the sample:

- School IDs 03-08-0227-43 and 03-08-0144-43: These school were initially selected at random into the 30-computer plus Internet and tablets sub-interventions respectively, but the equipment was stolen and Funsepa decided not to re-equip them because the schools could not guarantee increased security surveillance.
- School ID 03-16-0004-43: This school was originally selected at random into the pure comparison group, but Funsepa equipped the school half way through the implementation of the pilot, which is why it was excluded from the evaluation sample.

Schools switched from original sub-intervention:

- School ID 03-13-0190-43: This school was initially selected at random into the Endless Mobile sub-intervention, but Funsepa later switched it to the tablets sub-intervention due to equipment costs.
- School ID 03-05-0008-43: This school was originally selected at random into the tablets sub-intervention, but Funsepa later switched it due to costs associated with equipping this school with tablets.
- School ID 03-03-0089-43: This school was initially selected at random into the tablets sub-intervention to substitute for one of the schools where the equipment was stolen, but Funsepa later discarded it as potential replacement due to costs associated with equipping this school with tablets.

Annex 2. Sampling and Randomization Protocol

Sampling

The overall sample size of students in the intervention was calculated based on the total population of primary level students in Sacatepéquez (est. 2013) and based on a 95% level of confidence. This led to a desired sample of 420 students, which was increased to 480 to leave a cushion for attrition, as we originally planned to do a longitudinal study. Based on the average number of students per school, we determined that we needed to visit about four schools per sub-intervention: two for sub-interventions with Internet and two for sub-interventions without Internet.

The selection of the sample for the evaluation was performed using a two-stage randomization process. First, schools were randomly selected for participation in the pilot. Using class rosters, students were then randomly selected within the schools for data collection.

Randomization at the school level

FUNSEPA provided a full list of public schools in the department of Sacatepéquez. After excluding schools that already had some type of Funsepa programming, schools were selected into the intervention (and sub-interventions) at random, using the following process:

1. Schools were listed in Excel in no particular order.
2. A new column was created in which a random number was generated between 0 and 100.
3. Schools were sorted according to the newly generated random number.
4. The first four schools listed were selected into the first sub-intervention, the next four schools were selected into the second sub-intervention and so on.

A total of 16 schools were selected into the intervention group. NOTE: As Funsepa implemented the pilot, there were a number of challenges in some schools (e.g. computers were stolen or school was an accelerated learning school) and these schools were removed from the sample. For this reason, some sub-interventions do not have two schools as originally planned.

Randomization at the student level

The randomization at the student level was done using class rosters. Roster numbers do not change for a given academic year (e.g. Pablo Garcia will be roster #3 the entire academic year) and students know their number. Roster numbers are referred to as "claves" by teachers and students. Funsepa provided MANAUS with either the class rosters or the total number of students in each grade's roster. Based on this, MANAUS randomized the roster numbers in advance by following a similar process to the one used for randomizing schools (i.e. random number in Excel) and created unique identification numbers for each student to be interviewed and tested.

Enumerators were provided with a list similar to the one shown below and only interviewed/tested students whose "claves" were in the list. For example, as per the sample list below, the first student to be interviewed/tested for 3rd grade Section A is student with "clave" 21 or the 21st student in the roster list for that class. We also provided additional “claves” (listed as “extra”) in case a student in the main list could not be found.

Sample of pre-randomized student list for interviews/tests

Escuela UDI: 03-01-0028-43
Nombre: EOU # 1 José Adrian Coronado Polanco
Dirección: 5a calle poniente No. 21
Municipio: ANTIGUA GUATEMALA
Municipalidad:
Enumerador _________________________
Fecha _________________________________

Tamaño de la muestra (estudianes): 32
Tamaño de la muestra (maestros): 4

MUNIC: 2 digitos
ESCUELA: 4 digitos
GRADO: 2 digitos -
Primero digito es el grado y segundo es el seccion (Sin seccion = 0; Seccion A=1; Seccion B= 2; Seccion C=3).
CLAVE: 2 digitos - clave de estudiante

	MUNIC	ESCUELA	GRADO/Sección	CLAVE	Encuesta	Examen
	01	0028	31	21		
	01	0028	31	14		
	01	0028	31	02		
	01	0028	31	24		
	01	0028	31	26		
	01	0028	31	30		
	01	0028	31	09		
	01	0028	31	05		
	01	0028	31	04		
	01	0028	32	27		
	01	0028	32	15		
	01	0028	32	11		
	01	0028	32	08		
	01	0028	32	16		
	01	0028	32	23		
	01	0028	32	25		
	01	0028	61	03		
	01	0028	61	09		
	01	0028	61	18		
	01	0028	61	01		
	01	0028	61	04		
	01	0028	61	13		
	01	0028	61	26		
	01	0028	61	14		
	01	0028	62	15		
	01	0028	62	29		
	01	0028	62	16		
	01	0028	62	08		
	01	0028	62	24		
	01	0028	62	27		
	01	0028	62	30		
	01	0028	62	19		
Extra	01	0028	31	12		
	01	0028	31	18		
	01	0028	32	10		
	01	0028	32	19		
	01	0028	61	07		
	01	0028	61	17		
	01	0028	61	25		

NOTE: 31= 3rd grade, section A; 32= 3rd grade, section B; 61= 6th grade, section A; 62= 6th grade, section B. Grades with only one section were coded as 30= 3rd grade, unique section or 60= 6th grade, unique section.

Annex 3. Progress out of Poverty Index (PPI) for Guatemala

The Progress out of Poverty Index (PPI) is a poverty measurement tool that is statistically sound while simple to use. Answers to 10 questions about a household's characteristics and asset ownership are scored to compute the likelihood that the household is living below the poverty line. The latest version of the PPI for Guatemala was created in May 2010. Indicators in the PPI for Guatemala are based on data from the 2006 Living Standards Measurement Survey (ENCOVI, Encuesta nacional de Condiciones de Vida). The following are the 10 questions assessed by the PPI:

1. How many household members are aged 13 or younger?
2. Did all children ages 7 to 13 enroll for the current school year?
3. Can the female head/spouse read and write?
4. Do any household members work mainly as casual laborers or domestic workers?
5. What is the main construction material for the residence's floors?
6. Does the household have a refrigerator?
7. Does the household have a gas or electric stove?
8. Does the household have a stone mill?
9. Does the household have an electric iron?
10. If any household member works mainly in agriculture, animal husbandry, hunting or fishing, does the household have any cows, bulls, calves, pigs, horses, burros, or mules?

The evaluation team used the Spanish version of the PPI tool for Guatemala, as officially translated by the Grameen Foundation.

Source: http://www.progressoutofpoverty.org/country/guatemala

Annex 4. Student Survey (endline version)

NOTE: The survey version shown below includes additional questions on student's experience working with Khan Academy. The baseline question only included a control question on whether students knew about Khan Academy and had ever used it. Also, please note that the survey was exported directly from Magpi, which is why some introductory notes are numbered as questions when they are actually not questions.

FUNSEPA Student Survey

1. Esta es la encuesta para ESTUDIANTES del proyecto de FUNSEPA.
2.Seleccione la identificación de enumerador:
- 001 (001)
- 002 (002)
- 003 (003)
- 004 (004)
- 005 (005)
- 006 (006)
- 007 (007)
- 008 (008)

3.Fecha de la encuesta:

4.Hola, mi nombre es __________ y trabajo para una organización que se llama FUNSEPA. Estamos realizando una encuesta sobre el uso de la tecnología en escuelas, como por ejemplo las computadoras, y sobre cómo te ayuda a aprender. Me gustaría hacerte unas preguntas sobre ti y tu uso de la tecnología. No compartiremos tus respuestas con ninguna persona. Todas tus respuestas son CONFIDENCIALES y todo de lo que tú me digas es privado. Si no quieres responder alguna pregunta, decímelo y pasaremos a la siguiente pregunta. ¿Podemos comenzar?

- Sí (1)
- No (0) If this response, jump to 58

5.¿Cuál es tu nombre completo? [Enumerador: Escriba los 4 nombres en este orden: 'Primer Nombre' 'Segundo Nombre' 'Primer Apellido' 'Segundo Apellido'; NO SE DEBEN INCLUIR TILDES Y LA 'ñ' SE DEBE ESCRIBIR CON 'n']

6.[Enumerador: Escriba el género del/la estudiante.]

- Hombre (0)
- Mujer (1)

7. Primero te quiero hacer unas preguntas sobre ti y tu familia.

8.¿Cuántos años tienes? [Enumerador: Indique 88 si no sabe y 99 si no responde]

9.¿Cuántas personas viven en tu casa, contándote a ti? [Enumerador: Anote los miembros de familia y sus edades en una hoja aparte. Introduzca 88 si no sabe y 99 si no responde]

10.¿Cuántas de las personas que viven en tu casa tienen 13 años o menos, contándote a ti? [Enumerador: Confirmar respuesta con la lista de miembros de familia y sus edades que el/la estudiante proporcionó anteriormente]

- 5 o más (0)
- 4 (10)
- 3 (12)
- 2 (17)
- 1 (23)
- Ninguna (33)
- No sé (88)
- No responde (99)

11.¿Todos los niños que viven en tu casa y que tienen entre 7 y 13 años asisten a la escuela actualmente, contándote a ti? [Enumerador: Confirmar respuesta con la lista de miembros de familia y sus edades que el/la estudiante proporcionó anteriormente]

- No (0)
- No hay niños entre 7 y 13 años de edad en su casa (2)
- Sí (6)

12.¿La jefa de tu casa sabe leer y escribir? La jefa de tu casa sería tu mamá, abuela u otro miembro femenino en tu casa. [Enumerador: Si no tiene madre, pregúntele sobre su abuela u otro miembro femenino que sea cabeza de familia]

- No (0)
- Sí (6)
- No hay mujeres como cabeza de familia (9)
- No sé (88)
- No responde (99)

13.¿Trabaja algún miembro de tu casa en su mayoría como jornalero, obrero, albañil, vendedor o empleado doméstico? Por ejemplo, cocinar para vender, limpiar casas, trabajar en el jardín de alguien, trabajar en una finca o manejar para alguien.

- Sí (0)
- No (5)
- No sé (88)
- No responde (99)

14.¿Cuál es el material del piso de tu casa? [Enumerador: Lea las opciones en voz alta y muestre las fotos]

- Tierra, arena, madera u otra (0)
- Ladrillo de lodo o losa de cemento (3)
- Ladrillos de cemento (9)
- Parquet, granito, cerámica (15)
- No sé (88)
- No responde (99)

15.¿Tiene tu casa un refrigerador? Este mantiene la comida y las bebidas frías. [Enumerador: Muestre las fotos]

- No (0)
- Sí (9)
- No sé (88)
- No responde (99)

16.¿Tiene tu casa una estufa eléctrica o de gas? Esta se utiliza para cocinar o hervir agua. No incluye polleton ni las estufas que utilizan leña. [Enumerador: Muestre las fotos]

- No (0)
- Sí (8)
- No sé (88)
- No responde (99)

17.¿Tiene tu casa un molino de piedra? Esto se utiliza para deshacer granos y hacer pan. [Enumerador: Muestre las fotos]

- Sí (0)
- No (3)
- No sé (88)
- No responde (99)

18.¿Tiene tu casa una plancha eléctrica? Esta se utiliza para planchar la ropa. [Enumerador: Muestre las fotos]

- No (0)
- Sí (8)
- No sé (88)
- No responde (99)

19.Si algún miembro de la casa se dedica en su actividad principal a la agricultura, ganadería, caza o pesca, ¿tiene vacas, toros, terneros, cerdos, caballos, burros o mulas?

- No (0)
- Sí (3)
- Nadie trabaja en agricultura (4)
- No sé (88)
- No responde (99)

20. Ahora quiero hacerte algunas preguntas sobre la escuela y el uso de tecnología como computadoras en la escuela.

21.¿En qué grado estás?

- 3 (3)
- 6 (6)
- No sé (88)
- No responde (99)

22.¿Repetiste este grado alguna vez?

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

23.¿Estudiabas en esta misma escuela el año pasado?

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

24.¿Cómo llegas a la escuela todos los días? [Enumerador: Lea las opciones en voz alta]

- Caminando (1)
- Autobús (2)
- Carro (3)
- Otro (4)
- No sé (88)
- No responde (99)

25.¿Te gusta la escuela?

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

26.¿Cuál es tu materia favorita en la escuela? [Enumerador: Lea las opciones en voz alta]

- Matemáticas (1)
- Literatura/Lenguaje (2)
- Ciencia/Medio social y natural/Ciencias naturales y sociales (3)
- Clase de computación (4)
- Idiomas (Por ejemplo: Mayas, Garífuna, Xinka) (5)
- Formación Ciudadana (6)
- Otra (7)
- No tengo una materia favorita (0)
- No sé (88)
- No responde (99)

27.¿Usas una computadora, laptop o tablet en tu CASA. Me refiero sólo a una computadora, laptop o tablet que usas en tu casa y no fuera de tu casa.

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

28.¿Tus padres saben cómo usar una computadora, laptop o tablet?

- Sí (1)
- No (0) If this response, jump to 30
- No sé (88) If this response, jump to 30
- No responde (99) If this response, jump to 30

29.¿Te ayudan tus padres cuando tienes preguntas sobre cómo usar la computadora, laptop o tablet?

- Sí (1)
- No (0)

- No sé (88)
- No responde (99)

30.¿Usas una computadora, laptop o tablet en sitios que NO son ni tu casa ni tu escuela? Por ejemplo un café internet, la casa de un amigo(a) u otro lugar.

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

31.¿Cuántas veces a la semana usas las computadoras, laptops o tablets en tu CASA o EN LOS LUGARES QUE MENCIONASTE? [Enumerador: Mencione los lugares que el estudiante nombró. Especifique que usted NO se refiere a tecnologías en la escuela]

- Estudiante no usa tecnología en su casa ni en otro lugar (0) If this response, jump to 35
- Todos los días (7 días por semana) (1)
- Entre 5 y 6 días por semana (5)
- Entre 3 y 4 días por semana (2)
- Entre 1 y 2 días por semana (3)
- Menos de 1 vez por semana (4)
- No sé (88) If this response, jump to 35
- No responde (99) If this response, jump to 35

32.¿Usas las computadoras, laptops o tablets en tu CASA U OTROS LUGARES (ej.: café internet) para hacer tus tareas de la escuela?

- Sí (1)
- No (2)
- No sé (88)
- No responde (99)

33.Y más allá de las tareas de la escuela, ¿para qué usas las computadores, laptops, o tablets en tu CASA u OTROS LUGARES? [Enumerador: Especifique que usted no se refiere a tecnologías en la escuela]

- Jugar juegos (1)
- Navegar el Internet/ Buscar información (3)
- Mandar correos electrónicos (4)
- La compra/la venta de artículos (5)
- Chatear/comunicarme con amigos/familia (6)
- Usar Khan Academy (7)
- Usar Facebook/Twitter/Instagram/etc. (8)
- Bajar música y/o videos (9)
- Practicar matemáticas (12)
- Otro (11)
- No usa la tecnología aparte de para las tareas (0)
- No sé (88)
- No responde (99)

34.¿Para cuál de esas actividades que mencionaste usas más la computadora/la tablet en la casa u otro lugar FUERA DE LA ESCUELA? [Enumerador: Lea las actividades que mencionó en la pregunta anterior]

- Jugar juegos (1)
- Completar tareas escolares/estudiar (2)
- Navegar el Internet/ Buscar información (3)
- Mandar correos electrónicos (4)
- La compra/la venta de artículos (5)
- Chatear/comunicarme con amigos/familia (6)
- Usar Khan Academy (7)
- Usar Facebook/Twitter/Instagram/etc. (8)
- Bajar música y/o videos (9)
- Practicar matemáticas (12)
- Otro (11)
- No sé (88)
- No responde (99)

35.¿Usabas una computadora o tablet para recibir alguna materia en la ESCUELA durante el AÑO ESCOLAR PASADO?

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

36.¿Usas una computadora o tablet para recibir alguna materia en la ESCUELA durante ESTE AÑO ESCOLAR?

- Sí (1)
- No (0) If this response, jump to 51
- No sé (88) If this response, jump to 51
- No responde (99) If this response, jump to 51

37.¿En qué materias utilizas la computadora/tablet? [Enumerador: Lea las opciones en voz alta]

- Matemáticas (1)
- Literatura/Lenguaje (2)
- Ciencia/Medio social y natural/Ciencias naturales y sociales (3)
- Clase de computación (4)
- Idiomas (Por ejemplo: Mayas, Garífuna, Xinka) (5)
- Formación Ciudadana (6)
- Otra (7)
- Todas las clases (8)
- No sé (88)
- No responde (99)

38.En una semana de clases, ¿cuántas veces usas la computadora/tablet? [Enumerador: De ser necesario, mencione todos los días de la semana y según las respuestas del estudiante calcule la frecuencia.]

- Todos los días (5 días por semana) (1)
- Entre 3 y 4 días por semana (2)
- Entre 1 y 2 días por semana (3)
- Menos de 1 vez por semana (4)
- No sé (88)
- No responde (99)

39.Cuando trabajas con la computadora/tablet en la ESCUELA, ¿por cuánto tiempo utilizas la computadora/tablet?

- Más de 2 horas (1)
- 2 horas (2)
- 1 hora (3)
- Menos de 1 hora (4)
- No sé (88)
- No responde (99)

40.¿Y siempre que trabajas con la computadora/la tablet lo haces en ese mismo horario y por el mismo tiempo que me acabas de mencionar o eso cambia de semana a semana/mes a mes? [Enumerador: Determine si la frecuencia y uso de la tecnología es regular o si varía significativamente en el año escolar]

- Misma frecuencia y tiempo de duración (1)
- Varía de semana a semana/mes a mes (2)

41.Y cuando trabajas con la computadora/la tablet en la ESCUELA, ¿trabajas con la computadora/la tablet tú solo(a) o compartes la computadora con otro(a) estudiante?

- Yo solo(a) / Por mi mismo(a) (1)
- Con otro(a) estudiante (2)
- A veces yo solo(a) y a veces con otro(a) estudiante (3)

42.¿Usas el Internet con la computadora/tablet en la ESCUELA?

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

43.¿Para qué usas la computadora/tablet en la ESCUELA?

- Jugar juegos (1)
- Completar tareas escolares/estudiar (2)
- Navegar el Internet/ Buscar información (3)
- Mandar correos electrónicos (4)
- La compra/la venta de artículos (5)
- Chatear/comunicarme con amigos/familia (6)
- Usar Khan Academy (7)
- Usar Facebook/Twitter/Instagram/etc. (8)
- Bajar música y/o videos (9)
- Practicar matemáticas (12)
- Otro (11)
- No sé (88)
- No responde (99)

44.¿Para cuál de esas actividades que mencionaste usas más la computadora/la tablet en la ESCUELA? [Enumerador: Lea las actividades que mencionó en la pregunta anterior]

- Jugar juegos (1)
- Completar tareas escolares/estudiar (2)
- Navegar el Internet/ Buscar información (3)
- Mandar correos electrónicos (4)
- La compra/la venta de artículos (5)
- Chatear/comunicarme con amigos/familia (6)
- Usar Khan Academy (7)
- Usar Facebook/Twitter/Instagram/etc. (8)
- Bajar música y/o videos (9)
- Practicar matemáticas (12)
- Otro (11)
- No sé (88)
- No responde (99)

45.¿Te gusta trabajar con la computadora/tablet?

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

46.¿Es difícil usar la computadora/tablet que tienes en la ESCUELA?

- Sí (0)
- No (1)
- No sé (88)
- No responde (99)

47.¿Tu maestro(a) te ayuda con la computadora/la tablet?

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

48.Cuando estás trabajando en la computadora y tienes una pregunta, ¿quién es la persona que normalmente te ayuda con esa pregunta: tu maestro(a), otro(a) estudiante o el/la maestro(a) de computación? [Encuestador: Clarifique diferencia entre el maestro convencional del aula y el maestro de computación]

- Maestro(a) de aula (NO de computación) (1)
- Estudiante(s) (2)
- Maestro(a) de computación (3)
- No sé (88)
- No responde (99)

49.¿Qué materia es mejor para usar la computadora/tablet? [Enumerador: Lea las opciones en voz alta]

- Matemáticas (1)

- Literatura/Lenguaje (2)
- Ciencia/Medio social y natural/Ciencias naturales y sociales (3)
- Clase de computación (4)
- Idiomas (Por ejemplo: Mayas, Garífuna, Xinka) (5)
- Formación Ciudadana (6)
- Otra (7)
- Todas las clases (8)
- No sé (88)
- No responde (99)

50.¿Crees que utilizar la computadora/tablet te ayuda a aprender mejor?

- Sí (1)
- No (0)
- No sé (88)
- No responde (99)

51.¿Has usado Khan Academy alguna vez en la ESCUELA? [Enumerador: Si pregunta qué es Khan Academy, se debe explicar: "Khan Academy es una biblioteca digital de materias de la escuela que se puede usar en la computadora, laptop o tablet. Khan Academy incluye videos y problemas ejemplos para ayudarte a aprender distintas materias"]

- Sí (1)
- No (0) If this response, jump to 58
- No sé (88) If this response, jump to 58
- No responde (99) If this response, jump to 58

52.¿Cuántas veces en UNA SEMANA usas Khan Academy en la ESCUELA? [Enumerador: De ser necesario, mencione todos los días de la semana y según las respuestas del estudiante calcule la frecuencia]

- Todos los días (5 días por semana) (1)
- Entre 3 y 4 días por semana (2)
- Entre 1 y 2 días por semana (3)
- Menos que 1 vez por semana (4)
- No sé (88)
- No responde (99)

53.¿Qué materia practicas o estudias más cuando usas Khan Academy? [Enumerador: Lea las opciones en voz alta]

- Matemáticas (1)
- Literatura/Lenguaje (2)
- Ciencia/Medio social y natural/Ciencias naturales y sociales (3)
- Clase de computación (4)
- Idiomas (Por ejemplo: Mayas, Garífuna, Xinka) (5)
- Formación Ciudadana (6)
- Economía y finanzas (9)
- Otra (7)
- Todas las clases (8)
- No sé (88)
- No responde (99)

54.Cuando usas Khan Academy, ¿normalmente trabajas solo(a) o trabajas junto con otro(a) estudiante? [Enumerador: Explique que trabajar con otro estudiante significa que comparten la misma computadora/tablet y la misma sesión de Khan Academy]

- Trabaja solo(a) (1)
- Trabaja con otro(a) estudiante(s) (2)
- No sé (88)
- No responde (99)

55.¿Qué tanto te gusta trabajar con Khan Academy? [Enumerador: Lea las opciones en voz alta]

- Me gusta mucho (1)
- Me gusta algo (2)
- Ni me gusta ni me disgusta (3)
- No me gusta mucho (4)
- No me gusta para nada (5)
- No responde (99)

56.¿Qué tanto crees que trabajar con Khan Academy te ha ayudado a aprender matemáticas? [Enumerador: Lea las opciones en voz alta]

- Me ha ayudado mucho (1)
- Me ha ayudado en algo (2)
- Ni me ha ayudado ni me me lo ha dificultado (3)
- No me ha ayudado mucho (4)
- No me ha ayudado para nada (5)
- No responde (99)

57.Si pudieras escoger una forma ideal para estudiar matemáticas, ¿cuál de las siguientes opciones preferirías? [Enumerador: Lea las opciones en voz alta]

- Estudiar matemáticas sólo con Khan Academy (1)
- Estudiar matemáticas sólo con la/el maestra(o), sin utilizar Khan Academy (2)
- Estudiar matemáticas con ambos Khan Academy y la/el maestra(o) (3)
- No sé (88)
- No responde (99)

58.Indique los diez dígitos NÚMERO DE IDENTIFICACIÓN DEL ESTUDIANTE (diez dígitos). [Enumerador: Anote la clave del estudiante en la mano del estudiante]

59. Esa fue la última pregunta de la encuesta. ¡Gracias por conversar conmigo!

60.Indique los números del GRADO y la SECCIÓN usando la Hoja de Claves (dos dígitos). Primer dígito es de Grado. Segundo dígito es de Sección. Si no hay sección, indique 0. Si es sección A, indique 1. Si es sección B, indique 2. Si es sección C, indique 3.

61.Indique la CLAVE DEL ESTUDIANTE usando la Hoja de Claves (dos dígitos):

62.Indique el Código UDI de la escuela (diez dígitos):

63.Por favor indique si hay algo importante que se debe saber sobre esta encuesta.

64. Este es el final de la encuesta. Por favor guarde la encuesta ('Guardar como completado') y envíela ('Enviar datos completados')

Annex 5. Focus Group Discussion (FGD) Protocol

PROTOCOLO

Este protocolo tiene la finalidad de facilitar la discusión con los participantes del grupo focal. Las instrucciones en cada sección de este protocolo facilitarán la recolección de toda la información necesaria en el tiempo previsto para esta actividad y sin viciar las respuestas de los participantes. El protocolo será implementado por dos personas: una facilitadora liderará la discusión (moderadora) y otra persona tomará notas sobre lo que ocurre en la sesión (anotador/a). A fin de facilitar el análisis de la discusión, la sesión será gradada en su totalidad.

ACTIVIDADES PREVIAS AL GRUPO FOCAL

La siguiente información será recolectada antes de iniciar la discusión con los participantes:

1. **Hoja de Asistencia:** Cada participante debe colocar su nombre en una hoja de asistencia que permitirá llevar control del tamaño de cada uno de los grupos focales (Ver Apéndice).
2. **Hoja de Información del Participante:** Cada participante deberá completar una planilla con información demográfica básica (edad, sexo, nivel de educación, estatus marital, etc.). Los participantes no tendrán que escribir su nombre en esta planilla (Ver Apéndice).

BIENVENIDA E INTRODUCCIÓN

[A partir de este momento se debe comenzar a grabar. La moderadora nombrará el lugar, fecha y número de grupo focal que está por comenzar. El/la anotador(a) debe comenzar a tomar notas]

Buenos días/tarde. Bienvenidos y gracias por participar voluntariamente en esta sesión. Mi nombre es LULU, trabajo para una empresa llamada MANAUS, la cual está realizando un estudio sobre la incorporación de tecnología en la educación. Yo voy a ser la moderadora de esta sesión. En esta sesión me acompaña [ANOTADOR(A)], quien estará tomando notas y ayudándome con la sesión. Al momento que llegaban, les pasamos un formulario. Por favor, llenen el formulario si aún no lo han hecho y se lo entregan a [ANOTADOR(A)] cuando hayan terminado.

Cada uno(a) de ustedes tiene una tarjeta/gafete con su nombre pero me gustaría que ustedes mismos se presentaran al resto del grupo dando su nombre, qué grado y qué materias enseñan actualmente.

[Agradecimientos a los participantes por presentarse]

PROPÓSITO DEL GRUPO FOCAL

Ahora que ya nos conocemos, déjenme explicarles el propósito de esta actividad. Mi colega y yo estamos interesadas(os) en conocer sus experiencias y opiniones sobre la utilización de la tecnología (ej. computadoras, tabletas) en la enseñanza tradicional. Nos gustaría saber cuáles son sus opiniones sobre las ventajas y retos de combinar el uso de tecnología con métodos tradicionales de enseñanza No hay respuestas correctas o incorrectas, así que no se sientan mal si sus opiniones difieren a las del resto del grupo. La participación en esta sesión es completamente voluntaria. Todo lo que sea discutido aquí se utilizará únicamente para el estudio y sin identificar a ningún participante individualmente.

Una grabadora digital está siendo utilizada para grabar esta sesión. Esto va a facilitar analizar la información que ustedes van a compartir con nosotros(as) pues [ANOTADOR(A)] no puede tomar nota de absolutamente todo lo que se diga.

Con el propósito de tener una sesión exitosa, quisiera establecer algunas reglas básicas para garantizar el respeto de unos a otros durante y después de la discusión. Estas son las reglas básicas:

1. Por favor respeten a los otros miembros del grupo evitando divulgar lo que los otros participantes compartan.

2. Por favor hablen uno a la vez. Si usted tiene algo que decir y otro participante está hablando, por favor levante la mano y espere que le den la palabra.

3. Por favor, trátense con respeto. Esto significa evitar hacer o decir cosas que puedan hacer a los otros incómodos.

4. Al tiempo que queremos que usted sea respetuoso con los demás, también queremos que exprese sus opiniones sin vergüenza. El objetivo de esta sesión es escuchar diversos puntos de vista.

5. Por favor, apaguen sus teléfonos celulares o póngalos en silencio.

6. Si usted tiene que dejar el grupo focal por alguna razón, por favor levante la mano e infórmelo oportunamente.

Antes de que comencemos con la discusión, ¿tienen alguna pregunta sobre la discusión?

[De haber preguntas, se responden al momento y antes de continuar con la sesión]

PREGUNTAS DE DISCUSIÓN

Como mencioné brevemente al comienzo de la sesión, el propósito de este grupo focal es conocer sus experiencias y opiniones sobre la utilización de la tecnología (ej. computadoras, tablets) en la enseñanza tradicional.

Quisiera comenzar escuchando sus experiencias con el uso de la tecnología.

1. ¿Podrían describirme qué tipo de tecnología usan en su escuela (ej. computadoras, tabletas)? y ¿Cómo la utilizan las computadoras/tabletas para su enseñanza? [PROMPT: ¿para introducir nuevos conceptos? ¿para reforzar conocimientos aprendidos de forma tradicional?] ¿Qué proceso utilizan para que los estudiantes usen la tecnología: *los llevan al laboratorio o usan la tecnología en la misma aula? ¿Los estudiantes comparten el uso de la tecnología o cada uno usa su propia tecnología? ¿Me pueden dar ejemplos? Por favor, sean tan detallados como sea posible. ¿Hay suficientes tecnologías para los estudiantes? Si no, ¿cómo hacen para que todos los estudiantes puedan utilizar la tecnología?*

2. Una vez que los estudiantes están trabajando con la tecnología, ¿qué actividades hacen y en qué materias se enfocan? *[Dejar discutir por unos minutos]* ***¿Utilizan alguna plataforma, software o aplicación en particular?*** *[Si no mencionan Khan Academy, sugerir y dejar discutir]¿Cómo utilizan esa(s) plataforma(s)/aplicación(es)?* ***¿Qué rol tienen ustedes cuando los estudiantes están utilizando Khan*** *[Dejar discutir y preguntar si ellos enseñan mientras usan Khan o sólo ayudan a los estudiantes a navegar la plataforma]?*

3. ¿Ustedes dejan que los estudiantes trabajen por su cuenta con Khan Academy o ustedes los dirigen en cuanto a qué hacer o qué modulo trabajar? *¿Por qué usa esa modalidad? Por favor de ejemplos.* ***¿Y todos los estudiantes en la misma "misión" o nivel de Khan?*** *[Esperar que respondan espontáneamente y luego preguntar] ¿O utilizan actividades diferentes dependiendo de las destrezas del estudiante?* ***¿Y ustedes utilizan el "tutor" de Khan—donde pueden ver el progreso/logros de los estudiantes?*** *En caso afirmativo, dar ejemplos. En caso negativo, ¿por qué no?*

[La siguiente pregunta es sólo para escuelas con COMPUTADORAS y no tabletas]

4. Y cuando los estudiantes están trabajando con Khan Academy, ¿están conectados al Internet? ¿Qué beneficios o desventajas tiene [Tener/No Tener] acceso al Internet cuando se usa la plataforma desde el punto de vista del aprendizaje de los estudiantes? *¿Por qué es eso una ventaja o una desventaja? Por favor, sean tan detallados como puedan.*

5. ¿Me podrían explicar cómo se preparan ustedes normalmente para sus clases? *[Dejar discutir por unos minutos]* ***Y en cuanto al uso de Khan Academy, ¿cómo preparan la clase y las actividades que van a realizar a través del uso de Khan*** *[PROMPT: por ejemplo, ven los videos con anticipación o tienen una lista ya prediseñada que indica qué videos deben ver para cada tópico pero no ven el video, etc.] ¿Qué más hacen para preparar sus clases?*

6. En su opinión, ¿cuál es la mayor ventaja de utilizar esta modalidad de enseñanza (tecnología y Khan Academy) versus sólo utilizar la enseñanza tradicional? ¿Cuál es la mayor desventaja de utilizar esta modalidad? *¿Por qué? ¿Me puede dar ejemplos de conceptos/actividades en las que esta modalidad es mejor y ejemplos de conceptos/actividades en la que la enseñanza tradicional es mejor?*

Ahora quisiera hablar un poco sobre las capacitaciones que ustedes han recibido para utilizar la tecnología y la plataforma en su enseñanza diaria.

7. ¿Han recibido ustedes algún tipo de capacitación para la incorporación de la tecnología en el aula? *¿Cómo cuál? ¿Qué otra capacitación? ¿Hace cuánto que recibieron esa(s) capacitación(es)? ¿Considera que fue(ron) útil(es)? ¿Cómo/por qué? ¿Considera que fue(ron) suficiente? ¿Por qué?*

8. ¿Y han recibido ustedes algún tipo de capacitación sobre el uso de Khan Academy? *¿Cómo cuál? ¿Qué otra capacitación? ¿Hace cuánto que recibieron esa(s) capacitación(es)? ¿Considera que fue(ron) útil(es)? ¿Cómo/por qué? ¿Considera que fue(ron) suficiente? ¿Por qué?*

9. ¿Han recibido ustedes algún tipo de capacitación en matemáticas? *¿Cómo cuál? ¿Qué otra capacitación? ¿Hace cuánto que recibieron esa(s) capacitación(es)? ¿Considera que fue(ron) útil(es)? ¿Cómo/por qué? ¿Considera que fue(ron) suficiente? ¿Por qué?*

Ahora me gustaría hablar sobre su nivel de comodidad al utilizar la tecnología, Khan Academy o ambas cosas.

10. ¿Consideran que es fácil o difícil enseñar utilizando Khan Academy? *¿Por qué fácil/difícil? [PROMPT: sin importar si responden fácil o difícil, preguntar:] ¿Qué es lo más difícil o incómodo de enseñar a sus estudiantes utilizando Khan Academy? ¿Por qué?* ***¿Han observado cambios en su confianza y actitud en torno a la tecnología o su propia enseñanza como resultado de trabajar con Khan?*** *En caso afirmativo, ¿qué cambios? ¿me puede dar ejemplos?*

CIERRE DEL GRUPO FOCAL

[**Agradecer a los participantes por su participación]**

Hemos llegado a final de la sesión. Han contestado todas nuestras preguntas. Hicieron un excelente trabajo y realmente apreciamos que tomaron de su tiempo para venir a esta sesión. Sus opiniones ciertamente van a contribuir mucho con este estudio. Muchas gracias y que tengan un buen día.

Annex 6. Teacher Survey (endline)

Nombre del Maestro: ____

UDI de la Escuela: ____

Grado y Sección en el que está tomando este examen: ____________________

Género: Mujer ____ Hombre ____

P1. ¿Por cuántos años ha sido maestro? ________

P2. ¿Enseñaba en esta misma escuela el año escolar pasado?

Sí ____ (Continúe a la pregunta P3)

No ____ (Continúe a la pregunta P4)

P3. ¿Qué grado(s) enseñabas el año pasado? ________

P4. ¿Usa una computadora, laptop o tableta en su casa u otro lugar fuera de la escuela? (Seleccione sólo una respuesta):

a. Sí, casi todos los días de la semana ______

b. Sí, algunas veces por semana ______

c. Sí, pero raramente ______

d. No, tengo acceso a una computadora/laptop/tableta que funciona pero no la uso ____

e. No tengo acceso a una computadora/laptop/tableta que funciona ______

P5. ¿Para qué usas la computadora/laptop/tableta?

____

P6. ¿Hay computadoras disponibles para los estudiantes en tu clase o un laboratorio de computación en la escuela?

Sí _____ (Por favor, responda P6a y P6b)

No ____ (Por favor, continúe a P9)

P6.a. ¿Cuántas computadoras/laptops/tabletas (disponibles para sus estudiantes) hay?

Computadoras/laptops _________

Tabletas/Ipads ________

P6.b. Típicamente, ¿con qué frecuencia los estudiantes utilizan la computadora/laptop/tableta? (Seleccione sólo una respuesta)

a. Todos los días (5 días por semana) ______

b. Entre 3 y 4 días por semana ______

c. Entre 1 y 2 días por semana ______

d. Menos de 1 vez por semana ______

e. Hay computadoras/tabletas que funcionan pero mis estudiantes no las usan ______

P7. Además de usar la computadora/laptop/tabletas con los estudiantes, ¿utiliza usted las computadoras en la escuela para su propio uso? ¿Con qué frecuencia? (Seleccione sólo una)

a. Sí, casi todos los días de la semana ______

b. Sí, algunas veces por semana ______

c. Sí, pero raramente ______

d. No, no la uso ______

e. No tengo acceso a una computadora/tableta que funciona en la escuela ______

P8. ¿Para qué usas las computadoras en la escuela? (Seleccione todas las que apliquen)

a. Para registrar el progreso de los estudiantes ______

b. Para enseñar contenido ______

c. Para reforzar la enseñanzas del aula ______

d. Para mejorar mis conocimientos and destrezas académicas ______

e. No uso las computadoras en la escuela ______

f. Otra razón ______

P9. En el presente año escolar, ¿ha recibido usted alguna capacitación sobre el uso de tecnologías (como computadoras o tabletas) en su enseñanza?

Sí ______ (Continúe a la P9a)

No ______ (Continúe a la P10)

P9a. ¿Qué organización proporcionó la capacitación sobre el uso de tecnologías en su enseñanza?

FUNSEPA______

Otra organización ______

FUNSEPA y otra organización ______

P10. En el presente año escolar, ¿ha recibido usted alguna capacitación sobre el uso de Khan Academy?

Sí ______ (Continúe a la P10a)

No ______ (Continúe a la P11)

P10a. ¿Qué organización proporcionó la capacitación sobre el uso de Khan Academy?

FUNSEPA______

Otra organización ______

FUNSEPA y otra organización ______

P11. En el presente año escolar, ¿ha recibido usted alguna capacitación en el área de matemáticas o sobre mejores prácticas para la enseñanza de matemáticas?

Sí ______ (Continúe a la P11a)

No ______ (Terminó la encuesta)

P11a. ¿Qué organización proporcionó la capacitación en el área de matemáticas o sobre mejores prácticas para la enseñanza de matemáticas?

FUNSEPA______

Otra organización ______

FUNSEPA y otra organización ______

Annex 7. Comparison of results using raw total scores and JML-estimated scores

Effect of Pilot Intervention Using Raw Total Scores

Effect Type	Effect
Funsepa group	4.877*
Khan group	10.00***

Khan Modalities	Effect
16 computers	7.848**
30 computers	7.751**
Tablets	10.22**
Endless Mobile	8.206**

*** p<0.01, ** p<0.05, * p<0.1

This model estimates the effect of the evaluation groups on student match scores (total raw scores) controlling for other variables, such as age, gender, PPI, repetition, time of exposure to intervention, class size, teacher score, among others.

Effect of Pilot Intervention Using JML-estimated Scores (based on answers to individual questions)

Effect Type	Effect
Funsepa group	7.280*
Khan group	13.31***

Khan Modalities	Effect
16 computers	11.17**
30 computers	10.46**
Tablets	15.29**
Endless Mobile	10.06**

*** p<0.01, ** p<0.05, * p<0.1

This model estimates the effect of the evaluation groups on student match scores (based on a Joint Maximum Likelihood –JML– estimator to account for potential harder questions) controlling for other variables, such as age, gender, PPI, repetition, time of exposure to intervention, class size, teacher score, among others.

Annex 8. List of variables used in the analysis

Variable	Type	Description
Student score	continuous	Score attained by the student in the standardized math test. It ranges from 0 to 100 points.
Khan	binary	1=student is in a school that received the pilot intervention; 0=student is in a comparison school
Funsepa	binary	1=student is in a school that received the traditional Funsepa intervention (TPE+AF) 0=student is in a comparison school
16 computers	binary	1=student is in a school that received the 16-computer + Khan Academy sub-intervention; 0=student is in a comparison school
30 computers	binary	1=student is in a school that received the 30-computer + Khan Academy sub-intervention; 0=student is in a comparison school
Tablets	binary	1=student is in a school that received the tablets + Khan Academy sub-intervention 0=student is in a comparison school
Endless	binary	1=student is in a school that received the 1-Endless Mobile computer + Khan Academy sub-intervention; 0=student is in a comparison school
Internet	binary	1=student is in a school that received the pilot intervention with the online platform 0=student is in a comparison school
No Internet	binary	1=student is in a school that received the pilot intervention with the offline platform 0=student is in a comparison school
Time (t)	binary	Time variable: 1= endline; 0= baseline
Age	continuous	Student's age
Gender	binary	Student's gender: 1=female; 0=male
Grade	categorical	3=third grade; 6=sixth grade
PPI	continuous	Progress out of poverty index (PPI) score; based on a 0-100 point scale
Grade repetition	binary	1=student repeated grade at least once; 0=otherwise
Favorite subject	binary	1=student's favorite subject is math; 0=otherwise
Technology at home	binary	1=student has technology at home (e.g. computers, laptops, tablets, etc.; excluding phones); 0=otherwise
Exposure	continuous	Number of months the pilot intervention has been implemented in the student's school
Use frequency	categorical	Frequency with which students access the technology in a week: 1= Never; 2= Less than once a week; 3= 1-2 days a week; 4= 3-4 days a week; 5= Every day (5 days a week)
Time of use	categorical	Time students spend with the technology at a time: 1= No time; 2= Less than 1 hour; 3= 1 hour; 4= 2 hours; 5= More than 2 hours
Class size	continuous	Number of students in the classroom of the student
Teacher score	continuous	Score achieved by the student's teacher in the standardized math test; based on a 0-30 point scale.

Annex 9. Sample characteristics and comparability across evaluation groups

The final evaluation sample includes a total of 2,356 students: 1,146 interviewed/tested at baseline and 1,210 interviewed/tested at endline. The final sample is fairly distributed across the main evaluation groups: 782 individuals are students in schools in the pilot intervention group, 788 are students in Funsepa schools, and 786 are students in schools in the comparison group.

Evaluation Groups	Number of students	Sample Share (%)
Pilot intervention	782	33.19
Funsepa	788	33.45
Comparison	786	33.36
Total	**2,356**	**100.00**

Within the pilot intervention group, 200 individuals correspond to students in schools that received 16-computer labs and access to the online or offline Khan Academy platform; 230 are students in schools that received 30-computer labs and access to the online or offline Khan Academy platform; 139 are students in schools that received tablets and access to the offline KA Lite platform; and 213 are students in schools that received one-Endless Mobile computer per classroom and access the online or offline Khan Academy platform (Figure 5). As for Internet connectivity, subsamples across intervention subgroups are also fairly distributed, with the exception of the Tablets subgroup that was only implemented using the offline KA Lite platform.

Figure 5. Evaluation Sample by Groups and Subgroups

Evaluation Group	Internet Connectivity		Number of students	Sample Share (%)
	Internet	No Internet		
Pilot intervention	331	451	782	33.19
16 computers	88	112	200	8.49
30 computers	120	110	230	9.76
Tablets	---	139	139	5.90
Endless Mobile	123	90	213	9.04
Funsepa	---	---	788	33.45
Comparison	---	---	786	33.36
Total	**---**	**---**	**2,356**	**100.00**

Comparability between evaluation groups

The students in the intervention group are statistically similar to students in the comparison group, as assessed by several socio-demographic characteristics. The proportion of female to male students is fairly even across evaluation groups, with overall 52% of the sample being female students and 48% male students. This shows that the randomization protocol at the student level was properly followed. Students in the sample are also similar in terms of age across evaluation groups, with an average age of 11 years across groups.

As for socio-economic status, students across groups had an average PPI score of 55 points, which means that the average student in the sample lives under the national poverty line. Over 73% of students said their household does not have technology and nearly 20% live in a home where the head of the household cannot read. These findings overall suggest that students across groups are statistically comparable.

Statistics	Total (N=2,356)	Evaluation Group			p-value*
		Pilot (N=782)	Funsepa (N=788)	Comparison (N=786)	
Gender (female, %)	**51.99**	51.02	50.25	54.71	0.168
Age (mean)	**11.09**	11.14	11.15	10.99	0.157
PPI (poverty index)	**55.39**	55.43	55.12	55.63	0.806
HH does not have technology	**73.13**	72.63	74.62	72.14	0.501
Head of HH cannot read	**19.69**	18.67	21.57	18.83	0.266

** p-values for the difference in statistics across evaluation groups. Insignificant p-values indicate that statistics are similar across the groups.*

In terms of comparability between baseline and endline students, the statistics below show that students generally had comparable characteristics before and after the pilot intervention. Such characteristics include poverty levels, household size, access to technology at home, and whether parents know how to use technology.

Detailed Statistics		#	Mean	Standard Error	Standard Deviation	p-value**
Gender	Baseline (N=1,146)	Female: 577 Male: 569	-	-	-	0.217
	Endline (N=1,210)	Female: 648 Male: 562	-	-	-	
Age	Baseline (N=1,146)	-	10.98	0.06	1.87	0.026
	Endline (N=1,210)	-	11.20	0.05	1.81	
PPI (poverty index)	Baseline (N=1,146)	-	55.28	0.49	16.66	0.732
	Endline (N=1,210)	-	55.50	0.42	14.66	
Household Size	Baseline (N=1,134)	-	7.35	0.12	3.90	0.318
	Endline (N=1,200)	-	7.20	0.10	3.46	
Student has technology at home	Baseline (N=1,146)	Yes: 297 No: 849	-	-	-	0.329
	Endline (N=1,210)	Yes: 336 No: 874	-	-	-	
Student's parents know how to use the computer[1]	Baseline (N=297)	Yes: 200 No: 97	-	-	-	0.800
	Endline (N=336)	Yes: 223 No: 113	-	-	-	

[1] *Question only asked to students who said they had technology at home. ** p-values for the difference between baseline and endline statistics.*

Annex 10. Detailed comparison of math scores across evaluation groups

Evaluation Group	Student Math Scores (0-100 points)						p-values
	Mean		Standard Error		Standard Deviation		
	Baseline	Endline	Baseline	Endline	Baseline	Endline	
Pilot (N=782)	33.74	44.72	0.67	0.58	12.91	11.62	<0.001 (a) 0.0377 (b)
Funsepa (N=788)	36.78	47.20	0.66	0.63	13.03	12.57	<0.001 (a) 0.4812 (b)
Comparison (N=786)	33.17	41.46	0.73	0.63	14.07	12.83	<0.001 (a) 0.0673 (b)

(a) p-values for the difference in mean scores between baseline and endline.
(b) p-values for the difference in standard deviation of scores between baseline and endline.

Evaluation Group	3rd Grade Student Math Scores (0-100 points)						p-values*
	Mean		Standard Error		Standard Deviation		
	Baseline	Endline	Baseline	Endline	Baseline	Endline	
Pilot (N=402)	31.72	46.68	1.01	0.89	14.42	12.61	<0.001 (a) 0.0593 (b)
Funsepa (N=403)	35.84	48.26	1.03	0.93	14.18	13.66	<0.001 (a) 0.6001 (b)
Comparison (N=404)	28.75	43.50	1.20	0.90	15.98	13.55	<0.001 (a) 0.0200 (b)

(a) p-values for the difference in mean scores between baseline and endline.
(b) p-values for the difference in standard deviation of scores between baseline and endline.

Evaluation Group	6th Grade Student Math Scores (0-100 points)						p-values*
	Mean		Standard Error		Standard Deviation		
	Baseline	Endline	Baseline	Endline	Baseline	Endline	
Pilot (N=380)	36.11	42.82	0.79	0.71	10.43	10.24	<0.001 (a) 0.8003 (b)
Funsepa (N=385)	37.64	45.94	0.83	0.82	11.84	11.03	<0.001 (a) 0.3311 (b)
Comparison (N=382)	37.15	38.95	0.76	0.84	10.68	11.42	0.1134 (a) 0.3499 (b)

(a) p-values for the difference in mean scores between baseline and endline.
(b) p-values for the difference in standard deviation of scores between baseline and endline.

Evaluation Group	Teacher Math Scores (0-100 points)						p-values*
	Mean		Standard Error		Standard Deviation		
	Baseline	Endline	Baseline	Endline	Baseline	Endline	
Pilot (N=94)	65.29	66.88	2.48	2.71	16.84	18.79	0.668
Funsepa (N=52)	62.73	58.00	3.66	3.14	17.17	17.19	0.331
Comparison (N=59)	65.86	64.52	3.41	3.93	18.36	20.79	0.797

** p-values for the difference in mean scores between baseline and endline.*

Annex 11. Multivariate Regression Analysis Output Tables

Difference in differences between students in the pilot intervention (khan) and the control group

VARIABLES	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)
Pilot intervention	**2.694****	**9.343*****	**9.862*****	**10.00*****
	(1.305)	(2.707)	(2.717)	(2.702)
Controls:				
Age	N	Y	N	Y
Grade	N	Y	Y	N
Gender	N	Y	Y	Y
PPI (household socioeconomic level)	N	Y	Y	Y
Grade repetition	N	Y	Y	Y
Favorite subject	N	Y	Y	Y
Technology is available at home	N	Y	Y	Y
Frequency and time of use of technology at school	N	Y	Y	Y
Class size	N	Y	Y	Y
Teacher math score	N	Y	Y	Y
Exposure	N	Y	Y	Y
Constant	33.17***	28.95***	23.27***	24.85***
	(0.726)	(3.896)	(3.039)	(3.763)
Observations	1,568	1,115	1,115	1,115
R-squared	0.129	0.220	0.217	0.213

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Difference in differences between students in the traditional Funsepa traditional intervention (TPE) and the control group

VARIABLES	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)
Funsepa traditional intervention (TPE)	**2.143**	**4.822***	**5.522****	**4.877***
	(1.327)	(2.746)	(2.756)	(2.735)
Controls:				
Age	N	Y	N	Y
Grade	N	Y	Y	N
Gender	N	Y	Y	Y
PPI (household socioeconomic level)	N	Y	Y	Y
Grade repetition	N	Y	Y	Y
Favorite subject	N	Y	Y	Y
Technology is available at home	N	Y	Y	Y
Frequency and time of use of technology at school	N	Y	Y	Y
Class size	N	Y	Y	Y
Teacher math score	N	Y	Y	Y
Exposure	N	Y	Y	Y
Constant	33.17***	35.80***	26.14***	30.36***
	(0.726)	(4.129)	(3.268)	(3.976)
Observations	1,574	935	935	935
R-squared	0.137	0.229	0.217	0.216

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Difference in differences between students in the 16-computer + Khan Academy sub-intervention and the control group

VARIABLES	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)
16-computer + Khan Academy sub-intervention	**2.086**	**7.422****	**7.798****	**7.848****
	(1.964)	(3.739)	(3.765)	(3.689)
Controls:				
Age	N	Y	N	Y
Grade	N	Y	Y	N
Gender	N	Y	Y	Y
PPI (household socioeconomic level)	N	Y	Y	Y
Grade repetition	N	Y	Y	Y
Favorite subject	N	Y	Y	Y
Technology is available at home	N	Y	Y	Y
Frequency and time of use of technology at school	N	Y	Y	Y
Class size	N	Y	Y	Y
Teacher math score	N	Y	Y	Y
Exposure	N	Y	Y	Y
Constant	33.17***	37.13***	29.70***	32.65***
	(0.726)	(5.484)	(4.396)	(5.395)
Observations	986	580	580	580
R-squared	0.106	0.172	0.166	0.162

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Difference in differences between students in the 30-computer + Khan Academy sub-intervention and the control group

VARIABLES	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)
30-computer + Khan Academy sub-intervention	**1.729**	**6.781****	**7.353****	**7.751****
	(1.779)	(3.424)	(3.441)	(3.427)
Controls:				
Age	N	Y	N	Y
Grade	N	Y	Y	N
Gender	N	Y	Y	Y
PPI (household socioeconomic level)	N	Y	Y	Y
Grade repetition	N	Y	Y	Y
Favorite subject	N	Y	Y	Y
Technology is available at home	N	Y	Y	Y
Frequency and time of use of technology at school	N	Y	Y	Y
Class size	N	Y	Y	Y
Teacher math score	N	Y	Y	Y
Exposure	N	Y	Y	Y
Constant	33.17***	30.22***	22.54***	22.19***
	(0.726)	(5.086)	(3.877)	(4.824)
Observations	1,016	606	606	606
R-squared	0.116	0.239	0.233	0.216

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Difference in differences between students in the Tablets + Khan Academy sub-intervention and the control group

VARIABLES	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)
Tablets + Khan Academy sub-intervention	**5.627****	**8.978***	**9.477****	**10.22****
	(2.279)	(4.729)	(4.740)	(4.692)
Controls:				
Age	N	Y	N	Y
Grade	N	Y	Y	N
Gender	N	Y	Y	Y
PPI (household socioeconomic level)	N	Y	Y	Y
Grade repetition	N	Y	Y	Y
Favorite subject	N	Y	Y	Y
Technology is available at home	N	Y	Y	Y
Frequency and time of use of technology at school	N	Y	Y	Y
Class size	N	Y	Y	Y
Teacher math score	N	Y	Y	Y
Exposure	N	Y	Y	Y
Constant	33.17***	28.81***	23.02***	22.51***
	(0.726)	(5.992)	(4.654)	(5.700)
Observations	925	511	511	511
R-squared	0.111	0.234	0.230	0.216

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Difference in differences between students in the 1-Endless Mobile computer + Khan Academy sub-intervention and the control group

VARIABLES	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)
1-Endless Mobile computer + Khan Academy sub-intervention	**2.683**	**6.865***	**7.710****	**8.206****
	(2.035)	(3.544)	(3.545)	(3.531)
Controls:				
Age	N	Y	N	Y
Grade	N	Y	Y	N
Gender	N	Y	Y	Y
PPI (household socioeconomic level)	N	Y	Y	Y
Grade repetition	N	Y	Y	Y
Favorite subject	N	Y	Y	Y
Technology is available at home	N	Y	Y	Y
Frequency and time of use of technology at school	N	Y	Y	Y
Class size	N	Y	Y	Y
Teacher math score	N	Y	Y	Y
Exposure	N	Y	Y	Y
Constant	33.17***	34.03***	27.64***	28.19***
	(0.726)	(5.423)	(4.551)	(5.399)
Observations	999	573	573	573
R-squared	0.101	0.218	0.213	0.197

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Difference in differences between students in the Khan Academy + Internet sub-intervention and the control group

VARIABLES	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)
Pilot intervention using the online platform (Khan Academy)	**3.198***	**5.101***	**5.763****	**5.796****
	(1.633)	(2.872)	(2.884)	(2.870)
Controls:				
Age	N	Y	N	Y
Grade	N	Y	Y	N
Gender	N	Y	Y	Y
PPI (household socioeconomic level)	N	Y	Y	Y
Grade repetition	N	Y	Y	Y
Favorite subject	N	Y	Y	Y
Technology is available at home	N	Y	Y	Y
Frequency and time of use of technology at school	N	Y	Y	Y
Class size	N	Y	Y	Y
Teacher math score	N	Y	Y	Y
Exposure	N	Y	Y	Y
Constant	33.17***	32.56***	25.16***	26.97***
	(0.726)	(4.783)	(3.855)	(4.703)
Observations	1,117	698	698	698
R-squared	0.127	0.214	0.208	0.202

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Difference in differences between students in the Khan Academy without Internet sub-intervention and the control group

VARIABLES	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)	Student Score (0-100 points)
Pilot intervention using the offline platform (KA Lite)	**2.086**	**6.748****	**7.186*****	**7.701*****
	(1.507)	(2.720)	(2.727)	(2.703)
Controls:				
Age	N	Y	N	Y
Grade	N	Y	Y	N
Gender	N	Y	Y	Y
PPI (household socioeconomic level)	N	Y	Y	Y
Grade repetition	N	Y	Y	Y
Favorite subject	N	Y	Y	Y
Technology is available at home	N	Y	Y	Y
Frequency and time of use of technology at school	N	Y	Y	Y
Class size	N	Y	Y	Y
Teacher math score	N	Y	Y	Y
Exposure	N	Y	Y	Y
Constant	33.17***	28.69***	23.55***	23.94***
	(0.726)	(4.667)	(3.556)	(4.491)
Observations	1,237	805	805	805
R-squared	0.109	0.174	0.171	0.164

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Annex 12. Multivariate Regression Analysis Output by Grade

Difference in differences between students in the pilot intervention (khan) and the control group by grade

VARIABLES	3rd Grade Students Student Score (0-100 points)	6th Grade Students Student Score (0-100 points)
Pilot intervention	**7.847****	**9.018****
	(3.768)	(4.278)
Controls:		
Age	Y	Y
Grade	N	N
Gender	Y	Y
PPI (household socioeconomic level)	Y	Y
Grade repetition	Y	Y
Favorite subject	Y	Y
Technology is available at home	Y	Y
Frequency and time of use of technology at school	Y	Y
Class size	Y	Y
Teacher math score	Y	Y
Exposure	Y	Y
Constant	26.91***	44.41***
	(7.614)	(6.583)
Observations	560	555
R-squared	0.321	0.137

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Annex 13. Effect of Frequency and Time Exposure to Khan Academy

Difference between students in the pilot intervention (khan) and the comparison group (N=1,115)

	Student Score
1-2 days a week for 1 hour***	27.83
1-2 days a week for 2 hours***	24.07
1-2 days a week for more than 2 hours	16.00

*** p<0.01, ** p<0.05, * p<0.1